Alarm identification

The Rad-87 visually and audibly indicates alarm conditions that the system detects.

Audible alarms may be silenced, without affecting the operation of visual alarms.

Three levels of alarm priority are implemented: high, medium and low priority. The following table outlines the alarm priority specifications.

ALARM PRIORITY	PARAMETER/MEASUREMENT — ALARM SETTING RANGE	ALARM TYPE
High	Low arterial oxygen saturation	Audible and visual
	High carboxyhemoglobin saturation	
	High methemoglobin saturation	
	Low total hemoglobin concentration High total hemoglobin concentration	
	High pulse rate Low pulse rate	
	Sensor off and no sensor	
	Defective Sensor	
	Defective Patient Cable	
	System failures	
Medium	High saturation	
	Low PI High PI Low PVI High PVI	
	Low battery, monitoring patient	
Low	Low carboxyhemoglobin saturation	
	Low methemoglobin saturation	
	Low battery, not monitoring patient	

NOTE: *There are no alarms associated with SpOC.*

Alarm indication

An alarm condition caused by an out-of-limit parameter/measurement is indicated by:

- Audible alarm tone
- Flashing Out-of-limit parameter/measurement label and value
- System Status Light flashes red for high priority alarms, flashes yellow for medium priority alarms or shows solid yellow for low priority alarms
- Red flashing Alarm Bell for high priority alarms

Alarm limits

CAUTION: TO ENSURE THAT ALARM LIMITS ARE APPROPRIATE FOR THE PATIENT BEING MONITORED, CHECK THE LIMITS EACH TIME THE RAD-87 IS USED.

When an alarm limit is exceeded, an audible alarm activates and the Alarm Bell flashes red for high priority alarms and the System Status Light is solid yellow for low priority alarms, flashes yellow for medium priority alarms or flashes red for high priority alarms. When a sensor is not connected to a patient, "SEN OFF" message will show on the display. When a sensor is not connected to its cable, "NO SEN" message will show on the display.

NOTE: *An audible alarm will accompany the visual indicators unless the Rad-87 has been set to Interface Alarms "Off" (only SpO_2 and BPM alarms muted) or to Sleep Mode (all alarms muted).*

ALARM LIMIT: USER CONFIGURABLE SETTINGS

SETTING	RANGE
SpO_2 High Limit	The SpO_2 high alarm limit can be set anywhere between 2% and 99%, then "---" (Off), with a 1% step size. In the "----" (Off) setting, the SpO_2 High Limit alarm is disabled.
SpO_2 Low Limit*	The SpO_2 low alarm limit can be set anywhere between 1% and 98%, with a 1% step size.
SpCO High Limit	The SpCO high alarm limit can be set anywhere between 2% and 98%, then "---" (Off), with a 1% step size.
SpCO Low Limit*	The SpCO low alarm limit can be set anywhere between "---" (Off), then 1% and 97%, with a 1% step size. In the "----" (Off) setting, the SpCO Low Limit alarm is disabled.
SpMet High Limit	The SpMet high alarm limit can be set anywhere between 1% and 99.5%, then "---" (Off). Adjust in increments of 0.1% for values between 0.1% to 2%. Adjust in increments of 0.5% for values between 2% and 99.5%.
SpMet Low Limit*	The SpMet low alarm limit can be set anywhere between "---" (Off), then 0.1% and 99%. Adjust in increments of 0.1% for values between 0.1% to 2%. Adjust in increments of 0.5% for values between 2% and 99.5%. When SpMet is placed in the "----" (Off) setting, the SpMet Low Limit alarm is disabled.

ALARM LIMIT: USER CONFIGURABLE SETTINGS (CONTINUED)

SETTING	RANGE
SpHb High Limit	The SpHb high alarm limit can be set anywhere between 2 g/dl and 24.5 g/dl, then "----" (Off). Adjust in increments of 0.1 g/dl step size between 2 g/dl and 20 g/dl and 0.5 g/dl step size between 20 g/dl and 24.5 g/dl. When SpHb is placed in the "----" (Off) setting, the SpHb High Limit alarm is disabled.
SpHb Low Limit*	The SpHb low alarm limit can be set to "---" (Off), then anywhere between 1 g/dl and 24 g/dl. Adjust in increments of 0.1 g/dl step size between 0.1 g/dl and 20 g/dl and 0.5 g/dl step size between 20 g/dl and 24 g/dl. When SpHb is placed in the "----" (Off) setting, the SpHb Low Limit alarm is disabled.
PI High Limit	The PI high alarm limit can be set anywhere between 0.04 % and 19%, then "----" (Off). Adjust in increments of 0.01% step size between 0.02% and 0.1%, 0.1% step size between 0.1% and 1% and 1% step size between 1% and 19%. When PI is placed in the "----" (Off) setting, the PI High Limit alarm is disabled.
PI Low Limit*	The PI low alarm limit can be set anywhere between "---" (Off), then 0.03% and 18%. Adjust in increments of 0.01% step size between 0.03% and 0.1%, 0.1% step size between 0.1% and 1% and a 1% step size between 1% and 18%. When PI is placed in the "----" (Off) setting, the PI Low Limit alarm is disabled.
PVI High Limit	The PVI high alarm limit can be set anywhere between 2% and 99%, then "----" (Off). Adjust in increments of 1% step size. When PVI is placed in the "----" (Off) setting, the PVI High Limit alarm is disabled.
PVI Low Limit*	The PVI low alarm limit can be set anywhere between "---" (Off), then 1 and 98%. Adjust in increments of 1 step size. When PVI is placed in the "----" (Off) setting, the PVI Low Limit alarm is disabled.
Pulse Rate High Limit (BPM)	The pulse rate high alarm limit can be set anywhere between 35 BPM and 235 BPM, with a 5 BPM step size.
Pulse Rate Low Limit (BPM)*	The pulse rate low alarm limit can be set anywhere between 30 BPM and 230 BPM, with a 5 BPM step size.

** The low alarm limit must always be set below the high alarm setting. Attempting to set the high alarm limit below the low alarm limit, the low alarm limit will automatically adjust the low limit to the next setting below the newly entered high alarm limit setting.*

***NOTE:** Pressing and holding down the up and down buttons allow for the rapid scrolling of changing alarm limits.*

***NOTE:** If there is a loss of power for any length of time, the Alarm settings will be set back to the User set defaults. If the user has not utilized this option, then all parameters/measurements will be set back to the factory defaults.*

SINGLE ALARM

When an alarm is activated, the display shows the screen containing the parameter/measurement in alarm status. The number value and the label (name) for the parameter/measurement in alarm status flash, an audible alarm activates, the Alarm Bell flashes red for high priority alarms and the System Status Light is solid yellow for low priority alarms, flashes yellow for medium priority alarms or flashes red for high priority alarms.

MULTIPLE PARAMETER/MEASUREMENT ALARMS

When multiple parameters/measurements alarm, the screen with the highest alarm priority (and with an parameter/measurement in alarm status) will show on the display. Refer to the table *Alarm Priority for Display Screens* located below. The number value and the label (name) for the parameter/measurement in alarm status flash, an audible alarm activates, the Alarm Bell flashes red for high priority alarms and the System Status Light is solid yellow for low priority alarms, flashing yellow for medium priority alarms and flashing red for high priority alarms. Additional parameters/measurements in alarm status (competing alarms) that are not contained on the active screen will show as flashing parameter/measurement labels (names). The parameters/measurements with competing alarms can be viewed by pressing the Display Button to scroll through the screens. When an alarm is resolved, the parameter/measurement label stops flashing. When all parameters/measurements in alarm status on a display screen are resolved, the screen changes to show the next priority screen with active alarms.

ALARM PRIORITY FOR DISPLAY SCREENS

PRIORITY	DISPLAY SCREEN	PARAMETERS/MEASUREMENTS SHOWN
1	Screen 1	%SpO_2, BPM, SpHb g/dl
2	Screen 2	PI, %SpCO ml/dl, PVI
3	Screen 3	%SpMet, %SpCO

The display screens are assigned alarm priority according to the table above. Screen 1 has first priority and displays if it contains a parameter/measurement in alarm status with other competing parameter/measurement alarms. When Screen 2 contains the competing parameter/measurement alarms, Screen 2 will take priority and show on the display. Screen 3 has the lowest priority.

ALARM SILENCE

Audible alarms may be silenced, while visual alarms remain active. The alarm silence function is controlled by pressing the Alarm Silence Button.

The Alarm Bell and the System Status Light provide visual feedback when the Rad-87 audible alarms are silenced.

Alarm Silence function when monitoring a patient:

Power-On – Alarms active, Alarm Bell flashes red for high priority alarms and the System Status Light is solid yellow for low priority alarms, flashes yellow for medium priority alarms or flashes red for high priority alarms.

Press Once – Alarm suspended for 120 seconds, audible alarms are silenced.

– The Alarm Bell flashes red for high priority alarms and the System Status Light flashes yellow for all alarms.

Press Twice – Return to audible alarms active, audible alarms return.

Repeated pressing of the Alarm Silence Button will cycle though alarm silence options above.

Alarm Silence function when not monitoring a patient:

Power-On – Alarms active, Alarm Bell is not flashing and the System Status Light is solid yellow.

Press Once – Device is silenced until it is cycled off/on or until monitoring begins.

– The Alarm Bell is not flashing and the System Status Light is solid yellow for low priority alarms.

ALARM BELL

The Alarm Bell flashes red for high priority alarms. Pressing the Alarm Silence Button once silences the audible alarm for 120 seconds (default) while the Alarm Bell flashes to indicate an alarm condition. If the high priority alarm condition is resolved during the Alarm silence interval, the Alarm Bell stops flashing. If the high priority alarm condition remains (Alarm Bell flashing red), pressing the Alarm Silence button again activates the audible alarms and the Alarm Bell continues to flash red. The Alarm Bell stops flashing when the high priority alarm conditions are resolved.

SYSTEM STATUS LIGHT

While monitoring a patient and an alarm condition occurs, an audible alarm activates and the System Status Light shows solid yellow for low priority alarms, flashes yellow for medium priority alarms or flashes red for high priority alarms. Pressing the Alarm Silence Button (one time) silences the alarm tone for 120 seconds (default). Pressing the Alarm Silence Button a second time activates the audible alarms and the System Status Light shows solid yellow for low priority alarms, flashes yellow for medium priority alarms or flashes red for high priority alarms. When all alarm conditions are resolved, the System Status Light changes to solid green.

When monitoring a patient and there are no alarm conditions, the System Status light shows green. Pressing the Alarm Silence Button (one time) silences the alarm tone for 120 seconds and the System Status Light flashes yellow if there is not alarm condition. Pressing the Alarm Silence Button a second time returns the device to normal monitoring status and the System Status Light illuminates green when patient monitoring begins.

While not monitoring a patient, the System Status Light illuminates solid yellow. If an alarm condition occurs the System Status Light shows solid yellow for low priority alarms. Pressing the Alarm Silence Button will permanently silence the alarm tone and the System Status Light is solid yellow until the power is cycled or patient monitoring begins.

Should the alarm condition be created by a low battery condition, plug the device into AC power immediately.

ALARM MUTE

When the Rad-87 is set to Interface Alarms "Off" (muting the SpO_2 and BPM audible alarms at the device) and SpO_2 or BPM alarms occur, the Alarm Bell flashes red and the System Status Light is solid yellow for low priority alarms, flashes yellow for medium priority alarms or flashes red for high priority alarms. The audible alarm (SpO_2, BPM) activates at the interfaced system while the audible alarm is muted at the device. Once the SpO_2 or BPM alarm condition is resolved and there are no other system or parameter/measurement alarms, the Alarm Bell stops flashing, the System Status Light changes to solid green and the audible alarm at the interfaced system deactivates.

NOTE: *The Rad-87 reverts to Interface Alarms "On" during power interruptions or when the interface connection is lost. This ensures that the Rad-87 provides SpO_2 and BPM audible alarms when connection to the interfaced system becomes compromised.*

MESSAGES

The Rad-87 Pulse CO-Oximeter will indicate other data or system errors.

Message conditions for the Rad-87 follow:

DISPLAY	TYPE	SOLUTION
SCROLLING ZEROS	Pulse Search	Wait for found pulse. (This Search should occur whenever a sensor is first applied to a patient).
PULSE BAR (SIQ) TURNS RED	Low Signal IQ	1. Rule out occlusion of blood flow. 2. Verify placement of sensor.
PERFUSION BAR (PI) TURNS RED	Low Perfusion	1. Rule out occlusion of blood flow. 2. Attempt to warm patient. 3. Move sensor to better perfused site. ***NOTE:*** *Masimo recommends using an adhesive sensor whenever low perfusion is expected or evident.*
PARAMETER/ MEASUREMENT LABEL AND NUMBER FLASH	Alarm Limit Exceeded	Assess /address patient condition. Re-set alarm limits if indicated.
Err ##	System Fault	Return for service. There are several error codes, all error codes require return of the device to an authorized service center for repair. See Section 9, *Service and Repair.*
bAd SEN	Defective Sensor	Replace sensor.
SEN (Blinking)	Unrecognized Sensor	Connect appropriate sensor.
INt dEt (Blinking)	Interference Detected	Ensure that the sensor is properly applied, and cover the sensor site with opaque material, if required.

Messages continued

DISPLAY	TYPE	SOLUTION
NO SEN	No Sensor Connected	Connect sensor to cable.
SEN OFF	Sensor off patient	1. Reattach sensor to patient. 2. Verify proper sensor placement.
SINGLE BATTERY LEVEL INDICATOR FLASHES (WITH AUDIBLE ALARM)	Battery level too low	Connect device to AC Power to charge the battery.
NO CbL	No Cable Connected	Connect appropriate cable to unit.
bAd CbL	Defective cable	Replace cable

Troubleshooting

The following chart describes what to do if the Rad-87 system does not operate properly or fails.

PROBLEM	TYPE	SOLUTION
DEVICE DOES NOT POWER ON	Low battery/ not plugged into AC power supply	Connect the AC Power Cord to the Rad-87 and to an AC outlet. Make sure that the AC Power Indicator light is on.
BATTERY RUN-TIME IS SIGNIFICANTLY REDUCED	Low battery	Contact Technical Services or your local Masimo representative.
CONTINUOUS SPEAKER TONE	Internal Failure	Device requires service. Press the Alarm Silence Button. If alarm continues to sound, power down device. If the power button does not turn the device off, press and hold the Power Button for 5 seconds. Return the device for service.
NO SPEAKER TONE	Pulse tone set to "mute"	Press Up Arrow or Alarm Volume Adjust.
NO ALARM TONE	Alarm Silence Enabled	The System Status Light flashes yellow. See Section 4, *Alarm Silence*.
BUTTONS FAIL TO WORK WHEN PRESSED	Internal Failure	Use auxilary power down method by pressing and holding Sensitivity and Display Buttons simultaneously. Return for service.
SENSOR OFF MESSAGE	Sensor not connected to patient properly. Sensor is damaged.	Properly reapply the sensor on the patient and reconnect the sensor to the unit or patient cable. If the sensor is damaged, replace the sensor.
NO SENSOR MESSAGE	Sensor is disconnected from patient cable. Sensor connected upside down into patient cable.	Check to see if the sensor LED is flashing. Disconnect and reconnect the sensor. If the LED fails to operate, replace the sensor.
LOW PERFUSION (PI BAR TURNS RED)	Improper sensor type. Poorly perfused site. Sensor is too tight. A disorder such as hypothermia, vasoconstriction, hypovolemia, peripheral vascular disease or anemia. Sensor is damaged.	Verify proper sensor and sensor size for the patient. Check and see if blood flow to the site is restricted. Be sure that the sensor is not on too tight. Set unit to MAX sensitivity. Warm the patient or sensor site. Move sensor to better perfused site.
LOW SIGNAL QUALITY	Improper sensor type or application. Excessive motion relative to perfusion. Sensor or cable is damaged or not functioning.	Check and see if blood flow to the site is restricted. Check the placement of the sensor. Re-apply sensor or move to a different site. Replace sensor or cable.

Troubleshooting continued

PROBLEM	POSSIBLE CAUSE(S)	RECOMMENDATION
SpO_2 VALUES DO NOT CORRELATE WITH CLINICAL ASSESSMENT OR ABGs.	Low perfusion or sensor displacement.	Check for error messages. See section 5 *Messages* for recommended corrections. Check placement of sensor or if it is too tight. Reapply sensor or select a new site. Set to MAX sensitivity and confirm that the sensor is securely on the patient. Refer to sensor Directions For Use.
PULSE SEARCH MESSAGE	Device is searching for pulse.	If device fails to display within 30 seconds, disconnect and reconnect sensor to patient. If pulse search continues, move sensor to better perfused site.
UNEXPECTED SpO_2, SpCO, SpMet or SpHb READING	Low SIQ or Perfusion Index (PI) values.	Reposition sensor to site with strong SIQ and PI. Submit blood sample for laboratory CO-Oximetry test for comparison.
	Inappropriate sensor size or sensor measurement location.	Verify proper sensor for patient size. Verify proper sensor site.
UNEXPECTED HIGH SpCO READING	Possible elevated methemoglobin level*.	Submit blood sample for laboratory CO-Oximetry test.
DIFFICULTY OR NO SpO_2/SpCO/SpMet/SpHb READING	Low battery/ not plugged into AC power supply.	Connect the AC Power Cord to the Rad-87 and to an AC outlet. Make sure that the AC Power Indicator light is on.
	Interference from line-frequency induced noise.	Verify/set 50/60hz menu setting. See section 3, Rad-87 Power Requirements.
	Inappropriate sensor or sensor size.	Verify proper sensor and sensor size for the patient.
	Excessive ambient or strobing light.	Shield the sensor from excessive or strobing light.
	Also, see Section 4, Successful Monitoring for additional information.	
DIFFICULTY OR NO SpCO/ SpMet/SpHb READING	Excessive motion.	Minimize or eliminate motion at the monitoring site.
	Inappropriate sensor or sensor size.	Verify use of an SpCO/SpMet/SpHb capable sensor. Verify proper sensor size for the patient.
	Excessive ambient or strobing light.	Shield the sensor from excessive or strobing light.
PRINT FUNCTION DOES NOT WORK	Wrong serial cable is used.	Make sure a null modem cable is used.
WIRELESS RADIO NO CONNECTION	Radio Off.	Confirm the Wireless Radio is ON.
	Network settings are not configured correctly.	Confirm wireless network settings.
	No/inadequate wireless coverage.	Confirm wireless coverage.

Rad-87 specifications

PERFORMANCE

Measurement Range	
SpO_2:	0 -100%
SpMet:	0 - 99.9%
SpCO:	0 - 99%
SpHb	0 - 25 g/dl
SpOC	0 - 35 ml of O_2/dl of blood
Pulse Rate:	25 - 240 (bpm)
Perfusion Index:	0.02% - 20%
Pleth Variability Index:	0 - 100%
Accuracy:	
Arterial **Oxygen Saturation Accuracy**[1]	
Saturation	60% to 80%
No Motion	
Adults, Infants, Pediatrics	±3%
Saturation	70% to 100%
No Motion[2]	
Adults, Infants, Pediatrics	± 2%
Neonates*	± 3%
Motion[3]	
Adults, Infants, Pediatrics, Neonates	± 3%
Low Perfusion[4]	
Adults, Infants, Pediatrics, Neonates	± 2%
Pulse Rate Accuracy[5]	
Pulse Rate:	25 - 240 (bpm)
No Motion	
Adults, Infants, Pediatrics, Neonates	± 3 bpm
Motion[4]	
Adults, Infants, Pediatrics, Neonates	± 5 bpm
Low Perfusion	
Adults, Infants, Pediatrics, Neonates	± 3 bpm
Carboxyhemoglobin saturation accuracy (%SpCO)[1]	
Adults, Infants, Pediatrics	1% - 40% ± 3%
Methemoglobin saturation accuracy (%SpMet)[1]	
Adults, Infants, Pediatrics, Neonates	1% - 15% ± 1%
Total Hemoglobin accuracy (SpHb g/dl)[9]	
Adults, Pediatrics	8 - 17 g/dl ±1 g/dl
Resolution	
Arterial Oxygen Saturation (%SpO_2)	1%
Carboxyhemoglobin Saturation (%SpCO)	1%
Methemoglobin Saturation (%SpMet)	0 .1%
Total Hemoglobin (SpHb g/dl)	0 .1 g/dl
Pulse Rate (bpm)	1 bpm

* Only Rainbow sensors provide ± 2% for Neonates

ELECTRICAL

AC Power requirements:	100 - 240 VAC, 47-83 Hz
Power consumption:	15 VA max.
Batteries	
Type:	Sealed lead acid
Capacity (battery life):	up to 4 hours[6]
Charging time:	8 hours

ENVIRONMENTAL

Operating Temperature:	41°F to 104°F (5°C to 40°C)
Transport/Storage Temperature:	-40°F to 158°F (-40°C to +70°C)[7]
Operating Humidity:	5% to 95%, non-condensing
Operating Altitude:	500 mbar to 1060 mbar pressure -1000 ft to 18,000 ft (-304 m to 5,486 m)

PHYSICAL CHARACTERISTICS

Dimensions:	8.2" x 6.0" x 3.0" (20.8 cm x 15.2cm x 7.6 cm)
Weight:	2.1 lbs. = .908 Kg. = 32 oz

Trending

72 hours of trending at 2 second resolution

Mode

Averaging mode:	2, 4, 8,10, 12, 14 or 16 seconds[8]
Sensitivity:	Normal, Maximum[9], and APOD

Alarms

Audible and visual alarms for high low saturation and pulse rate (SpO_2 range 1% - 99%, SpCO range 1% - 98%, SpMet range 1% - 99.5%, SpHb range1 g/dl - 24.5 g/dl, PI range 0.03% - 19%, PVI range 1% - 99%, pulse rate range 30 - 235 bpm)

Sensor condition, system failure and low battery alarms

High Priority Audible Alarm:	800 Hz tone, 5 pulse burst, pulse spacing: 0.250s, 0.250s, 0.500s, 0.250s, repeat time:10s
Medium Priority Audible Alarm	500 Hz tone, 3 pulse burst, repeat time: 5s
Low Priority Audible Alarm:	500 Hz tone, 3 pulse burst, repeat time: 5s
Alarm Volume:	High: 85 dB (min) Low: 45 dB (min)
High Priority Visual Alarm:	Red flashing 2 sec. (0-5 Hz)
Medium Priority Visual Alarm	Yellow flashing 4 sec (0.25 Hz)
Low Priority Visual Alarm:	Solid yellow

Display/Indicators

Display Language	English (default)
Data display:	$\%SpO_2$, %SpCO, %SpMet, SpHb g/dl, SpOC ml/dl, pulse rate, alarm status, status messages, Signal IQ, perfusion idex, pleth variability index, sensitivity modes, wireless radio connection, system status light.
Type:	LED
Display update rate:	1 second

PHYSICAL CHARACTERISTICS (CONTINUED)

Output Interface	
Serial RS-232	
Wireless Radio (if installed)	802.11 a/b/g
Nurse Call	
Philips VueLink, RadNet, Patient SafetyNet	
Compliance	
Safety Standard for Medical Equipment	EC 60601-1-2nd Edition UL 60601-1 CAN/CSA C22.2 No. 601-1 JIS 0601-1
Type of Protection	Class 1 (AC power), Internally powered (battery power)
Degree of Protection-(Pulse CO-Oximeter Cable):	Type BF, Defib Proof Applied-Part
Mode of Operation:	Continuous
EMC Standard	60601-1-2

1 SpO_2, SpCO and SpMet accuracy was determined by testing on healthy adult volunteers in the range 60% - 100% SpO_2, 0% - 40% SpCO and 0% - 15% SpMet against a laboratory CO-Oximeter. SpO_2 and SpMet accuracy was determined on 16 neonatal NICU patients ranging in age from 7 to 135 days old and weighting between 0.5 and 4.25 kgs. Seventy-nine (79) data samples were collected over a range of 70 - 100% SaO2 and 0.5 - 2.5% HbMet with a resultant accuracy of 2.9% SpO_2 and 0.9% SpMet. Contact Masimo for testing specifications.

2 The Masimo sensors have been validated for no motion accuracy in human blood studies on healthy adult male and female volunteers with light to dark skin pigmentation in induced hypoxia studies in the range of 70-100% SpO_2 against a laboratory CO-Oximeter and ECG monitor. This variation equals plus or minus one standard deviation. Plus or minus one standard deviation encompasses 68% of the population.

3 The Masimo sensors have been validated for motion accuracy in human blood studies on healthy adult male and female volunteers with light to dark skin pigmentation in induced hypoxia studies while performing rubbing and tapping motions, at 2 to 4 Hz at an amplitude of 1 to 2 cm and a non-repetitive motion between 1 to 5 Hz at an amplitude of 2 to 3 cm in induced hypoxia studies in the range of 70-100% SpO_2 against a laboratory CO-Oximeter and ECG monitor. This variation equals plus or minus one standard deviation. Plus or minus one standard deviation encompasses 68% of the population.

4 The Rad-87 has been validated for low perfusion accuracy in bench-top testing against a Biotek Index 2* simulator and Masimo's simulator with signal strengths of greater than 0.02% and transmission of greater than 5% for saturations ranging from 70-100%. This variation equals plus or minus one standard deviation. Plus or minus one standard deviation encompasses 68% of the population.

5 Masimo sensors have been validated for pulse rate accuracy for the range of 25-240 bpm in bench top testing against a Biotek Index 2 simulator. This variation equals plus or minus one standard deviation which encompasses 68% of the population.

6 This represents approximate run time at the lowest indicator brightness and pulse tone turned off using a fully charged battery without radio power.

7 If the batteries are to be stored for extended periods of time, it is recommended that they be stored between -20°C to +30°C, and at a relative humidity less than 85%. If stored for a prolonged period at environmental conditions beyond these limits, overall battery capacity may be diminished, and lifetime of the batteries may be shortened.

8 With FastSat the averaging time is dependent on the input signal. For the 2 and 4 second settings the averaging time may range from 2-4 and 4-6 seconds, respectively.

9. SpHb accuracy has been validated on healthy adult male and female volunteers and on surgical patients with light to dark skin pigmentation in the range of 8 g/dL to 17 g/dL SpHb against a laboratory CO-Oximeter. The variation equals plus or minus one standard deviation which encompasses 68% of the population. The SpHb accuracy has not been validated with motion or low perfusion.

*Registered trademark of Fluke Biomedical Corporation, Everett, Washington.

Serial interface specifications

The digital interface for serial communication is based on the standard RS-232 protocol.

The Rad-87 Pulse CO-Oximeter by default always outputs ASCII 1 text data through the serial port, unless the user selects a different output mode in the Output menu. To interface with the Rad-87 and receive serial text data, simply connect a serial interface cable with a serial output connector located on the back of the Rad-87.

NOTE: *Trend data packets are collected at 2 second intervals. Each data packet contains: the date, time, SpO_2, perfusion index, SpMet, SpCO, SpHb, PI, pulse rate, and alarm and exception values (in ASCII 2 format).*

SERIAL INTERFACE SETUP

To interface with the Rad-87 serial port, set the following communication parameters on the interfacing serial device:

PARAMETER	SETTING
BAUD RATE	9600 Baud bidirectional
NUMBER OF BITS PER CHARACTER	8
PARITY	None
BITS	1 start, 1 stop
HANDSHAKING	None
CONNECTOR TYPE	Female DB-9

The pin-outs for the RS-232 connector are shown in the following table:

PIN	SIGNAL NAME
1	No Connection
2	Receive data – RS-232 ±9 V (±5 Vmin)
3	Transmit data – RS-232 ±9 V (±5 Vmin)
4	No Connection
5	Signal Ground Reference for COM signals
6	No Connection
7	No Connection
8	No Connection
9	No Connection

SERIAL PRINTER SETUP

To print the SpO_2 and pulse rate data in ASCII 2 format on a serial printer, simply connect the serial printer to the serial port and set output mode to ASCII 2. Once serial communication is established, the Rad-87 will automatically start printing the ASCII 2 text data.

WARNING: ALL EXTERNAL DEVICE CONNECTIONS TO THE RS-232 SERIAL PORT MUST BE IEC-60950 COMPLIANT.

Nurse call specifications

The nurse call features are accessible via the 1/4" round female connector on the back of the device.

NURSE CALL

The nurse call feature on the Rad-87 Pulse CO-Oximeter is based on the relay closing or opening depending on alarm, Low Signal IQ events or both. In addition the nurse call polarity can be inverted to accommodate various nurse call stations requirements.

The nurse call relays have the following electrical specification per switch:

PARAMETER	SPECIFICATION
MAX VOLTAGE	36 VDC or 24 VAC peak

WARNING: THE NURSE CALL FEATURE IS DISABLED WHEN THE AUDIBLE ALARMS ARE SILENCED AND NURSE CALL SETTING IS SET TO "ALARMS".

Introduction

This section covers the use and cleaning of Masimo sensors and patient cables.

Before use of any sensor, carefully read the sensor's Directions for Use.

Use only Masimo sensors and cables with the Rad-87 Pulse CO-Oximeter. Other transducers, sensors and cables may affect Rad-87's performance.

Tissue damage can be caused by incorrect application or use of a sensor, for example by wrapping the sensor too tightly. Inspect the sensor site as directed in the sensor Directions for Use to ensure skin integrity, correct positioning and adhesion of the sensor.

CAUTIONS:

- DO NOT USE DAMAGED SENSORS OR PATIENT CABLES. DO NOT USE A SENSOR OR PATIENT CABLE WITH EXPOSED OPTICAL OR ELECTRICAL COMPONENTS.
- DO NOT IMMERSE THE SENSOR OR PATIENT CABLE IN WATER, SOLVENTS, OR CLEANING SOLUTIONS (THE SENSORS AND CONNECTORS ARE NOT WATERPROOF).
- UNLESS OTHERWISE SPECIFIED, DO NOT STERILIZE SENSORS OR PATIENT CABLES BY IRRADIATION, STEAM, AUTOCLAVE OR ETHYLENE OXIDE. SEE THE CLEANING INSTRUCTIONS IN THE DIRECTIONS FOR USE FOR REUSABLE MASIMO SENSORS.
- DO NOT ATTEMPT TO REPROCESS, RECONDITION OR RECYCLE ANY MASIMO SENSORS OR PATIENT CABLES AS THESE PROCESSES MAY DAMAGE THE ELECTRICAL COMPONENTS, POTENTIALLY LEADING TO PATIENT HARM.
- ALL SENSORS AND CABLES ARE DESIGNED FOR USE WITH SPECIFIC MONITORS. VERIFY THE COMPATIBILITY OF THE MONITOR, CABLE AND SENSOR BEFORE USE, OTHERWISE PATIENT INJURY CAN RESULT.

SELECTING A MASIMO SET SENSOR

When selecting a sensor, consider the patient's weight, the adequacy of perfusion, the available sensor sites, and the duration of monitoring. For more information refer to the following tables or contact your Sales Representative. Use only Masimo sensors and sensor cables. Select an appropriate sensor, apply it as directed, and observe all warnings and cautions presented in the **Directions for Use accompanying the sensor**. Monitor, cables and sensors must be compatible to ensure optimal performance. Incompatible components effect operation or data recovery.

High intensity extreme lights (such as pulsating strobe lights) directed on the Pulse CO-Oximeter sensors, may not allow the sensor to obtain vital sign readings. High ambient light sources such as surgical lights (especially those with a xenon light source), bilirubin lamps, fluorescent lights, infrared heating lamps, and direct sunlight can interfere with the performance of the sensor. 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.

SENSOR APPLICATION INSTRUCTIONS

Unless indicated otherwise in the directions for use, reposition reusable sensors at least every 4 hours and for adhesive sensors inspect the site at least every 8 hours or sooner. If indicated by circulatory condition or skin integrity, reapply to a different monitoring site.

Masimo Rainbow Sensors

Masimo Rainbow sensors must be used for the Rad-87 Pulse CO-Oximeter parameters to enable measurement of Carboxyhemoglobin (SpCO), Methemoglobin (SpMet) and Total Hemoglobin (SpHb). Rainbow sensors will only measure SpO_2 and pulse rate on devices without Masimo Rainbow SET Technology.

RAINBOW REUSABLE SENSORS

SpO_2, SpCO, SpMet, SpHb and pulse rate accuracy for the Rainbow sensors is specified in the following table.

Rainbow reusable sensors must be used in conjunction with Rainbow RC cables.

SENSOR	Weight Range	Saturation Accuracy		Pulse Rate Accuracy		Low Perfusion Accuracy		SpCO Accuracy	SpMet Accuracy	SpHb Conc. Accuracy
		No Motion	Motion	No Motion	Motion	Saturation	Pulse Rate	No Motion	No Motion	
DCI	> 30 kg	60 - 80 ± 3% 70 -100 ± 2%	± 3%	± 3 bpm	± 5 bpm	± 2%	± 3 bpm	± 3%	± 1%	± 1 g/dl
DCIP	10 - 50 kg	60 - 80 ± 3% 70 -100 ± 2%	± 3%	± 3 bpm	± 5 bpm	± 2%	± 3 bpm	± 3%	± 1%	± 1 g/dl

RAINBOW DIRECT CONNECT SENSORS

SpO_2, SpCO, SpMet and pulse rate accuracy for the Rainbow sensors is specified in the following table.

Rainbow Direct Connect sensors connect to the device directly.

SENSOR	Weight Range	Saturation Accuracy		Pulse Rate Accuracy		Low Perfusion Accuracy		SpCO Accuracy	SpMet Accuracy
		No Motion	Motion	No Motion	Motion	Saturation	Pulse Rate	No Motion	No Motion
DCI-dc3 DCI-dc12	> 30 kg	60 - 80 ± 3% 70 -100 ± 2%	± 3%	± 3 bpm	± 5 bpm	± 2%	± 3 bpm	± 3%	± 1%
DCIP-dc3 DCIP-dc12	10 - 50 kg	60 - 80 ± 3% 70 -100 ± 2%	± 3%	± 3 bpm	± 5 bpm	± 2%	± 3 bpm	± 3%	± 1%

SpO_2, SpCO, SpMet, SpHb and pulse rate accuracy for the Rainbow sensors is specified in the following table.

Rainbow Direct Connect sensors connect to the device directly.

SENSOR	Weight Range	Saturation Accuracy		Pulse Rate Accuracy		Low Perfusion Accuracy		SpCO Accuracy	SpMet Accuracy	SpHb Conc. Accuracy
		No Motion	Motion	No Motion	Motion	Saturation	Pulse Rate	No Motion	No Motion	
DC-3 DC-12	> 30 kg	60 - 80 ± 3% 70 -100 ± 2%	± 3%	± 3 bpm	± 5 bpm	± 2%	± 3 bpm	± 3%	± 1%	± 1 g/dl
DCP-3 DCP-12	10 - 50 kg	60 - 80 ± 3% 70 -100 ± 2%	± 3%	± 3 bpm	± 5 bpm	± 2%	± 3 bpm	± 3%	± 1%	± 1 g/dl

Masimo SpO_2 Sensors

The Rad-87 may use standard Masimo LNOP, LNOPv and LNCS SpO_2 sensors, when used with Red PC, Red LNC or Rainbow RC cables respectively.

Select the appropriate patient cable to attach the LNOP or LNCS sensor to the device.

RED DIRECT CONNECT SENSORS

Masimo Red sensors can be used with the Rad-87 to enable measurement of SpO_2 and pulse rate only. Red sensors will only function with oximeter devices equipped with Masimo Rainbow SET technology. Red Direct Connect sensors connect to the device directly.

SENSOR	Weight Range	Saturation Accuracy		Pulse Rate Accuracy		Low Perfusion Accuracy	
		No Motion	Motion	No Motion	Motion	Saturation	Pulse Rate
DC-3 DC-12	> 30 kg	± 2%	± 3%	± 3 bpm	± 5 bpm	± 2%	± 3 bpm
DCP-3 DCP-12	10 - 50 kg	± 2%	± 3%	± 3 bpm	± 5 bpm	± 2%	± 3 bpm

LNOP® REUSABLE SENSORS

LNOP reusable sensors must be used in conjunction with Red PC cables.

SENSOR	Weight Range	Saturation Accuracy		Pulse Rate Accuracy		Low Perfusion Accuracy	
		No Motion	Motion	No Motion	Motion	Saturation	Pulse Rate
LNOP DCI	> 30 kg	± 2%	± 3%	± 3 bpm	± 5 bpm	± 2%	± 3 bpm
LNOP DCIP	10 - 50 kg	± 2%	± 3%	± 3 bpm	± 5 bpm	± 2%	± 3 bpm
LNOP YI	> 1 kg	± 2%	± 3%	± 3 bpm	± 5 bpm	N/A	N/A
LNOP TC-I	> 30 kg	± 3.5%	N/A	± 3 bpm	N/A	± 3.5%	± 3 bpm
LNOP DC-195	> 30 kg	± 2%	± 3%	± 3 bpm	± 5 bpm	± 2%	± 3 bpm
LNOP TF-I	> 30 kg	± 2%	N/A	± 3 bpm	N/A	± 2%	± 3 bpm

NOTE: *The LNOP TF-I and TC-I sensors were not validated under motion conditions.*

LNOPv™ ADHESIVE SENSORS

LNOPv adhesive sensors must be used in conjunction with Red PC cables

SENSOR	Weight Range	Saturation Accuracy		Pulse Rate Accuracy		Low Perfusion Accuracy	
		No Motion	Motion	No Motion	Motion	Saturation	Pulse Rate
LNOPv In	3 - 20 kg	± 2%	± 3%	± 3 bpm	± 5 bpm	± 2%	± 3 bpm
LNOPv Ne	< 3 kg	± 3%	± 3%	± 3 bpm	± 5 bpm	± 3%	± 3 bpm
LNOPv Ad	> 30 kg	± 2%	± 3%	± 3 bpm	± 5 bpm	± 2%	± 3 bpm

LNOP® SPECIALTY SENSORS

LNOP specialty sensors must be used in conjunction with Red PC cables

SENSOR	WeightRange	Saturation Accuracy		Pulse Rate Accuracy		Low Perfusion Accuracy	
		No Motion	Motion	No Motion	Motion	Saturation	Pulse Rate
LNOP Newborn Infant (thumb or great toe)	3 - 30 kg	± 2%	± 3%	± 3 bpm	± 5 bpm	± 2%	± 3 bpm
Infant (finger or toe)	10 - 30 kg	± 3%	± 3%	± 3 bpm	± 5 bpm	± 3%	± 3 bpm
LNOP Newborn Neonatal	< 3 kg	± 3%	± 3%	± 3 bpm	± 5 bpm	± 3%	± 3 bpm
LNOP Trauma	> 30 kg	± 2%	± 3%	± 3 bpm	± 5 bpm	± 2%	± 3 bpm
LNOP Blue	2.5 - 30 kg	60 - 80% ± 4%	N/A	± 3 bpm	N/A	± 3%	± 3 bpm
		70 - 100% ± 3.3%	N/A	± 3 bpm	N/A	± 3%	± 3 bpm
		80 - 100% ± 3%	N/A	± 3 bpm	N/A	± 3%	± 3 bpm

LNCS® REUSABLE SENSORS

LNCS reusable sensors must be used in conjunction with Red LNC or Rainbow RPC cables

SENSOR	Weight Range	Saturation Accuracy		Pulse Rate Accuracy		Low Perfusion Accuracy	
		No Motion	Motion	No Motion	Motion	Saturation	Pulse Rate
LNCS DCI	> 30 kg	± 2%	± 3%	± 3 bpm	± 5 bpm	± 2%	± 3 bpm
LNCS DCIP	10 - 50 kg	± 2%	± 3%	± 3 bpm	± 5 bpm	± 2%	± 3 bpm
LNCS TC-I	> 30 kg	± 3.5%	N/A	± 3 bpm	N/A	± 3.5%	± 3 bpm
LNCS TF-I	> 30 kg	± 2%	N/A	± 3 bpm	N/A	± 2%	± 3 bpm
LNCS YI	> 1 kg	± 2%	± 3%	± 3 bpm	± 5 bpm	N/A	N/A

NOTE: *The LNCS TF-I and TC-I sensors were not validated under motion conditions.*

LNCS® ADHESIVE SENSORS

LNCS sensors must be used in conjunction with Red LNC or Rainbow RPC cables

SENSOR	Weight Range	Saturation Accuracy		Pulse Rate Accuracy		Low Perfusion Accuracy	
		No Motion	Motion	No Motion	Motion	Saturation	Pulse Rate
LNCS Adtx LNCS Adtx-3	> 30 kg	± 2%	± 3%	± 3 bpm	± 5 bpm	± 2%	± 3 bpm
LNCS Pdtx LNCS Pdtx-3	10 - 50 kg	± 2%	± 3%	± 3 bpm	± 5 bpm	± 2%	± 3 bpm
LNCS Inf-L LNCS Inf LNCS Inf-3	3 - 20 kg	± 2%	± 3%	± 3 bpm	± 5 bpm	± 2%	± 3 bpm
LNCS Neo-L	< 3 kg	± 3%	± 3%	± 3 bpm	± 5 bpm	± 3%	± 3 bpm
LNCS Neo LNCS Neo-3	> 40 kg	± 2%	± 3%	± 3 bpm	± 5 bpm	± 2%	± 3 bpm
LNCS NeoPt-L LNCS NeoPt-L LNCS NeoPt-3	< 1 kg	± 3%	± 3%	± 3 bpm	± 5 bpm	± 3%	± 3 bpm
LNCS NeoPt-500	< 1 kg	± 3%	± 3%	± 3 bpm	± 5 bpm	± 3%	± 3 bpm

LNCS® SPECIALTY SENSORS

LNCS specialty sensors must be used in conjunction with Red LNC cables or Rainbow RPC cables.

SENSOR	Weight Range	Saturation Accuracy		Pulse Rate Accuracy		Low Perfusion Accuracy	
		No Motion	Motion	No Motion	Motion	Saturation	Pulse Rate
LNCS Newborn Infant/Pediatric	< 3 kg	± 2%	± 3%	± 3 bpm	± 5 bpm	± 2%	± 3 bpm
LNCS Newborn Neonatal	< 3 kg	± 3%	± 3%	± 3 bpm	± 5 bpm	± 3%	± 3 bpm
LNCS Trauma	> 30 kg	± 2%	± 3%	± 3 bpm	± 5 bpm	± 2%	± 3 bpm

SENSOR ACCURACY

Refer to Section 7, *Specifications* for SpO_2, SpMet, SpCO, SpHb and pulse rate accuracy, unless otherwise specified in the previous tables:

Complete accuracy specifications are located in the sensor Directions For Use (DFU) and are specific for the type of Masimo sensor used.

CLEANING AND REUSE OF MASIMO REUSABLE SENSORS AND CABLES

Reusable sensors and patient cables can be cleaned per the following procedure:

1. Remove the sensor from the patient.
2. Disconnect the sensor from the patient cable.
3. Disconnect the patient cable from the monitor.
4. Wipe the entire sensor and/or patient cable clean with a 70% isopropyl alcohol pad.
5. Allow to air dry thoroughly before returning it to operation.

CAUTION: CAREFULLY ROUTE PATIENT CABLES TO REDUCE THE POSSIBILITY OF PATIENT ENTANGLEMENT OR STRANGULATION.

REATTACHMENT OF SINGLE USE ADHESIVE SENSORS

- Single use sensors may be reapplied to the same patient if the emitter and detector windows are clear and the adhesive still adheres to the skin.

NOTE: *If the sensor fails to track the pulse consistently, the sensors may be incorrectly positioned. Reposition the sensor or choose a different monitoring site.*

CAUTION: DO NOT ATTEMPT TO REPROCESS, RECONDITION OR RECYCLE ANY MASIMO SENSORS OR PATIENT CABLES AS THESE PROCESSES MAY DAMAGE THE ELECTRICAL COMPONENTS, POTENTIALLY LEADING TO PATIENT HARM.

CAUTION: TO PREVENT DAMAGE, DO NOT SOAK OR IMMERSE THE SENSOR IN ANY LIQUID SOLUTION. DO NOT ATTEMPT TO STERILIZE BY IRRADIATION, STEAM, AUTOCLAVE OR ANY METHOD OTHER THAN ETHYLENE OXIDE AS INDICATED.

WARNING: TO AVOID CROSS CONTAMINATION ONLY USE MASIMO SINGLE USE SENSORS ON THE SAME PATIENT.

Introduction

This chapter covers how to test the operation, properly clean and how to obtain service for the Rad-87 Pulse CO-Oximeter.

Under normal operation, no internal adjustment or recalibration is required. Safety tests and internal adjustments should be done by qualified personnel only. Safety checks should be performed at regular intervals or in accordance with local and governmental regulations.

WARNING: ELECTRICAL SHOCK AND FLAMMABILITY HAZARD - BEFORE CLEANING THE RAD-87, ALWAYS TURN IT OFF AND DISCONNECT THE POWER CORD FROM THE AC POWER SUPPLY.

The Rad-87 Pulse CO-Oximeter is a reusable device. The device is supplied and used non-sterile.

Cleaning

The outer surface of the Rad-87 Pulse CO-Oximeter can be cleaned with a soft cloth dampened with a mild detergent and warm water solution. Do not allow liquids to enter the interior of the instrument. The outer surface of the instrument can also be wiped down using the following solvents: Cidex Plus (3.4% Glutaraldehyde), 10% Bleach, and 70% Isopropyl Alcohol.

CAUTIONS:

- DO NOT AUTOCLAVE, PRESSURE STERILIZE, OR GAS STERILIZE THE RAD-87.
- DO NOT SOAK OR IMMERSE THE MONITOR IN ANY LIQUID.
- USE THE CLEANING SOLUTION SPARINGLY. EXCESSIVE SOLUTION CAN FLOW INTO THE MONITOR AND CAUSE DAMAGE TO INTERNAL COMPONENTS.
- DO NOT TOUCH, PRESS, OR RUB THE DISPLAY PANELS WITH ABRASIVE CLEANING COMPOUNDS, INSTRUMENTS, BRUSHES, ROUGH-SURFACE MATERIALS, OR BRING THEM INTO CONTACT WITH ANYTHING THAT COULD SCRATCH THE PANEL.
- DO NOT USE PETROLEUM-BASED OR ACETONE SOLUTIONS, OR OTHER HARSH SOLVENTS, TO CLEAN THE OXIMETER. THESE SUBSTANCES AFFECT THE DEVICE'S MATERIALS AND DEVICE FAILURE CAN RESULT.

Refer to Section 8, *Cleaning and Reuse of Masimo Reusable Sensors and Cables* for cleaning instructions of the sensor.

Battery Service

WARNING: THE BATTERY SHOULD BE INSTALLED AND/ OR REMOVED FROM THE RAD-87 BY QUALIFIED PERSONNEL ONLY.

Performance verification

To test the performance of the Rad-87 after repairs or during routine maintenance, follow the procedure outlined in this section. If the Rad-87 fails any of the described tests, discontinue its use and correct the problem before returning the device back to the user.

Before performing the following tests verify that the device is connected to AC power. Also disconnect any patient cables or probes or serial cables from the instrument.

POWER-ON SELF-TEST:

1. Turn the monitor on by depressing the Power. For about 2 seconds all available LEDs are illuminated and a brief beep tone sounds.
2. The Rad-87 begins normal operation.

KEY PRESS BUTTON TEST:

1. With the exception of the Power, press each button and verify that the device acknowledges each key-press with an audible beep tone or by indicating a change on the display.

ALARM LIMIT TEST:

1. With the monitor turned on, depress the alarm limits button and enter the alarm menu. Change the High Saturation Alarm parameter to a value below the currently selected value, and accept the change.
2. Verify that the newly set parameter is shown on the Saturation Alarm Limit Display.
3. Return the High Saturation Alarm parameter to its original setting.
4. Repeat steps 1 to 3 for the following alarm parameters:
   - Low SpO_2
   - Low and High pulse rate
   - High SpMet (optional feature)
   - High SpCO (optional feature)
   - Low and High SpHb
5. Reset the alarm limits again to the original settings.

LED BRIGHTNESS:

1. With the monitor turned on, press the Brightness Button once to enter the LED Brightness menu. The display will show the default setting Level 2.
2. Continue pressing the Brightness Button to scroll through the settings.
3. Press the Enter Button to accept the desired setting and exit to the home display screen.

TESTING THE RAD-87 WITH MASIMO SET TESTER (OPTIONAL):

1. Turn the Rad-87 off and then on again.
2. Connect the Masimo SET Tester to the Pulse CO-Oximeter Patient Cable Connector.
3. Verify that within 20 seconds all available pulse bars display.
4. Verify that the SpO_2 measurement is between 79% and 84%.
5. Verify that the pulse rate measurement is between 55 bpm and 65 bpm.
6. Set the SpO_2 low alarm limit to 90 (see Section 4, *Setup Menu Level 1, Parameter/ Measurement Alarm Limits - Screen 1,* and *Setup Menu Level 2, Alarm Volume*).
7. Verify that an audible alarm activates, the SpO_2 measurement and the SpO_2 parameter label are flashing, and the Alarm Bell and the System Status Light are flashing red.
8. Press the Alarm Silence Button once and verify that the alarm is silenced and the Alarm Bell is flashing red and the System Status Light is flashing red.
9. Wait 120 seconds and verify that the alarm silence times out, the audible alarm is activated again and the Alarm Bell and System Status Light are flashing red.
10. Press the up arrow button several times and verify that the loudness of the pulse beep tone increases.
11. Press the down arrow button and verify that the loudness of the pulse beep tone decreases until the pulse beep tone is turned off.
12. Reset the device to original settings and remove the tester to complete the procedure.

Service and repair

REPAIR POLICY
Masimo or an authorized Service Department must perform warranty repair and service. Do not use malfunctioning equipment. Have the device repaired.

> **WARNING:** AN OPERATOR MAY ONLY PERFORM MAINTENANCE PROCEDURES SPECIFICALLY DESCRIBED IN THIS MANUAL. REFER SERVICING TO QUALIFIED SERVICE PERSONNEL TRAINED IN THE REPAIR OF THIS EQUIPMENT.

Please clean contaminated and/or dirty equipment before returning, following the cleaning procedure described in Section 9, Cleaning. Make sure the equipment is fully dry before packing.

To return the Rad-87 Pulse CO-Oximeter for service, please follow the Return Procedure.

RETURN PROCEDURE
Please clean contaminated/dirty equipment before returning and make sure it is fully dry before packing the equipment. Call Masimo at 800-326-4890 and ask for Technical Support. Ask for an RMA number. Package the equipment securely – in the original shipping container if possible – and enclose or include the following information and items:

- A letter describing in detail any difficulties experienced with the Rad-87. Please include the RMA number in the letter.
- Warranty information – a copy of the invoice or other applicable documentation must be included.
- Purchase order number to cover repair if the device is not under warranty, or for tracking purposes if it is.
- Ship-to and bill-to information.
- Person (name, telephone/Telex/fax number, and country) to contact for any questions about the repairs.
- A certificate stating the Rad-87 has been decontaminated for bloodborne pathogens.

Return the Rad-87 to the following shipping address:

For USA and Asia Pacific:

Masimo Corporation
40 Parker
Irvine, California 92618
Tel: 949-297-7000
FAX: 949-297-7001

For Europe:

Masimo Europe Limited
304 RN6, Le Bois des Cotes 2
69760 Limonest
France
Tel: +33 (0) 472 17 93 70
FAX: +33 (0) 478 35 78 08

All other locations:

Contact your
local Masimo
Representative

Sales & End-User License Agreement

THIS DOCUMENT IS A LEGAL AGREEMENT BETWEEN YOU ("PURCHASER") AND MASIMO CORPORATION ("MASIMO") FOR THE PURCHASE OF THIS PRODUCT ("PRODUCT") AND A LICENSE IN THE INCLUDED OR EMBEDDED SOFTWARE ("SOFTWARE"). EXCEPT AS OTHERWISE EXPRESSLY AGREED IN A SEPARATE CONTRACT FOR THE ACQUISITION OF THIS PRODUCT, THE FOLLOWING TERMS ARE THE ENTIRE AGREEMENT BETWEEN THE PARTIES REGARDING YOUR PURCHASE OF THIS PRODUCT. IF YOU DO NOT AGREE TO THE TERMS OF THIS AGREEMENT, PROMPTLY RETURN THE ENTIRE PRODUCT, INCLUDING ALL ACCESSORIES, IN THEIR ORIGINAL PACKAGES, WITH YOUR SALES RECEIPT TO MASIMO FOR A FULL REFUND.

Warranty

Masimo warrants to the initial Purchaser for a period of one (1) year from the date of purchase that: (i) each new Product and the Software media as delivered are free from defects in workmanship or materials, and (ii) the Product and Software will perform substantially as labeled in the directions for use. Masimo's sole obligation under this warranty is to repair or replace any Product or Software that is covered under warranty.

Batteries are warranted for six (6) months.

To request a replacement under warranty, Purchaser must contact Masimo for a returned goods authorization. If Masimo determines that a Product must be replaced under warranty, it will be replaced and the cost of shipment covered. All other shipping costs shall be the responsibility of Purchaser.

Exclusions

The warranty does not extend to, and Masimo is not responsible for, repair, replacement, or maintenance needed because of: a) modification of the Product or Software without Masimo's written authorization; b) supplies, devices or electrical work external to the Product or not manufactured by Masimo; c) disassembly or reassembly of the Product by anyone other than an authorized Masimo agent; d) use of the Product with sensors or other accessories other than those manufactured and distributed by Masimo; e) use of the Product and Software in ways or in environments for which they are not labeled; and f) neglect, misuse, improper operation, accident, fire, water, vandalism, weather, war, or any act of God. This warranty does not extend to any Product that has been reprocessed, reconditioned or recycled.

This warranty also does not apply to any Products provided to Purchaser for testing or demonstration purposes, any temporary Products modules or any Products for which Seller does not otherwise receive a usage or purchase fee; all such Products are provided AS-IS without warranty.

Exclusions continued

THIS WARRANTY, TOGETHER WITH ANY OTHER EXPRESS WRITTEN WARRANTY THAT MAY BE ISSUED BY MASIMO IS THE SOLE AND EXCLUSIVE WARRANTY AS TO THE PRODUCT AND SOFTWARE. THIS WARRANTY IS EXPRESSLY IN LIEU OF ANY ORAL OR IMPLIED WARRANTIES, INCLUDING WITHOUT LIMITATION ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. MASIMO SHALL NOT BE LIABLE FOR ANY INCIDENTAL, SPECIAL OR CONSEQUENTIAL LOSS, DAMAGE OR EXPENSE DIRECTLY OR INDIRECTLY ARISING FROM THE USE OR LOSS OF USE OF ANY PRODUCTS OR SOFTWARE. IN NO EVENT SHALL MASIMO'S LIABILITY ARISING FROM ANY PRODUCT AND SOFTWARE (UNDER CONTRACT, WARRANTY, TORT, STRICT LIABILITY OR OTHER CLAIM) EXCEED THE AMOUNT PAID BY PURCHASER FOR THE PRODUCTS GIVING RISE TO SUCH CLAIM. THE LIMITATIONS IN THIS SECTION SHALL NOT BE DEEMED TO PRECLUDE ANY LIABILITY THAT CANNOT LEGALLY BE DISCLAIMED BY CONTRACT.

End-User License

1. Grant of License: In consideration of payment of the Software license fee, which is part of the price paid for the Product, Masimo grants to Purchaser a nonexclusive, nontransferable (except as set forth below) license ("License"), without right to sublicense, to use the copy of the Software in connection with Purchaser's use of the Product for its labeled purpose as set forth in these directions for use. Masimo reserves all rights not expressly granted to Purchaser.
2. Ownership of Software: The Software is licensed not sold; all rights and interests in the Software and all copies thereof remain at all times vested in Masimo, and do not pass to Purchaser. Any references in this Agreement to the purchase or sale of the Software shall be deemed the purchase or sale of a Software License as set forth herein.

Restrictions

1. Copyright Restrictions: The Software and the accompanying written materials are copyrighted. Unauthorized copying of the Software, including Software that has been modified, merged, or included with other software, or the written materials is expressly forbidden. Purchaser may be held legally responsible for any copyright infringement that is caused or incurred by Purchaser's failure to abide by the terms of this Agreement. Nothing in this License provides any rights beyond those provided by 17 U.S.C. §117.
2. Use Restrictions: Purchaser may physically transfer the Product from one location to another provided that the Software is not copied. Purchaser may not electronically transfer the Software from the Product to any other device. Purchaser may not disclose, publish, translate, release, distribute copies of, modify, adapt, translate, reverse engineer, decompile, disassemble, or create derivative works based on the Software or the written materials.
3. Transfer Restrictions: In no event may Purchaser transfer, assign, rent, lease, sell, or otherwise dispose of the Product or the Software on a temporary basis. Purchaser shall not assign or transfer this License, in whole or in part, by operation of law or otherwise without Masimo's prior written consent; except that the Software and all of Purchaser's rights hereunder shall transfer automatically to any party that legally acquires title to the Product with which this Software is included. Any attempt to assign any rights, duties or obligations arising hereunder other than as set forth in this paragraph shall be void.
4. U.S. Government Rights: If Purchaser is acquiring Software (including the related documentation) on behalf of any part of the United States Government, the following provisions apply: the Software and documentation are deemed to be "commercial software" and "commercial computer software documentation," respectively pursuant to DFAR Section 227.7202 FAR 12.212, as applicable. Any use, modification, reproduction, release, performance, display or disclosure of the Software (including the related documentation) by the U.S. Government or any of its agencies shall be governed solely by the terms of this Agreement and shall be prohibited except to the extent expressly permitted by the terms of this Agreement.

part numbers

Part Numbers

PART NUMBER	DESCRIPTION
32750	Rad-87 Operator's Manual (SpHb), French
32751	Rad-87 Operator's Manual (SpHb), German
32752	Rad-87 Operator's Manual (SpHb), Italian
32753	Rad-87 Operator's Manual (SpHb), Spanish
32754	Rad-87 Operator's Manual (SpHb), Japanese
32755	Rad-87 Operator's Manual (SpHb), Dutch
32756	Rad-87 Operator's Manual (SpHb), Portuguese
32757	Rad-87 Operator's Manual (SpHb), Danish
32758	Rad-87 Operator's Manual (SpHb), Swedish
32759	Rad-87 Operator's Manual (SpHb), Chinese

Please visit our website, www.masimo.com, for updated information about Masimo products.

www.masimo.com

Instruments and sensors containing Masimo Rainbow SET technology are identified with the Masimo Rainbow SET logo.