

# Service Manual



For the Sentec Digital Monitoring System

(Date of release: 2023-04)

## Warranty

The manufacturer warrants to the initial purchaser that each new Sentec Digital Monitor will be free from defects in workmanship and materials. The manufacturer's sole obligation under this warranty is to at its own choice repair or replace any monitor – for which the manufacturer acknowledges the warranty cover – with a replacement monitor.

## Warranty Exclusions and System Performance

Sentec AG can neither guarantee or verify instrument performance characteristics nor accept warranty claims or product liability claims if the recommended procedures are not carried out, if the product has been subject to misuse, neglect or accident, if the product has been damaged by extraneous causes, if accessories other than those recommended by Sentec AG are used, if the warranty seal on the lower side of the monitor is broken, or if instrument repairs are not carried out by Sentec authorized service personnel.

**CAUTION: Federal law (U.S.) restricts this device to sale by or on the order of a physician.**

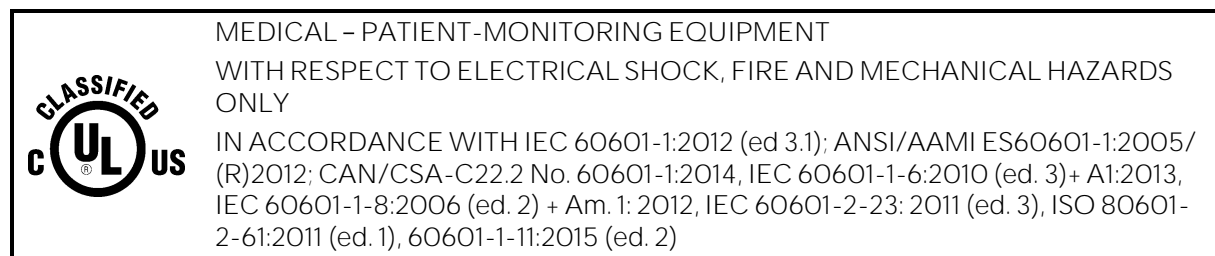
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International Industrial Design No. DM/054179, Japanese Design No. 1137696, U.S. Design Patent No. D483488.

Canadian Patent No. 2466105, European Patent No. 1335666, German Patent No. 5011822.5-08, Spanish Patent No. 2278818, Hong Kong Patent No. HK1059553, U.S. Patent No. 6760610.

Chinese Patent No. ZL02829715.6, European Patent No. 1535055, German Patent No. 50213115.2, Spanish Patent No. 2316584, Indian Patent No. 201300, Japanese Patent No. 4344691, U.S. Patent No. 7862698.

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## Abbreviations

AHP	Absolute Heating Power
CO <sub>2</sub>	Carbon dioxide
DS	Docking Station (calibration unit being integrated in the SDM)
HP	Heating Power
HPM	Heating Power Mode
LED	Light emitting diode
MRI	Magnetic Resonance Imaging
O <sub>2</sub>	Oxygen
PaCO <sub>2</sub>	Arterial carbon dioxide partial pressure
PaO <sub>2</sub>	Arterial oxygen partial pressure
PcCO <sub>2</sub>	Cutaneous carbon dioxide partial pressure (i.e. the CO <sub>2</sub> partial pressure at the skin surface)
PCO <sub>2</sub>	Used to display/label tcPCO <sub>2</sub> on the SDM and – unless explicitly stated otherwise – throughout this manual
PcO <sub>2</sub>	Cutaneous oxygen partial pressure (i.e. the O <sub>2</sub> partial pressure at the skin surface)
PI	Pulsation Index

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PO2	Used to display/label tcPO2 on the SDM and – unless explicitly stated otherwise - throughout this manual
POST	Power-On Self-Test
RO	Responsible Organization
PR	Pulse rate
RHP	Relative Heating Power
RMI	Remote monitoring interrupted
SaO2	Arterial oxygen saturation
SDM	Sentec Digital Monitor
SDMS	Sentec Digital Monitoring System
SpO2	Functional oxygen saturation of arterial hemoglobin as measured with a pulse oximeter
TC	Transcutaneous
tcPCO2	Transcutaneous carbon dioxide partial pressure, i.e., an estimate of PaCO2 calculated from the measured PcCO2 and displayed/labeled on the SDM and - unless explicitly stated otherwise - throughout this manual as 'PCO2'
tcPO2	Transcutaneous oxygen partial pressure, i.e., an estimate of PaO2 calculated from the measured PcO2 and displayed/labeled on the SDM and - unless explicitly stated otherwise - throughout this manual as 'PO2'
VOM	V-CareNeT Only Mode



# 1 Introduction

This Manual provides information on

- **maintenance and safety and functionality tests** for the Sentec Digital Monitoring System (SDMS) intended for **qualified personnel only** (*see section 3*);
- **troubleshooting** for the SDMS (*see section 4*). The troubleshooting list covers three levels of recommended troubleshooting procedures a) for the **operator**, b) for **qualified personnel**, and c) for **Sentec authorized technicians** only;
- **repair** procedures that do not require opening the cover of the SDM intended for **qualified personnel only** (*see section 5*).

**Note:** Repairs that require opening the SDM cover are described within Sentec's *Repair Manual for the SDMS* (which is distributed to Sentec authorized service personnel only). Within this manual, activities described as "for Sentec authorized service technicians only" refer to activities described in detail within the *Repair Manual for the SDMS* (HB-005755).

This manual must be read carefully prior performing service or repairs. *Section 1.2, "Safety Information"* must be read and understood.

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## 1.1 Related Documents

To perform service or repairs you must know how to operate the SDMS. The SDMS consists of the Sentec Digital Monitor (SDM), sensors and accessories.

Refer to the following Manuals and Directions for Use:

**Table 1 Related Documents**

System component	Manual	Content
SDMS	Quick Reference Guide	Routine Use: The <i>SDMS Quick Reference Guide</i> summarizes the key essentials. It is available for adult and neonatal mode.
SDMS	Instruction Manual for the SDMS	Getting started / Using the SDMS: The <i>Instruction Manual for the SDMS</i> highlights the essential points when using the SDMS. To ensure proper operation of the SDMS, precisely follow the instructions provided in the <i>Instruction Manual for the SDMS</i> step by step. Contains routine checks and maintenance procedures that can be performed by the operator.
SDM	Technical Manual for the SDM HB-005752	The <i>Technical Manual for the SDM</i> provides detailed information on the Sentec Digital Monitor (SDM).
SDMS	Service Manual for the SDMS (present manual)	Provides information on maintenance, safety, and functionality tests, troubleshooting and repair procedures that <b>do not require opening the cover</b> of the SDM as well as on service/maintenance procedures for sensors.
SDMS	Repair Manual for the SDMS HB-005755	The <i>Repair Manual for the SDMS</i> covers <b>repair procedures on the opened SDM</b> . The <i>Repair Manual for the SDMS</i> is <b>distributed to Sentec authorized service personnel only</b> .
Sensors / Disposables	Respective Directions for Use	Additional information on Sentec TC Sensors, the Membrane Changer and Membrane Changer Insert, the Ear Clip, the Multi-Site Attachment Rings, and Sentec's Staysite Adhesive is provided in the respective Directions for Use.
V-STATS	Installation Manual for V-STATS	This manual describes the procedures to install V-STATS on a PC.
V-STATS	Instruction Manual for V-STATS	The Instruction Manual for V-STATS provides detailed information on V-STATS.

**Note:** Related forms (as referenced within this manual) are listed in *section 8 "Appendix"*.

**Note:** The *Quick Reference Guide for the SDMS* and the *Instruction Manual for the SDMS* in all available languages can also be downloaded from Sentec's Webpage ([www.sentec.com/ifu](http://www.sentec.com/ifu)).



Information / Instructions about the Digital Sensor Adapter Cable, the Contact Gel and the Service Gas are provided in the *Instruction Manual for the SDMS* and the *Technical Manual for the SDM*.

**Note:** SDMS related tutorials are available for online viewing at [www.sentec.com/tv](http://www.sentec.com/tv)



## 1.2 Safety Information

### Warnings

This symbol identifies a WARNING statement. Warnings alert users to potential serious outcomes (death, injury, or adverse events) to the patient, user, or environment.



### Cautions

This symbol identifies a CAUTION statement. Cautions alert users to exercise appropriate care for safe and effective use of the product and the care necessary to avoid damage to the product that may occur as a result of use or misuse.



### For Sentec authorized service technicians only

This symbol indicates activities described as "For Sentec authorized service technicians only", described in the *Repair Manual for the SDMS* (HB-005755), which is distributed to Sentec authorized service personnel only.



Carefully read all safety information in this Manual and in the *Technical Manual for the SDM* (HB-005752) before operating the device or performing service/repairs.

## 1.2.1 General Safety Information

**WARNING:** The Sentec Digital Monitoring System (SDMS) is to be operated by qualified personnel only. Read this manual, accessory Directions for Use, all precautionary information, and specifications before use.



**WARNING:** The Sentec Digital Monitor (SDM) is not intended for diagnosis; it is intended only as an adjunct in patient assessment. It must be used in conjunction with clinical signs and symptoms. The SDM is a cutaneous blood gas monitor and not a blood gas analyzer.



**WARNING:** Do not use SDMs, sensors, cables, or connectors that appear damaged.



**WARNING:** Carefully route and fix cables to reduce the possibility of patient entanglement or strangulation.



**WARNING:** To ensure patient safety, do not place the SDM in any position that might cause it to fall on the patient.



**WARNING:** Do not lift the SDM by the sensor cable or the AC power cord because they could disconnect from the SDM, causing the SDM to fall on the patient.



**WARNING:** Do not spray, pour, or spill any liquid on the SDM, its accessories, connectors, switches, or openings in the chassis. If the SDM has been wetted accidentally, it must be removed from AC power, wiped dry externally, allowed to dry thoroughly, and inspected by qualified service personnel before further use.



**WARNING:** Keep the SDM (as well as any discarded parts) out of reach of children under the age of 5 years. Some parts of the SDM are small enough to be swallowed and may block the trachea.



**WARNING:** Explosion and flammability hazards. Do not use the SDM in the presence of flammable anesthetics / gases or other flammable substances in any environment which has increased oxygen content.



**WARNING:** The SDMS only can be used in patients undergoing hyperbaric therapy if the SDM (monitor) remains outside the hyperbaric environment.



**WARNING:** The SDM is protected against electrostatic/defibrillator discharge. Parameter display may be temporarily affected during discharge/defibrillation but will rapidly recover. Precisely follow the instructions given in the defibrillator manual.



**WARNING:** This device has been tested and found to comply with the requirements for medical devices according to the IEC 60601-1-2, and the Medical Device Regulation (EU) 2017/745. These requirements are designed to provide reasonable protection against harmful interference in a typical medical installation.



**WARNING:** To ensure protection of patient, operator, and equipment from the effects of defibrillation and diathermy/electro-surgery, cables manufactured by Sentec AG must be used.



**WARNING:** During normal operation (except transport), it is recommended that the monitor is always connected to the AC power outlet.



**WARNING:** Do not connect the SDM to an electrical outlet controlled by a wall switch, because the SDM may be accidentally turned off once the battery is depleted.



**WARNING:** To avoid risk of electric shock, this equipment must be connected to a supply mains with protective earth. Ensure that power and protective ground lines are connected correctly. If case of doubt (e.g., as this may be the case during home use of the SDM) disconnect the SDM from the outlet and use the battery power during patient monitoring.



**WARNING:** Do not use the protective earth terminal for any other purpose than protective earthing or functional earthing.



**WARNING:** For US, respectively Japan: Grounding reliability can only be achieved when the SDM is connected to an equivalent receptacle marked HG (Hospital Grade), respectively HGJ (Hospital Grade Japan).



**WARNING:** The SDM should not be used adjacent to or stacked with other equipment as these can cause electromagnetic interference and thereby result in incorrect measurements. If adjacent or stacked use is necessary, the SDM should be observed to verify normal operation in the configuration it is to be used.



**WARNING:** Certain types of mobile telecommunication equipment could potentially interfere with SDM operation. Mobile telecommunication equipment should not be used within five meters (16.4 feet) of the SDM. Otherwise, degradation of the device performance could result.



**WARNING:** The use of accessories, sensors, and cables other than those specified may result in increased emission and/or decreased immunity and inaccurate readings of the SDM.



**WARNING:** When connecting/ mounting the SDM to accessory equipment (e.g., PCs, PSG-Systems, (wireless) networks, roll stands, mounting plates, incubators, etc.), verify proper operation before clinical use of the SDM and accessory equipment. In certain cases, it may be required that the accessory equipment must be connected to a grounded AC outlet. In case of doubt, consult qualified technicians.



**WARNING:** Accessory equipment (e.g., a PC) connected to the SDM's data ports must be certified according to the IEC 60950 standard. All resulting combinations of equipment must be in compliance with the IEC standard 60601-1 systems requirements. Anyone who connects accessory equipment to the SDM configures a medical system and is, therefore, responsible for ensuring that the resulting system complies with the requirements of standard IEC 60601-1 and the electromagnetic compatibility standard IEC 60601-1-2.



**WARNING:** The mains power supply of the Sentec Digital Monitor (SDM) is separated by two Means of Patient Protection (MOPPs) between the sensor port (for the applied part, the sensor) and the interface connectors. The three interface connectors - serial data port, Multipurpose I/O port (analog outputs, nurse call), LAN port - of the SDM are not separated from each other. If at a time accessory equipment is connected to only one of the three interface connectors no additional safety measures are necessary to comply with the requirements of IEC 60601-1. If, however, accessory equipment is simultaneously connected to two or three of the SDM's interface connectors additional safety measures may be required to be compliant with



the requirements of IEC 60601-1. In case of doubt consult qualified technicians.

**WARNING:** The Roll Stand, model RS\_SDM, is intended for use with the SDM only or in combination with the Cable Cleat, model CC\_SDM, and the SDM. The mounting plates are intended for use with the Sentec Digital Monitor (SDM) only. Do not use the accessories for devices from other manufacturers than Sentec together with Sentec Digital Monitoring System (SDMS).



**WARNING:** Do not attach the basket of the Roll Stand, model RS\_SDM, in any position that might cause it to tip over and possibly fall on the patient. Ensure that the Roll Stand does not tip over with and without the SDM being mounted to it.



**WARNING:** This warning applies to all SDMs with serial numbers less than or equal to 302968 provided that the open thread has not been replaced by a blind thread already or is not sealed with slotted setscrew and thread locking adhesive. A screw entering 17 mm (0.67 inches) into one of the SDM's screw holes may touch the primary part of the SDM's power supply. If this screw is electrically conducting the resulting short circuit may cause an electrical isolation failure and, consequently, if the SDM is connected to AC power an electrical shock may occur to a person touching this screw or any other electrically conducting material being in contact with this screw.



**CAUTION:** To maintain monitor readiness in-between monitoring if using a Sentec TC Sensor:

1. **ALWAYS** clean the sensor before putting it into the Docking Station!
2. **ALWAYS** store the clean sensor in the Docking Station!
3. **ALWAYS** keep the monitor switched on!



**CAUTION:** Do not immerse the SDM nor the connectors of any connecting cables in liquid solution. Plugs and connectors meticulously must be kept clean and dry at all times.



**CAUTION:** To ensure accurate performance and prevent device failure, do not subject the SDM to heavy moisture, such as direct exposure to rain. Such exposure may cause inaccurate performance or device failure. If the SDM becomes wet accidentally, it should be removed from AC power, wiped dry externally, allowed to dry thoroughly, and inspected by qualified service personnel before further use.



**CAUTION:** Do not sterilize any parts of the SDMS by irradiation, steam, ethylene oxide, or H2O2 plasma.



**CAUTION:** Ensure that the SDM is properly grounded when operating on AC power. If you are uncertain whether the AC outlet is properly grounded, disconnect the SDM from the outlet and use the battery power. Contact a qualified electrician to examine the outlet for ground connections.



**CAUTION:** When installing/setting up the SDM, ensure that the SDM can easily be disconnected from the AC power source at any given time.



**CAUTION:** Use only hospital-grade power cords provided by Sentec.



**CAUTION:** Ensure to always use the correct type and rating of live and neutral fuses. Otherwise, you risk damage or malfunction of the SDM.



**CAUTION:** If the monitor is operated on an AC power source with a depleted battery and the AC power is subsequently lost, the monitor will shut down immediately.



**CAUTION:** Ensure that the fan of the SDM is clear of any obstructions and that the SDM is located in a well-ventilated dust-free atmosphere. Failure to do so could cause damage or malfunction of the SDM.



## 1.2.2 Safety Information regarding Repair and Service Operations

**WARNING:** Maintenance and repair requiring removal of the case or covers must be performed by Sentec authorized service personnel.



**WARNING:** Before attempting to open or disassemble the SDM, disconnect the device from the AC power outlet.



**WARNING:** Before replacing fuses of the SDM, disconnect the device from the AC power outlet.



**WARNING:** Use only accessories and spare parts supplied or recommended by Sentec AG. Do not perform other service and repair activities than specified and described by Sentec AG. Failure to comply may result in physical injury, inaccurate measurements, and/or damage to the device.



**WARNING:** Chemicals from a broken LCD display panel are toxic when ingested. Use caution when handling a SDM with a broken display panel. Electronic components may contain toxic chemicals. Do not ingest chemicals from a broken electronic component.



**WARNING:** Dispose of battery in accordance with local requirements and regulations.



**CAUTION:** Follow ESD (Electrostatic discharge) precautions when working with the SDM, especially when disassembling and reassembling the SDM and when handling any of the components. Use an ESD protective wrist-strap and tablemat connected to Earth while working with the electronics.



**CAUTION:** When reassembling the SDM tighten the screws to a torque of 5 Nm. Over-tightening could strip out the screw holes, rendering the part unusable.





## 2 The Sentec Digital Monitoring System (SDMS)

### 2.1 Components

The Sentec Digital Monitoring System (SDMS) comprises the following main components:

REF	Product (Brand) Name	Description
SDM	Sentec Digital Monitor	Stand-alone patient monitor.
VS-A/P/N	V-Sign™ Sensor 2	Digital carbon dioxide tension and oximetry sensor
OV-A/P/N	OxiVenT™ Sensor	Digital carbon dioxide tension, oxygen tension and oximetry sensor
AC-XXX	Digital Sensor Adapter Cable	Adapter cable required to connect digital Sentec sensors to the Sentec Digital Monitor. It transfers the power needed to run the micro-/optoelectronic components (LEDs) and to heat the sensor. It furthermore transmits digitized data between the digital sensor and the SDM.
PSG Cable A to PSG Cable X	PSG Adapter Cable	Adapter Cable to interface the SDM to Polygraphs (PG) or Polysomnographs (PSG). A PSG Cable transfers analogue data from the SMD to the PG or PSG system.
RFT100VA-XX	Isolation Transformer	Isolates the SDM from mains for use in home use environments.
V-STATS_CD	V-STATS	V-STATS: PC based download, data analysis, remote monitoring, and monitor management software.
SDM_WPC	SDM Water protection cover	This cover provides an IPX2 protection for the SDM against the ingress of water.
EC-MI	Ear Clip	Single use sensor application Ear Clip, recommended for adult and pediatric patients with mature/intact skin
MAR-MI	Multi-Site Attachment Ring for mature/ intact skin	Single use sensor application ring, recommended for adult, pediatric and neonatal patients with mature/intact skin
MARe-MI	Multi-Site Attachment Ring Easy for mature/intact skin	Single use sensor application ring, recommended for adult, pediatric and neonatal patients with mature/intact skin
MAR-SF	Multi-Site Attachment Ring for sensitive/fragile skin	Single use sensor application ring, recommended for adult, pediatric and neonatal patients with sensitive/fragile skin
MARe-SF	Multi-Site Attachment Ring Easy for sensitive/fragile skin	Single use sensor application ring, recommended for adult, pediatric and neonatal patients with sensitive/fragile skin
SA-MAR	Staysite Adhesive for Multi-Site Attachment Rings	Single-use adhesive for Multi-Site Attachment Rings (attaches complementary the MAR-SF / MARe-SF / MAR-MI / MARe-MI to the skin with an additional adhesive film)
MC	Membrane Changer	Membrane Changer single use
MC-R	Membrane Changer	Membrane change tool, reloadable

## 2 The Sentec Digital Monitoring System (SDMS)

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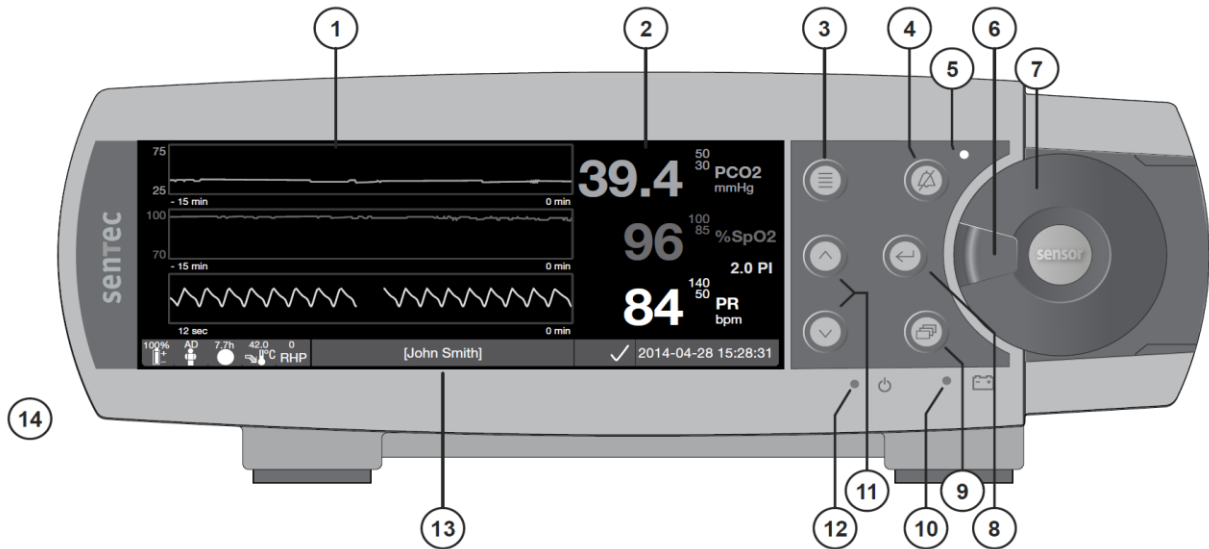
REF	Product (Brand) Name	Description
MC-I	Membrane Changer Insert	Separately bagged, single-use inserts required to reload a Membrane Changer prior reuse
GAS-0812	Service Gas for SDM	Calibration gas for docking station, cylinder of 0.56 l at 9.5 bar. Mixture of 8-vol % CO <sub>2</sub> , 12-vol% O <sub>2</sub> and 80-vol% N <sub>2</sub>
GEL-04	Contact Gel	Contact gel for Sentec transcutaneous sensors, bottle of 2 mL or 5 mL
GEL-SD	Single Dose Contact Gel	Contact gel for Sentec transcutaneous sensors, single-dose vials of 0.3 g each

**Table 2**      **Components of the SDMS**

**Note:** The components listed above do not necessarily correspond to the scope of delivery. Please refer to Sentec's Webpage ([www.sentec.com/products](http://www.sentec.com/products)) for additional information and other available accessories.

## 2.2 The Sentec Digital Monitor (SDM)

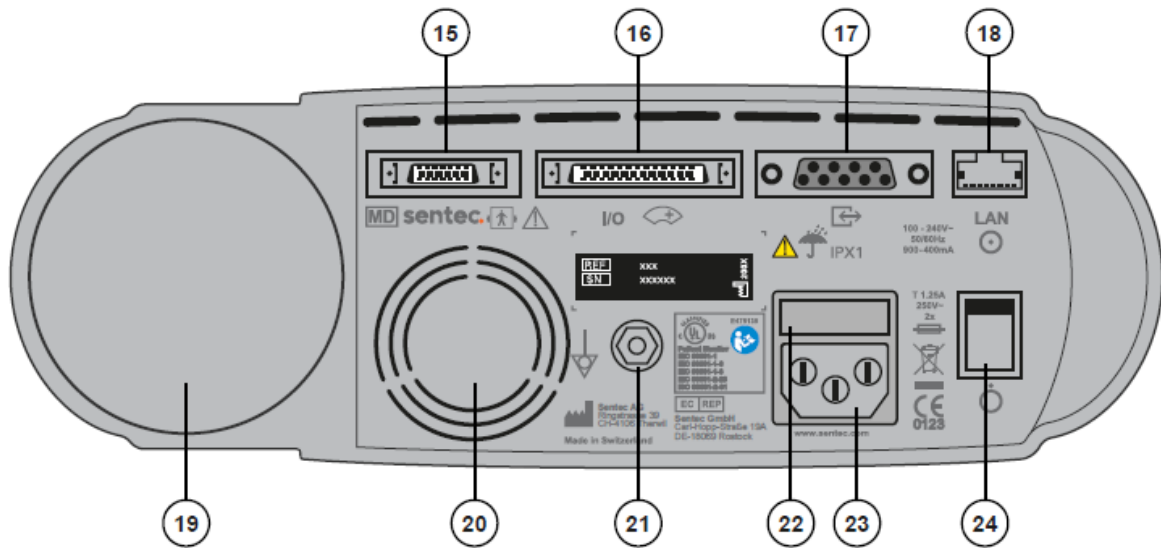
### 2.2.1 Front Panel



- |   |  |
|---|--|
| 1 Trend Display Area                      | 8 Enter Button                                   |
| 2 Numerical Display Area                  | 9 Display Button                                 |
| 3 Menu/ Previous Level Button             | 10 AC Power/Battery Indicator (green/yellow LED) |
| 4 AUDIO PAUSED/OFF Button                 | 11 UP/DOWN Buttons                               |
| 5 AUDIO PAUSED/OFF Indicator (yellow LED) | 12 ON/OFF Indicator (green LED)                  |
| 6 Door Handle                             | 13 Status Bar                                    |
| 7 Docking Station Door                    | 14 Speaker (on the side)                         |

Figure 1 Front Panel of the SDM

## 2.2.2 Rear Panel



- |    |  |    |  |
|----|--|----|--|
| 15 | Sensor Connection Port                               | 20 | Fan  |
| 16 | Multipurpose I/O-Port<br>(Nurse call, analog output) | 21 | Equipotential Terminal Connector<br>(ground) |
| 17 | Serial Data Port (RS-232)                            | 22 | Fuse Holder                                  |
| 18 | Network Port (LAN)                                   | 23 | AC Power Connector                           |
| 19 | Gas Bottle Slot                                      | 24 | ON/OFF Switch                                |

Figure 2 Rear Panel of the SDM

**WARNING:** Refer to *section 1.2.1* for warnings related to connecting/mounting the SDM to accessory equipment.

**CAUTION:** Ensure to always use the correct type and rating of live and neutral fuses. Otherwise, you risk damage or malfunction of the SDM.

**CAUTION:** Ensure that the fan of the SDM is clear of any obstructions and that the SDM is located in a well-ventilated dust-free atmosphere. Failure to do so could cause damage or malfunction of the SDM.



## 3 Maintenance/Safety & Functionality Tests

At normal use there is no internal adjustment or new calibration of the SDM required. However, to guarantee continuous performance, reliability, and safety of the SDMS routine checks and maintenance procedures (including cleaning/disinfection) as well as safety checks should be performed regularly.

Routine checks and maintenance procedures that can be performed by the **operator** are provided in the *Instruction Manual for the SDMS*. Instructions for cleaning and/or disinfecting the Sentec Digital Monitor (SDM) and the 'Digital Sensor Adapter Cable', are provided in the *Technical Manual for the SDM*. Please refer to the respective Directions for Use for instructions for cleaning and/or disinfection of Sentec TC Sensors. For a better overview and documentation of periodic routine checks and maintenance to be performed by the operator the Sentec, form *HB-007601 "SDMS Maintenance Checklist"* (see section 8.8) is available.

It is recommended that **qualified service personnel** perform the maintenance and all non-optional safety and functionality test as specified in this Manual at regular intervals (recommended every 12 months but at least every 24 months). Use *HB-005638 "Protocol for Safety & Functionality Test"* (see section 8.2) to guide you through the complete Test and to document your test results. **To perform a complete "Safety & Functionality Test", all tests not marked as optional in this chapter MUST be performed.**

**Note:** Prior to maintenance, service or repairs all components of the SDMS must be cleaned and disinfected. If equipment is sent to service personnel, a local Sentec representative or to Sentec AG a completed *"Certificate for Disinfection"* (see section 8.8) must be attached.

**WARNING:** If any of the tests specified below fails, the respective problem must be fixed before the equipment is returned to the user.



## 3.1 Sentec TC Sensors

Verify that the sensor has been cleaned / disinfected as described in the Instruction Manual for the SDMS (HB-005771) and "Cleaning and Disinfection Agents" (HB-010143). If necessary, remove dried up gel / electrolyte residues with a soft brush while immersing the (membraned) sensor into clean tap water.

### 3.1.1 Cleaning and Disinfection

For cleaning and disinfection procedures for the Sentec TC Sensors please refer to [www.sentec.com/ifu](http://www.sentec.com/ifu).

### 3.1.2 Visual Inspection

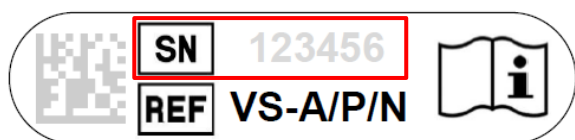
Visually inspect the sensor body, cable, and membrane for damage. Check the cable plug and its connectors for damages.

If any of the components of the sensor is irreversibly damaged, replace the sensor with a new Sentec TC Sensor.

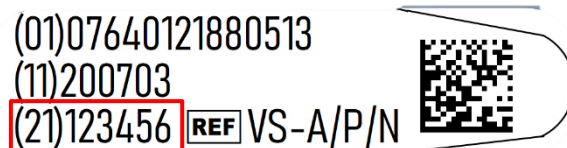
### 3.1.3 Labeling

Check presence/legibility of the label on the plug of the sensor cable.

The sensor's serial number can be found on the label on the plug (see figures below), either after the SN symbol (left figure) or after the application identifier (21) (right figure).



*SN label with serial number (123456) after the SN symbol*



*UDI label with serial number (123456) after the application identifier (21)*

If the label is not present / legible then connect the sensor to an SDM, switch the monitor on and read the sensor's serial number in the menu "System information".

### 3.1.4 Sensor LEDs

**Note:** This test is optional and may be skipped.


Connect the sensor to the SDM and switch on the monitor. Verify that the sensor emits red light and is recognized by the SDM. When using an OxiVenT™ Sensor additionally verify that the sensor also emits green light (provided PO2 is activated).

**Note:** To be able to verify the function of the green LED, PO2 must be enabled (software option) and the PO2 parameter must be enabled (under 'enabled parameters').

Then insert the sensor into the Docking Station. Ensure that the calibration screen appears.

If the above-described functions do not operate properly, refer to *section 4.2.1 "Troubleshooting PCO<sub>2</sub> / PO<sub>2</sub> monitoring"* to further evaluate the problem.

### 3.1.5 Sensor Temperature Display

Check that the measured sensor temperature (as displayed by the temperature indicator  located in the Status Bar of the SDM's display) is within  $\pm 0.3$  °C of the currently selected 'Sensor SET Temperature' (e.g., as displayed in the upper right corner of the 'Ready for use' or calibration screen: **SET T [°C] = 39.5**).

### 3.1.6 Sensor Temperature Surveillance

**Note:** The 'Sensor Temperature' Icon in the Status Bar indicates the measured sensor temperature (in °C).

Connect the sensor to the SDM and switch on the monitor. Verify that the sensor temperature reaches the SET temperature within 2 to 3 minutes. Then immerse the sensor into clean tap water of 45 °C – 50 °C and verify that the measured sensor temperature increases (i.e., by observing the temperature indicator located in the Status Bar of the SDM's display). Verify that the red sensor LED switches off, a low priority alarm starts to sound and that the message "Temp. limiter active" (or 'Sensor problem 38', 'Sensor problem 42') displays.

If the message "Sensor Fault xx" or "SFxx" was triggered, you must restart the SDM to reset the message. Do not use the sensor if the message "Sensor Fault xx" or "SFxx" is not reset by power cycling the SDM. Instead contact qualified service personnel or your local Sentec representative.

**Do not use the sensor if the test fails!**

**CAUTION:** Ensure that the temperature of the water bath is < 50 °C. Temperatures above 50 °C may damage the sensor.



### 3.1.7 Cleaning / Inspecting without Membrane

1. Remove the sensor membrane using the membrane remover located at the bottom of the Membrane Changer as shown in the figure below (note that the Membrane Changer is shown upside down). Step ❶: Slide the Sentec TC Sensor into the membrane remover with its membrane facing the bottom of the Membrane Changer. Step ❷: Lift the Sentec TC Sensor up to remove the membrane from the sensor body.

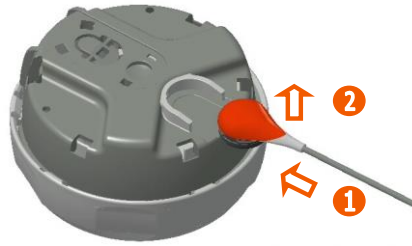


Figure 3 Removal of the Membrane from the TC Sensor

**CAUTION:** Do not touch any of the measuring units in the center of the sensor surface after removing the sensor membrane. Do not rub the sensor surface.

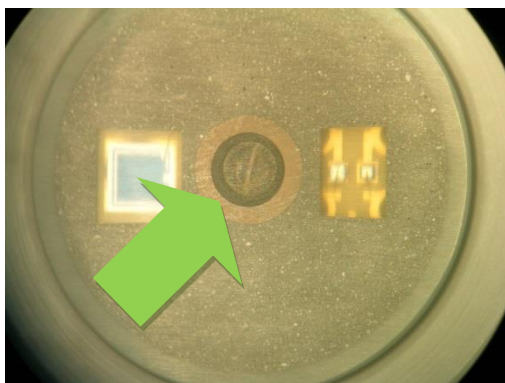


**CAUTION:** Do not leave the sensor without membrane in air. Perform the following steps uninterrupted.

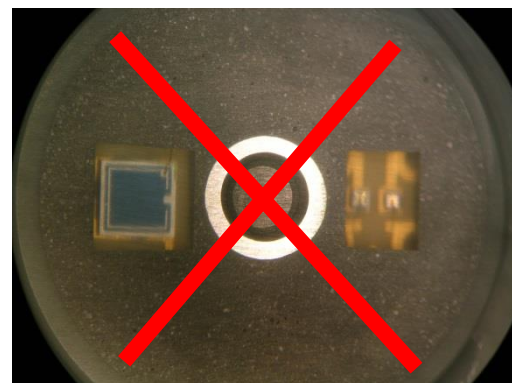


2. Immerse the sensor into clean, room temperature tap water for 3 minutes.
3. Use a soft brush to completely remove dried up gel / electrolyte residues from the grooves on the sensor circumference.
4. Softly rinse the sensor with clean tap water.
5. Dab the sensor dry using a clean lint-free towel. Pay attention not to touch the ring and the pH-glass in the center of the sensor surface. Do not rub the sensor surface!
6. Inspect the ring around the pH-glass for damages and brownish color (*see Figure 4 Top view of the V-Sign™ Sensor*). Note that the same criteria apply for the OxiVenT™ Sensor.

If the ring around the pH-glass is broken, parts of it are missing, the brown color is lost, or the ring has a metallic luster, then replace the sensor with a new Sentec TC Sensor.



The sensor has an intact brown ring around the pH-glass.



The ring around the pH-glass is intact but has a metallic luster, this sensor needs to be replaced

Figure 4 Top view of the V-Sign™ Sensor



7. Inspect the sensor to ensure that the grooves on the sensor circumference are clean and intact. **If the grooves on the sensor circumference are damaged replace the sensor with a new Sentec TC Sensor. Do not use** the sensor if there is any visible damage to/trapped air underneath the membrane, or if the sensor's red LED does not light when the sensor is connected to the SDM.
8. OxiVen™ Sensor only: Verify that the white oxygen sensing spot (i.e., off-centered, white, circular spot) is present and intact.



The white oxygen sensing spot is defect. This sensor needs to be replaced

Figure 5 Top view of the OxiVen™ Sensor

9. If the visual inspections (steps 6 to 8) passed re-membrane the sensor using the Membrane Changer (for instructions, please refer to the Directions for Use of the Membrane Changer).
10. After placing a new membrane, verify that
  - a) the membrane ring is intact and securely seated on the sensor.
  - b) there are no air bubbles between membrane and sensor surface.

**In case of loose fit, damage, or trapped air you must repeat the membrane change.** Otherwise confirm the membrane change in the menu of the monitor and calibrate sensor.

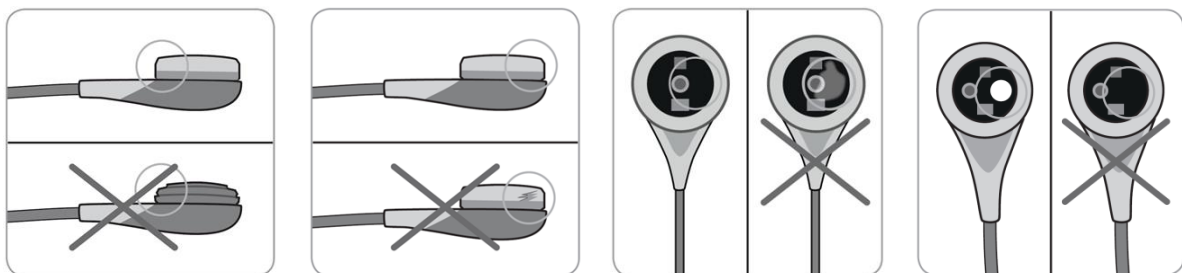


Figure 6 Inspection after re-membraning the sensor

## 3.1.8 PCO<sub>2</sub> / PO<sub>2</sub> Sensitivity & Calibration Duration

**WARNING:** A wrong barometer reading, or a gas leak can lead to a false positive/negative test result. Prior to performing a 'Sensitivity Test' verify Docking Station integrity/cleanliness (see section 3.3 " Docking Station ") and barometer function (see section 3.2.11 "Barometric Pressure").



**Note:** If the procedure below is not strictly followed the 'Sensitivity Test' will abort. Strictly observe the indicated times. 'SP12: Check membrane & gasket' (PCO<sub>2</sub> sensitivity) or 'Sensor problem 72' (PO<sub>2</sub> sensitivity) will only reset if the test was successful.

**Note:** If a V-Sign™ Sensor is connected to the SDM the function 'Sensitivity Test' will test the sensor's PCO<sub>2</sub> sensitivity. If an OxiVenT™ Sensor is connected to the SDM the function 'Sensitivity Test' will test the sensor's PCO<sub>2</sub> and PO<sub>2</sub> sensitivity in parallel.

Test the PCO<sub>2</sub>/PO<sub>2</sub> sensitivity as follows:

1. Verify that the sensor SET temperature is 42 °C (in case of a V-Sign™ Sensor) or 43 °C (in case of an OxiVenT™ Sensor) and that the local atmospheric pressure is at least 600 mmHg (80 kPa) (see respective icon).

**Note:** You may optionally activate the display of the calibration curve by using "V-STATS" (PC-Software for the SDM).
2. Insert the sensor into the Docking Station.
3. Use the menu-function 'Measurement Settings / PCO<sub>2</sub> Settings / Sensitivity Test' OR the menu-function 'Measurement Settings / PO<sub>2</sub> Settings / Sensitivity Test' to activate the test (both menu-functions will initiate the same test). The Status Message 'Open Docking Station door' displays (accompanied by a high pitched two beep signal tone).
4. Open the Docking Station door within 1 minute to expose the sensor to ambient air. As soon as the door is open the Status Message changes back to 'Sensitivity Test'.
5. After 2 minutes, the Status Message 'Close Docking Station door' and the corresponding image appears. Insert the sensor into the Docking Station and close it within 10 minutes.
6. Once the sensor is placed in the Docking Station, the sensor will automatically calibrate. In the Status Bar the Status Message 'Sensitivity Test' is displayed, while 'Calibration in progress' is displayed on the screen.
7. To determine the calibration duration, note down the time interval between message 'Calibration in progress' is displayed on the screen until 'Leak test in progress' (see step 8) is displayed on the screen.

8. After sensor calibration, a leak test of the Docking Station is automatically performed. In the Status Bar the Status Message 'Sensitivity Test' is displayed, while 'Leak test in progress' is displayed on the screen.

If the 'Sensitivity Test' for PCO<sub>2</sub> **failed**, 'SP12: Check membrane & gasket' will display when the sensor is in the Docking Station and PCO<sub>2</sub> subsequently will be flagged as invalid.

If the 'Sensitivity Test' for PO<sub>2</sub> **failed**, 'Sensor problem 72' will display when the sensor is in the Docking Station and PO<sub>2</sub> subsequently will be flagged as invalid.

Please refer to **troubleshooting P0305** (see section 4.2.1 "Troubleshooting PCO<sub>2</sub> / PO<sub>2</sub> monitoring") before you repeat the test.

If the 'Sensitivity Test' **passed**, the Status Message 'Ready for use' appears.

**Calibration Duration:** The calibration duration should be shorter than 14 minutes. If the calibration duration is longer than 14 minutes 'PCO<sub>2</sub> slow' or 'SP11: Change sensor membrane' or 'Sensor problem 71' is displayed. Refer to troubleshooting P0304.

### 3.1.9 PCO<sub>2</sub> / PO<sub>2</sub> Slope Test

**Note:** This test is optional and may be skipped.

- Tools:
- Sensor Tester Unit (alternatively an SDM can be used)
  - V-STATS Software (optional, to enable calibration curve on SDM)
  - interface online log software, e.g., "Hterm" freeware available on the internet (optional, for easier on-line logging of calibration values)

**Note:** For a V-Sign™ Sensor, only the PCO<sub>2</sub> Slope Test must be performed. For an OxiVenT™ Sensor both, PCO<sub>2</sub> and PO<sub>2</sub> Slope Test, must be performed.

**Note:** The Slope Test can also be performed using a second SDM instead of a Sensor Tester Unit. Also, a single SDM can be used (requiring changing gas bottles after each step). **If you use one single SDM, make sure that the correct gas bottle with the correct gas concentration (with 8% CO<sub>2</sub>, 12% O<sub>2</sub>) remains in the SDM at the end of the test.**

**Note:** Prior performing the Slope Test please ensure that the sensor is properly stabilized, i.e., stored for at least 4 hours in the Docking Station with the monitor switched on. For an overview about the Slope Test please refer to *Figure 7 Examples: PCO<sub>2</sub> and PO<sub>2</sub> Slope Test.*

**Note:** After the test ensure to reset all parameters and settings to the ones originally selected by your customer

1. You may optionally activate the display of the calibration curve by using "V-STATS" (PC-Software for the SDM).

2. Verify proper function of the Sentec Sensor Tester (ST-DSU). In particular, verify the integrity of the Docking Station. Verify the expiration date of the test gas bottles.
3. Power-cycle the SDM before starting the Slope Test (i.e., turn the SDM off and on again to ensure that the next calibration is a so-called 'Initial Calibration', which calibrates both, the PCO<sub>2</sub> and PO<sub>2</sub> channel).
4. Verify that the sensor SET temperature is 42 °C or else set the sensor temperature to 42 °C (for V-Sign™ Sensor and OxiVenT™ Sensor), the 'Severinghaus Correction Mode' is set to AUTO and that the local atmospheric pressure is at least 600 mmHg (80 kPa) (see respective icon). Note down the atmospheric pressure value. If you are using an OxiVenT™ Sensor, ensure that the PO<sub>2</sub>-parameter is enabled (e.g., select Neo-mode and enable PCO<sub>2</sub>/PO<sub>2</sub> parameters and set sensor SET-temperature to 42 °C).
5. Insert the sensor into the Docking Station of the SDM. Sensor calibration starts automatically. If not: Use the menu-function 'Measurement Settings / PCO<sub>2</sub> Settings / Calibrate sensor' to manually activate the sensor calibration (**note:** In case of an OxiVenT™ Sensor this function will initiate a PCO<sub>2</sub> and PO<sub>2</sub> calibration). After the calibration (with 8% CO<sub>2</sub>, 12% O<sub>2</sub>) is finished please wait 6 minutes (this is to ensure that no gas leak is present in the Docking Station of the SDM).
6. Insert the test bottle with 5% CO<sub>2</sub> and 6% O<sub>2</sub> into the Sensor Tester. Use the menu-function 'PCO<sub>2</sub> Settings / Calibrate Sensor' or press the ENTER Button twice to start a calibration. Record PCO<sub>2</sub> (5%) and PO<sub>2</sub> (6%), i.e., the PCO<sub>2</sub>/PO<sub>2</sub> values just before termination of the calibration. After the calibration is finished please wait 6 minutes (this is to ensure that no gas leak is present in the Docking Station of the Sentec Sensor Tester).

**Note:** If you are using an SDM for the Slope Test and in case of an OxiVenT™ Sensor the message 'Sensor Problem 73' appears on the SDM at this stage. This is an expected behavior of the sensor.

7. Compare the measured PCO<sub>2</sub> (5%) and PO<sub>2</sub> (6%) with the values expected for the respective local atmospheric pressure (see Slope Test Control Table). PCO<sub>2</sub> (5%) should be within 5\_min and 5\_max. PO<sub>2</sub> (6%) should be within 6\_min and 6\_max.
8. Remove the sensor from the Docking Station of the Sensor Tester, insert the sensor into the Docking Station of the SDM and use the menu- 'PCO<sub>2</sub> Settings / Calibrate Sensor' to start a calibration (with 8% CO<sub>2</sub>, 12% O<sub>2</sub>).

**Note:** In case of an OxiVenT™ Sensor the message 'Sensor Problem 73' will disappear from the SDM's display at this stage.

9. Insert the test bottle with 30% CO<sub>2</sub> and 21% O<sub>2</sub> into the Sensor Tester. Use the menu-function 'PCO<sub>2</sub> Settings / Calibrate Sensor' or press the ENTER Button twice to start a calibration. Wait until calibration is finished and record PCO<sub>2</sub> (30%) and PO<sub>2</sub> (21%), i.e., the PCO<sub>2</sub> value just before termination of the calibration.

**Note:** If you are using an SDM for the Slope Test and in case of an OxiVenT™ Sensor the message 'Sensor Problem 73' appears on the SDM at this stage. This is an expected behavior of the sensor.

10. Compare the measured PCO<sub>2</sub> (30%) and PO<sub>2</sub> (21%) with the values expected for the respective local atmospheric pressure (see Slope Test Control Table). PCO<sub>2</sub> (30%) should be within 30\_min and 30\_max. PO<sub>2</sub> (21%) should be within 21\_min and 21\_max.
11. In case of an OxiVenT™ Sensor: To clear the message 'Sensor Problem 73' you must do either of the following: a) power-cycle the SDM; b) connect the OxiVenT™ Sensor to a different SDM; or c) perform a calibration with the standard gas concentration (i.e., with 8% CO<sub>2</sub>, 12% O<sub>2</sub>).
12. If you have used one single SDM for the Slope Test, always perform a calibration with the standard gas concentration (i.e., with 8% CO<sub>2</sub>, 12% O<sub>2</sub>) at the end of the Slope Test.

**If the readings are outside the respective limits, replace the sensor and report the sensor behavior/replacement to Sentec.**

**Note:** If you have reduced the OxiVenT™ Sensor SET temperature to 42 °C to perform the Slope Test, ensure to reset the temperature to the one originally selected by your customer after completing the test.

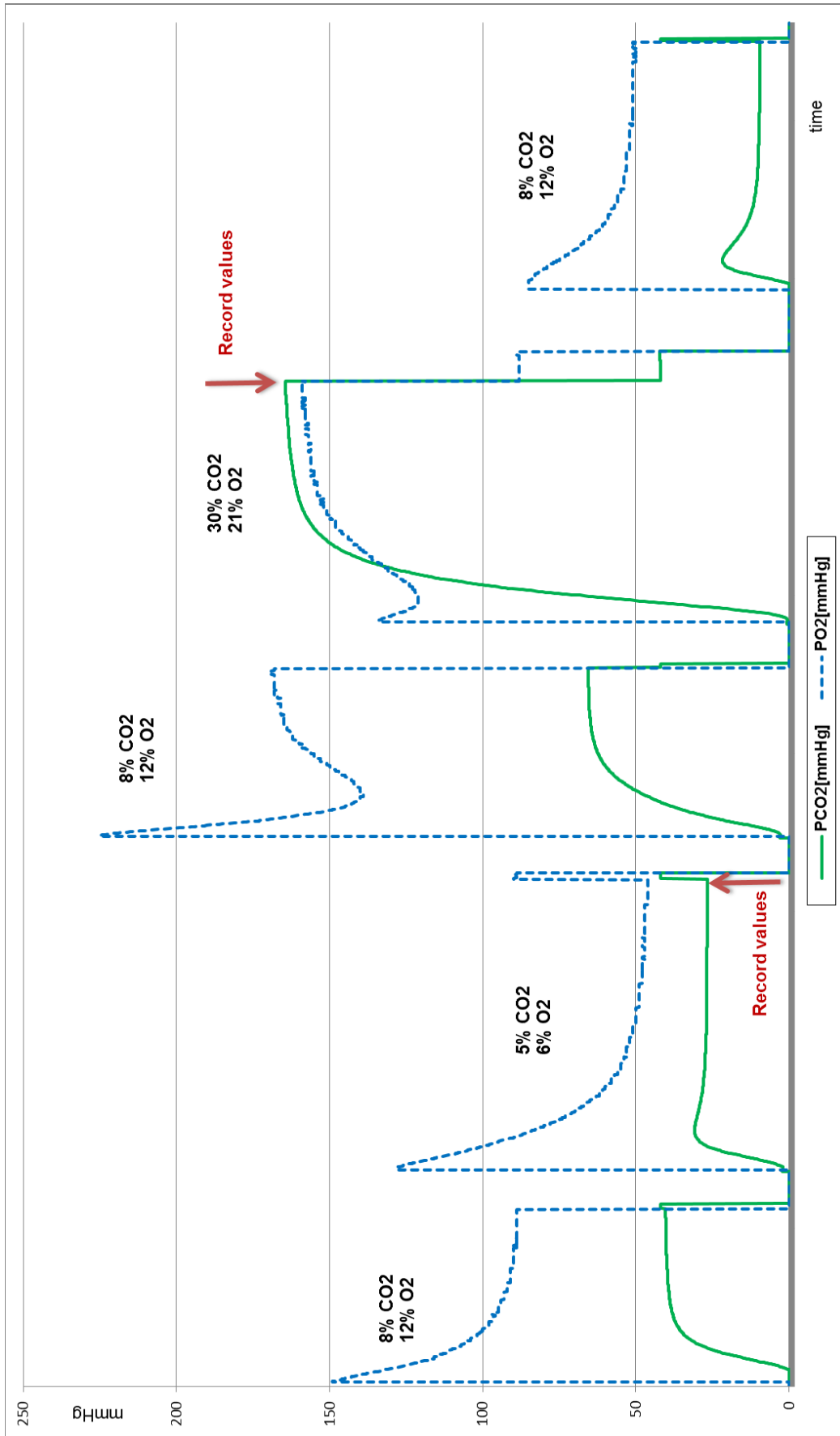


Figure 7 Examples: PCO2 and PO2 Slope Test

Slope Test Control Table CO<sub>2</sub> – in mmHg (after 5% and 30% CO<sub>2</sub> calibration)

Pcal = value after calibration with 8%CO<sub>2</sub>.

Table is only valid for sensor temp. of 42 °C.

P <sub>atm</sub>	P <sub>cal</sub>	5_min	5_ideal	5_max	30_min	30_ideal	30_max
600	33.5	19.0	19.8	21.1	123	134	144
605	33.8	19.2	20.0	21.3	124	135	145
610	34.1	19.4	20.2	21.5	125	136	146
615	34.4	19.6	20.4	21.7	127	137	148
620	34.7	19.8	20.6	21.9	128	138	149
625	35.0	19.9	20.8	22.1	129	139	150
630	35.3	20.1	21.0	22.3	130	140	151
635	35.6	20.3	21.1	22.5	131	142	152
640	35.9	20.5	21.3	22.7	132	143	154
645	36.2	20.7	21.5	22.9	133	144	155
650	36.5	20.9	21.7	23.1	134	145	156
655	36.8	21.0	21.9	23.3	135	146	157
660	37.1	21.2	22.1	23.5	136	147	159
665	37.4	21.4	22.3	23.7	137	148	160
670	37.7	21.6	22.5	23.9	138	150	161
675	38.0	21.8	22.7	24.1	139	151	162
680	38.3	21.9	22.9	24.3	140	152	163
685	38.6	22.1	23.0	24.5	141	153	165
690	38.9	22.3	23.2	24.7	142	154	166
695	39.2	22.5	23.4	24.9	143	155	167
700	39.5	22.7	23.6	25.1	144	156	168
705	39.8	22.9	23.8	25.3	145	157	170
710	40.1	23.0	24.0	25.5	147	159	171
715	40.5	23.2	24.2	25.7	148	160	172
720	40.8	23.4	24.4	25.9	149	161	173
725	41.1	23.6	24.6	26.1	150	162	174
730	41.4	23.8	24.7	26.3	151	163	176
735	41.7	24.0	24.9	26.5	152	164	177
740	42.0	24.1	25.1	26.7	153	165	178
745	42.3	24.3	25.3	26.9	154	167	179
750	42.6	24.5	25.5	27.1	155	168	181
755	42.9	24.7	25.7	27.3	156	169	182
760	43.2	24.9	25.9	27.5	157	170	183
765	43.5	25.1	26.1	27.7	158	171	184
770	43.8	25.2	26.3	27.9	159	172	185

### 3 Maintenance/Safety & Functionality Tests

#### Slope Test Control Table CO<sub>2</sub> – in kPa (after 5% and 30% CO<sub>2</sub> calibration)

Pcal = value after calibration with 8% CO<sub>2</sub>.

Table is only valid for sensor temp. of 42 °C.

P <sub>atm</sub>	P <sub>cal</sub>	5_min	5_ideal	5_max	30_min	30_ideal	30_max
80.0	4.46	2.54	2.64	2.81	16.4	17.8	19.2
80.7	4.50	2.56	2.67	2.84	16.6	18.0	19.3
81.3	4.54	2.58	2.69	2.86	16.7	18.1	19.5
82.0	4.58	2.61	2.72	2.89	16.9	18.3	19.7
82.7	4.62	2.63	2.74	2.92	17.0	18.4	19.8
83.3	4.66	2.66	2.77	2.94	17.1	18.6	20.0
84.0	4.71	2.68	2.79	2.97	17.3	18.7	20.2
84.7	4.75	2.71	2.82	3.00	17.4	18.9	20.3
85.3	4.79	2.73	2.84	3.02	17.6	19.0	20.5
86.0	4.83	2.76	2.87	3.05	17.7	19.2	20.6
86.7	4.87	2.78	2.89	3.08	17.9	19.3	20.8
87.3	4.91	2.80	2.92	3.10	18.0	19.5	21.0
88.0	4.95	2.83	2.95	3.13	18.1	19.6	21.1
88.7	4.99	2.85	2.97	3.16	18.3	19.8	21.3
89.3	5.03	2.88	3.00	3.18	18.4	19.9	21.5
90.0	5.07	2.90	3.02	3.21	18.6	20.1	21.6
90.7	5.11	2.93	3.05	3.24	18.7	20.2	21.8
91.3	5.15	2.95	3.07	3.26	18.8	20.4	22.0
92.0	5.19	2.98	3.10	3.29	19.0	20.5	22.1
92.7	5.23	3.00	3.12	3.32	19.1	20.7	22.3
93.3	5.27	3.02	3.15	3.34	19.3	20.8	22.4
94.0	5.31	3.05	3.17	3.37	19.4	21.0	22.6
94.7	5.35	3.07	3.20	3.40	19.5	21.1	22.8
95.3	5.39	3.10	3.22	3.42	19.7	21.3	22.9
96.0	5.43	3.12	3.25	3.45	19.8	21.5	23.1
96.7	5.47	3.15	3.27	3.48	20.0	21.6	23.3
97.3	5.51	3.17	3.30	3.50	20.1	21.8	23.4
98.0	5.55	3.19	3.32	3.53	20.2	21.9	23.6
98.7	5.60	3.22	3.35	3.56	20.4	22.1	23.7
99.3	5.64	3.24	3.38	3.58	20.5	22.2	23.9
100.0	5.68	3.27	3.40	3.61	20.7	22.4	24.1
100.7	5.72	3.29	3.43	3.64	20.8	22.5	24.2
101.3	5.76	3.32	3.45	3.66	20.9	22.7	24.4
102.0	5.80	3.34	3.48	3.69	21.1	22.8	24.6
102.7	5.84	3.37	3.50	3.72	21.2	23.0	24.7



## Slope Test Control Table PO2 – in mmHg (after 6% and 21% O2 calibration)

Pcal = value after calibration with 12% O2

Table is only valid for sensor temp. of 42 °C.

P <sub>atm</sub>	P <sub>cal</sub>	6 <sub>min</sub>	6 <sub>ideal</sub>	6 <sub>max</sub>	21 <sub>min</sub>	21 <sub>ideal</sub>	21 <sub>max</sub>
600	72.0	31	36	41	116	126	136
605	72.6	31	36	41	117	127	137
610	73.2	32	37	42	118	128	138
615	73.8	32	37	42	119	129	139
620	74.4	32	37	42	120	130	140
625	75.0	33	38	43	121	131	141
630	75.6	33	38	43	122	132	142
635	76.2	33	38	43	123	133	143
640	76.8	33	38	43	124	134	144
645	77.4	34	39	44	125	135	145
650	78.0	34	39	44	127	137	147
655	78.6	34	39	44	128	138	148
660	79.2	35	40	45	129	139	149
665	79.8	35	40	45	130	140	150
670	80.4	35	40	45	131	141	151
675	81.0	36	41	46	132	142	152
680	81.6	36	41	46	133	143	153
685	82.2	36	41	46	134	144	154
690	82.8	36	41	46	135	145	155
695	83.4	37	42	47	136	146	156
700	84.0	37	42	47	137	147	157
705	84.6	37	42	47	138	148	158
710	85.2	38	43	48	139	149	159
715	85.8	38	43	48	140	150	160
720	86.4	38	43	48	141	151	161
725	87.0	39	44	49	142	152	162
730	87.6	39	44	49	143	153	163
735	88.2	39	44	49	144	154	164
740	88.8	39	44	49	145	155	165
745	89.4	40	45	50	146	156	166
750	90.0	40	45	50	148	158	168
755	90.6	40	45	50	149	159	169
760	91.2	41	46	51	150	160	170
765	91.8	41	46	51	151	161	171
770	92.4	41	46	51	152	162	172

### 3 Maintenance/Safety & Functionality Tests

#### Slope Test Control Table PO2 – in kPa (after 6% and 21% O2 calibration)

Pcal = value after calibration with 12% O2

Table is only valid for sensor temp. of 42 °C.

P <sub>atm</sub>	P <sub>cal</sub>	6 <sub>min</sub>	6 <sub>ideal</sub>	6 <sub>max</sub>	21 <sub>min</sub>	21 <sub>ideal</sub>	21 <sub>max</sub>
80.0	9.6	4.1	4.8	5.5	15.5	16.8	18.1
80.7	9.7	4.1	4.8	5.5	15.6	16.9	18.2
81.3	9.8	4.2	4.9	5.6	15.8	17.1	18.4
82.0	9.8	4.2	4.9	5.6	15.9	17.2	18.5
82.7	9.9	4.3	5.0	5.7	16.1	17.4	18.7
83.3	10.0	4.3	5.0	5.7	16.2	17.5	18.8
84.0	10.1	4.3	5.0	5.7	16.3	17.6	18.9
84.7	10.2	4.4	5.1	5.8	16.5	17.8	19.1
85.3	10.2	4.4	5.1	5.8	16.6	17.9	19.2
86.0	10.3	4.5	5.2	5.9	16.8	18.1	19.4
86.7	10.4	4.5	5.2	5.9	16.9	18.2	19.5
87.3	10.5	4.5	5.2	5.9	17.0	18.3	19.6
88.0	10.6	4.6	5.3	6.0	17.2	18.5	19.8
88.7	10.6	4.6	5.3	6.0	17.3	18.6	19.9
89.3	10.7	4.7	5.4	6.1	17.5	18.8	20.1
90.0	10.8	4.7	5.4	6.1	17.6	18.9	20.2
90.7	10.9	4.7	5.4	6.1	17.7	19.0	20.3
91.3	11.0	4.8	5.5	6.2	17.9	19.2	20.5
92.0	11.0	4.8	5.5	6.2	18.0	19.3	20.6
92.7	11.1	4.9	5.6	6.3	18.2	19.5	20.8
93.3	11.2	4.9	5.6	6.3	18.3	19.6	20.9
94.0	11.3	4.9	5.6	6.3	18.4	19.7	21.0
94.7	11.4	5.0	5.7	6.4	18.6	19.9	21.2
95.3	11.4	5.0	5.7	6.4	18.7	20.0	21.3
96.0	11.5	5.1	5.8	6.5	18.9	20.2	21.5
96.7	11.6	5.1	5.8	6.5	19.0	20.3	21.6
97.3	11.7	5.1	5.8	6.5	19.1	20.4	21.7
98.0	11.8	5.2	5.9	6.6	19.3	20.6	21.9
98.7	11.8	5.2	5.9	6.6	19.4	20.7	22.0
99.3	11.9	5.3	6.0	6.7	19.6	20.9	22.2
100.0	12.0	5.3	6.0	6.7	19.7	21.0	22.3
100.7	12.1	5.3	6.0	6.7	19.8	21.1	22.4
101.3	12.2	5.4	6.1	6.8	20.0	21.3	22.6
102.0	12.2	5.4	6.1	6.8	20.1	21.4	22.7
102.7	12.3	5.5	6.2	6.9	20.3	21.6	22.9

### 3.1.10 Function Test: PCO<sub>2</sub> / PO<sub>2</sub>

Calibrate the TC Sensor and apply it to the ear of a healthy person: Verify that the PCO<sub>2</sub> readings equilibrate (stabilize) within 2 to 10 minutes and are within 33 to 47 mmHg after stabilization.

When using an OxiVenT™ Sensor, additionally test the PO<sub>2</sub> function:

Power-cycle the SDM (i.e., switch it off and on again). Then calibrate the OxiVenT™ Sensor. After successful calibration the PO<sub>2</sub> function test can be performed as follows: Open the Docking Station Door to expose the sensor to ambient air. Then enable the 'Enforced Sensor On Patient Mode' to start measuring PO<sub>2</sub> (i.e., by entering the Quick Access Menus and selecting 'Start Monitoring'). Wait until PO<sub>2</sub> readings equilibrate (stabilize), usually within 2 to 10 minutes. Check the atmospheric pressure (P<sub>atm</sub>) and verify that PO<sub>2</sub> readings are within the range shown in the tables below. Note that PO<sub>2</sub> ranges in the tables below are only valid for ambient temperatures between 18 °C and 28 °C and relative humidity between 30% r.H. and 60% r.H.!

If these requirements are not met refer to [section 4.2.1 "Troubleshooting PCO<sub>2</sub> / PO<sub>2</sub> monitoring"](#) to further evaluate the problem.

**Note:** When using an OxiVenT™ Sensor, it is recommended to check the remaining 'Usage Time' / 'Lifetime'. This can be done on the SDM's 'Sub-menu System Information' (refer to the *Technical Manual for the SDM* for further information).

### 3 Maintenance/Safety & Functionality Tests

#### PO2 Function Test Control Table PO2 – in mmHg and kPa

PO2 ranges are valid for ambient temperatures between 18 °C and 28 °C and relative humidity between 30% r.H. and 60% r.H.

Patm [mmHg]	ambient_min	ambient_PO2	ambient_max	Patm [kPa]	ambient_min	ambient_PO2	ambient_max
600	116	123	130	80.0	15.4	16.4	17.4
605	117	124	131	80.7	15.6	16.6	17.5
610	118	125	133	81.3	15.7	16.7	17.7
615	119	126	134	82.0	15.9	16.9	17.8
620	120	128	135	82.7	16.0	17.0	17.9
625	121	129	136	83.3	16.1	17.1	18.1
630	122	130	137	84.0	16.3	17.3	18.2
635	123	131	138	84.7	16.4	17.4	18.4
640	124	132	139	85.3	16.6	17.6	18.5
645	125	133	140	86.0	16.7	17.7	18.6
650	126	134	141	86.7	16.8	17.8	18.8
655	127	135	142	87.3	17.0	18.0	18.9
660	128	136	143	88.0	17.1	18.1	19.1
665	129	137	144	88.7	17.3	18.3	19.2
670	130	138	145	89.3	17.4	18.4	19.3
675	132	139	146	90.0	17.5	18.5	19.5
680	133	140	147	90.7	17.7	18.7	19.6
685	134	141	148	91.3	17.8	18.8	19.8
690	135	142	149	92.0	18.0	19.0	19.9
695	136	143	150	92.7	18.1	19.1	20.0
700	137	144	151	93.3	18.2	19.2	20.2
705	138	145	152	94.0	18.4	19.4	20.3
710	139	146	153	94.7	18.5	19.5	20.5
715	140	147	154	95.3	18.6	19.6	20.6
720	141	148	156	96.0	18.8	19.8	20.7
725	142	149	157	96.7	18.9	19.9	20.9
730	143	151	158	97.3	19.1	20.1	21.0
735	144	152	159	98.0	19.2	20.2	21.2
740	145	153	160	98.7	19.3	20.3	21.3
745	146	154	161	99.3	19.5	20.5	21.4
750	147	155	162	100.0	19.6	20.6	21.6
755	148	156	163	100.7	19.8	20.8	21.7
760	149	157	164	101.3	19.9	20.9	21.8
765	150	158	165	102.0	20.0	21.0	22.0
770	151	159	166	102.7	20.2	21.2	22.1

### 3.1.11 Function Test: SpO<sub>2</sub> + PR

Apply the sensor to the earlobe of a healthy person: Compare SpO<sub>2</sub> and PR readings against the readings of a reference pulse oximeter (e.g., N595 with Durasensor 100 from Nellcor). The SpO<sub>2</sub> and PR reading should be within  $\pm 3\%$  SpO<sub>2</sub> and  $\pm 3$  bpm, respectively.

If this requirement is not met refer to *section 4.2.1 "Troubleshooting SpO<sub>2</sub> / PR monitoring"* to further evaluate the problem.

## 3.2 Sentec Digital Monitor

### 3.2.1 Cleaning and Disinfection

Clean or disinfect the SDM (including AC power cord) as often as required per institutional ordinances (recommended weekly). For cleaning and disinfection instructions refer to the *Technical Manual for the SDM* (HB-005752).

### 3.2.2 Visual Inspection


Visually check the entire SDM for possible damages.

If you detect damage, the SDM needs to be repaired according to *section 5 "Repairs"*.

### 3.2.3 Labeling

Check the SDM for presence and legibility of the following labels and symbols:

Front panel: Symbols for buttons and LED's (*see Figure 1 Front Panel of the SDM*).

Rear panel: Labels of all ports, connectors, and switches; label with SN, REF and , CE label, UL label and WEEE Disposable label (*see Figure 2 Rear Panel of the SDM*).

If the above requirements are not met contact your local Sentec representative or send back the monitor according to *section 8.7 "Instructions for Shipment"*.

 **For Sentec authorized service technicians only:** If the above requirements for the front panel are not fulfilled, then replace the SDM Case, upper part according to the *Repair Manual for the SDMS* (HB-005755).

### 3.2.4 Electrical Safety Check

The Sentec Digital Monitoring System (SDMS) has been designed to comply with the standards IEC 60601-1, ANSI/AAMI ES60601-1 and CAN/CSA-C22.2 No.60601-1 (UL and cUL). To ensure electrical safety of the equipment it is recommended that **qualified service personnel** perform the electrical safety check once a year (but every two years the latest) and after repair.

The electrical safety tests for the SDMS must be performed in accordance with the standards IEC 60601-1, ANSI/AAMI ES60601-1 (USA) or CAN/CSA-C22.2 No.60601-1 (Canada) for instruments classified as Class 1 and Type BF (defibrillation proof). Technicians must be familiar with these standards applicable to the institution and the country. Test equipment and its application must comply with the applicable standard.

### 3.2.4.1 Safety test according to IEC 60601-1 / IEC 62353

**Note:** Safety test according to IEC 62353 may be performed if the following criteria are met:

- The SDM has not been opened.
- No changes have been made to the mains power connections and none of the protective earth connections (PE) have been disconnected.

**Tools**

- Electrical safety analyzer for tests according to IEC 60601-1 / IEC 62353 (e.g., Seculife ST Pro from Gossen Metrawatt)

If the required equipment is not available, send the SDM to your local Sentec representative for testing.

**WARNING:** Before performing the safety test, read the operating instructions of your safety analyzer.

**WARNING:** Make sure that all connecting cables are plugged in correctly. Poor or missing connections may lead to false positive test results.



The sensor is an applied part of Type BF. The interface ports of the SDM meet the same requirements as the sensor port and are tested in an analogous manner.

The safety test is performed according to IEC 60601-1 or alternatively IEC 62353. The following connections must be tested (while the SDM is switched on):

- Protective Earth Resistance Test: Earth wire of the AC power cord, equipotential terminal (ground, see *Figure 2 Rear Panel of the SDM*), gas bottle (Caution: Avoid damaging the o-ring or the gas bottle thread when contacting the brass block). The resistance between two of these must be less than  $0.2\ \Omega$  ( $0.3\ \Omega$  if measured with AC power cord according to IEC 62353).
- Insulation Resistance Test: AC Power Connector – housing (equipotential terminal). The resistance must be more than  $2\ \text{M}\Omega$  @500V DC
- Patient Insulation Resistance: Sensor Connection Port (Ground) – housing (equipotential terminal). The resistance must be more than  $2\ \text{M}\Omega$  @500V DC
- Earth Leakage Current: The current must be below  $5000\ \mu\text{A}$  (normal condition) /  $10000\ \mu\text{A}$  (single fault condition) see IEC 60601-1 Figure 13 and chapter 8.7.3 d)
- Patient Leakage Current from patient connection to earth. The current must be below  $100\ \mu\text{A}$  (normal condition) /  $500\ \mu\text{A}$  (single fault condition) see IEC 60601-1 Figure 15
- Patient Leakage Current and external voltage on SIP/SOP port. The current must be below  $100\ \mu\text{A}$  (normal condition) /  $500\ \mu\text{A}$  (single fault condition) see IEC 60601-1 Figure 17
- Patient Leakage Current caused by an external voltage on the Patient Connection (Type BF). The current must be below  $5000\ \mu\text{A}$  see IEC 60601-1 Figure 16

If the above-described functions do not operate properly, the SDM needs to be repaired. Refer to *section 4.2.4 "SDM-specific troubleshooting"* to further evaluate the problem.

Check the AC power cord for damages of the isolation. Check the connectors for damages.

The AC power cord must be tested when connected to the AC power outlet. Thereby the cable must be swayed to detect potential cable breaks or loose contacts. The AC power cord must be tested together with the Ground Integrity.

If the above specifications are not met, then the AC power cord needs to be replaced by a new AC power cord from Sentec AG, see *section 8.3 "Testing Accessories and Spare Parts"*.



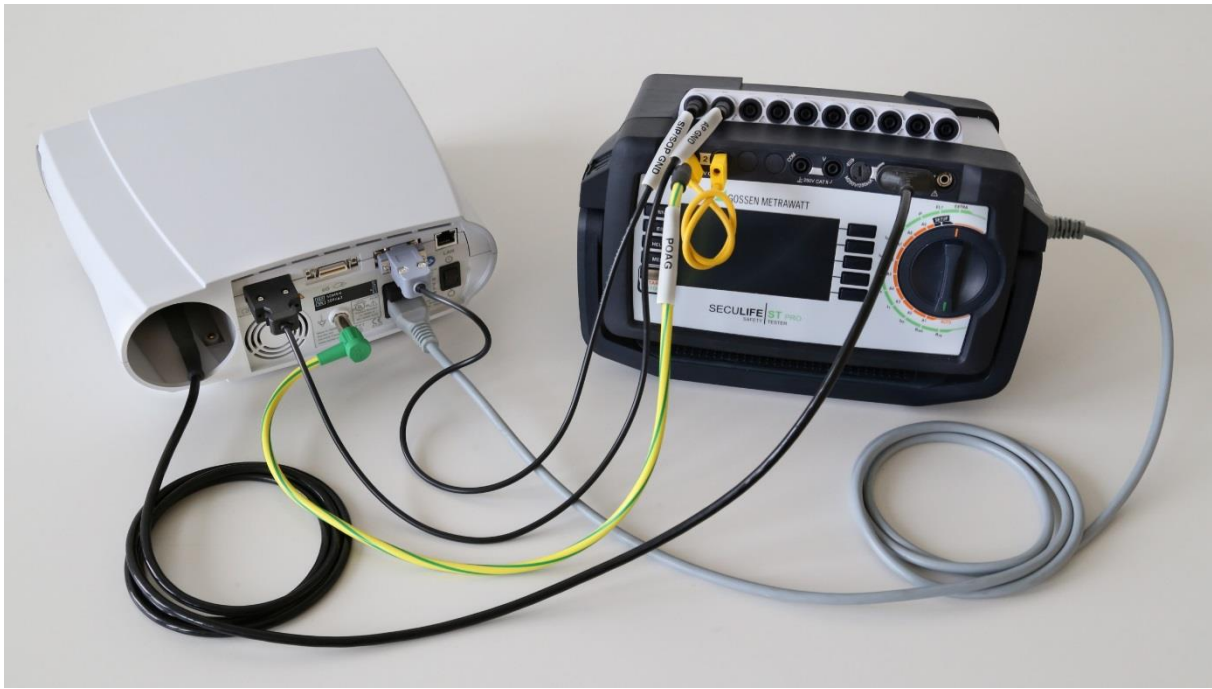


Figure 8 Connections for the Safety Test

Setup with Seculife ST Pro from Gossen Metrawatt (example)













### 3.2.5 POST

After turning on the SDM performs a power-on self-test (POST), which tests the SDM's circuitry and functions (internal test). The display, as well as the visual and audible indicators (i.e., LED's and speaker) are activated. The result of the POST is indicated by a ✓ (passed) or ✗ (failed) symbol. If no problems are detected during the POST, the message 'passed' (✓) is displayed; else the message 'failed' (✗) is displayed.

If the POST fails, an error message shows up at the bottom of the POST screen, refer to PO405 (see section 4.2.4 "SDM-specific troubleshooting"). The SDM needs to be repaired according to section 5 "Repairs".

**⚠ For Sentec authorized service technicians only:** Replace the defective parts according to the *Repair Manual for the SDMS* (HB-005755).

### 3.2.6 Keyboard

1. Activate the Main Menu by pressing 
2. Select the menu "System Settings" by scrolling down in the menu using 
3. Activate the selection by pressing 
4. Select the sub-menu "Audio Settings" by scrolling down using 
5. Activate the selection by pressing 
6. Select the item "Key Click" by navigating through the menu using  or 
7. **Activate** the selection by pressing  once.
8. Adjust the volume of the Key Click by using the UP  and DOWN  Button. When the Key Click is ON you hear a beep when pushing a button.
9. Push the Display Button  twice to exit the menus.
10. If you push the AUDIO PAUSED / OFF Button  the AUDIO PAUSED / OFF Button Indicator (yellow LED) should light up (note: if the parameter "Alarm Volume" is set to OFF pressing the AUDIO PAUSED / OFF Button has no function).

If the above-described functions do not operate properly contact your local Sentec representative or return the monitor according to *section 8.7 "Instructions for Shipment"*.

 **For Sentec authorized service technicians only:** If the above requirements for the Keyboard are not fulfilled then replace the SDM Case, upper part according to the *Repair Manual for the SDMS*(HB-005755).

### 3.2.7 Clock Settings

Verify that the clock settings are correct. If necessary, adjust the clock in the SDM Menu "System Settings → Date / Time".

Power cycle the SDM and control the clock settings.

If the clock settings are not correct refer to *section 4.2.4 "SDM-specific troubleshooting"* to further evaluate the problem.

 **For Sentec authorized service technicians only:** Replace the defective parts according to the *Repair Manual for the SDMS*(HB-005755).

### 3.2.8 Display/LEDs

Check indicator LEDs and the display for defects:

1. Connect the SDM to AC power. Switch the SDM OFF and ON again: During the POST, the Alarm Mute Indicator (yellow LED) and the ON/OFF Indicator (green LED) are activated. The AC Power/Battery Indicator LED is lit yellow (battery charging) or green (battery full). Refer to *Figure 1 Front Panel of the SDM* for location of the indicator LEDs.
2. Control the readability of the following critical areas: graph window, numerical displays, status bar may be accepted.

If the above-described functions do not operate properly contact your local Sentec representative or send back the monitor according to *section 8.7 "Instructions for Shipment"*.

**⚠ For Sentec authorized service technicians only:** If the above requirements for the LEDs are not fulfilled, replace the SDM Case, upper part according to the *Repair Manual for the SDMS* (HB-005755).

If the above requirements for the display are not fulfilled, replace the display according the *Repair Manual for the SDMS* (HB-005755).

### 3.2.9 Speaker (POST)

Switch ON the SDM and verify three signal tones of 0.2 seconds each during the POST.

If the speaker does not sound during the POST refer to *section 4.2.4 "SDM-specific troubleshooting"* to further evaluate the problem.

### 3.2.10 Fan

The fan should briefly activate during POST. The fan should rotate freely and without causing unusual noises. The fan should rotate without obstruction when you blow into the fan slits on the rear panel of the SDM (note that the fan needs to be off during this test).

If the above-described functions do not operate properly refer to *section 4.2.4 "SDM-specific troubleshooting"* to further evaluate the problem.

### 3.2.11 Barometric Pressure

**Tools**

- Reference Barometer

Compare the barometric pressure measured by the SDM against a calibrated reference barometer. The barometric pressure measured by the SDM is displayed in the status bar if PCO2 is enabled and if the sensor is in the docking station. The unit (mmHg or kPa) depends on the setting of the menu parameter "Pressure Unit".

If the difference between the two barometric pressure readings is larger than  $\pm 3$  mmHg (0.4 kPa) the SDM must be repaired. Refer to *section 4.2.4 "SDM-specific troubleshooting"*, to further evaluate the problem.

### 3.2.12 Analog Output

**Note:** This test is optional if the analog output interface is not used.

- Tools**
- Multimeter
  - 'PSG Cable-X'

For a detailed description of the analog output refer to the *Technical Manual for the SDM*. The analog output is part of the Multipurpose I/O Port (see *Figure 2 Rear Panel of the SDM*).

Measure the Analog Output voltages for the Pleth Waveform (Pin 1+2), for PR (pin 3+4), for SpO<sub>2</sub> (Pin 5 + 6), and for PCO<sub>2</sub> (Pin 7 + 8) using a voltmeter. To facilitate the connection of the lead of the voltmeter to the pins, it is recommended to use the 'PSG Cable-X' (see *section 8.3 "Testing Accessories and Spare Parts"*) or a 26 pin Mini Delta Ribbon connector (e.g. 3M part no. 10126-3000VE).

In the menu "Interfaces / Analog Outputs" the parameter range that is attributed to the 0 to 1 Volt output range can be changed for PCO<sub>2</sub>, SpO<sub>2</sub>, and PR. During measurements on the patient the voltage differential varies proportionally from 0 to 1 Volt as the pin's parameter varies over the selected parameter range.

Activating the menu function "Calibration Sequence" in the menu "Interfaces / Analog Outputs" causes for all parameters the output of 1 Volt for 60 seconds, followed by the output of 0 Volt for another 60 seconds. When the calibration sequence is running, the current output voltage is indicated on the display.

**Note:** By pressing ENTER it is possible

- a) to change from 1 Volt to 0 Volt (if output of 1 Volt is active)
- b) to stop the calibration sequence (if output of 0 Volt is active)

If the above-described functions do not operate properly, the SDM needs to be repaired. Refer to *section 4.2.4 "SDM-specific troubleshooting"* to further evaluate the problem.

### 3.2.13 Serial Data Port (RS-232)

For a detailed description of the Serial Data Port (RS-232) refer to the corresponding section of the *Technical Manual for the SDM*. The Serial Data Port is located on the rear panel of the SDM (see *Figure 2 Rear Panel of the SDM*).

To verify the data transmission to an external device (e.g., PC) activate the protocol "SentecLink" (proceed as described in the *Technical Manual for the SDM*).

Connect one end of a serial cable to the serial data port (RS-232) of the SDM and connect the other end of the cable to a serial port of your PC. If your computer has no serial port but USB-ports a USB232 Converter Cable can be used.

Start V-STATS software on your PC. Select the appropriate COM-port in the Sub-menu "Communication / Settings ...". Start the sub-menu "Communication / with SDM (via Serial Interface) ...", this opens dialog "Communication with SDM (via Serial Interface)" with the "Connection Status" indicator showing the status of the communication between V-STATS and the SDM (for detail description see *V-STATS Instruction Manual*).

Verify that data transmission between V-STATS and the SDM works properly. The "Connection Status" indicator lights green if the connection is established and the communication is successful between V-STATS and SDM.

If the above-described functions do not operate properly, the SDM needs to be repaired. Refer to *section 4.2.4 "SDM-specific troubleshooting"* to further evaluate the problem.

### 3.2.14 LAN Test

**Note:** This test is optional if the LAN interface is not used.

To test correct LAN communication, the following steps need to be performed:

- You will need a network environment to plug in your PC running a registered V-STATS and the SDM. Alternatively, you may use a crossover LAN cable and connect the PC and SDM. Attach PC and SDM to the network. Note: Please consult the online help of V-STATS for further information.
- Configure the SDM and connect the SDM to the PC via serial cable.
- Run V-STATS (latest version) and open the dialog-window "Communication with SDM (via Serial Interface) ..." by clicking on the respective big button in the center main window or on the icon in the upper menu-bar of the graphic window or by using the menu "Communication / with SDM (via Serial Interface) ..."
- Activate/check LAN link: Click on the control 'Profiles / SDM settings' and select 'Interfaces' tab of Current SDM Profile. Verify that 'LAN selectable' is checked and that 'LAN' is set to 'On'. Also select appropriate setting for 'DHCP mode', depending on your network configuration (set to 'Off' in case of direct connection with crossover cable). Enter IP address when DHCP mode was set to 'Off'. Normally the other settings can be left at their defaults.
- Close 'Profiles / SDM settings' window.
- On the SDM: navigate to menu Interfaces → LAN interface. If in DHCP mode, you should now see the IP address assigned by the DHCP server.
- With V-STATS: Using the trial mode of V-CareNeT start a remote monitoring session with the SDM.
- Note: consult online help if you need specific help on how to start the communication.
- Verify that a green icon is shown in the V-CareNeT Control Window for the connection status of the SDM (**LAN test 1**).
- After admitting a patient: The Remote Monitoring Window is shown, click in the black data field and open the Additional Data window.
- Verify that the time displayed in the status bar of the window corresponds to the time of the SDM (lagging no more than 5 seconds) and that the serial number in the Monitor Configuration / Status Information field corresponds to the serial number of the device under test (**LAN test 2**).

### 3.2.15 Capacity of Rechargeable Lithium Battery

- Tools**
- A PC with a terminal emulation software

Test using a PC:

1. Connect the SDM to AC power and wait until the battery is completely charged. (AC Power/Battery Indicator on the front panel of the SDM (*see Figure 1*) lights up green).
2. Adjust the brightness in the menu "Systems Settings / Display Settings" to 100%.
3. Activate the communication protocol "SentecLink" in the menu "Interfaces / Serial Interfaces".
4. Connect the Serial Data Port (RS-232) of the SDM to an external PC and record the on-line data using a terminal program.
5. Activate data recording using a terminal program and disconnect the SDM from AC power.
6. When the battery capacity is below 10% the status message "Battery Low" displays and the status code "LB" is recorded. Once the remaining battery is critical the message "Battery critical" displays and the status code "BC" is output. The time stamp of the last data set recorded on the PC corresponds to the time when the battery was empty and the SDM switched off automatically. With the first- and last-time stamps of the recorded data set you can calculate the running time.

In case of a SDM with a display with 'CCFL Backlight' a new, fully charged battery provides approximately 6 hours of monitoring time (if SLEEP MODE = OFF) and approximately 13 hours (if SLEEP MODE = ON).

In case of a SDM with a display with 'LED Backlight' a new, fully charged battery provides approximately 11 hours of monitoring time (if SLEEP MODE = OFF) and approximately 16 hours (if SLEEP MODE = ON).

**Note:** The message 'LED Backlight' displays on the POST screen (*see section 3.2.5* POST) and in the sub-menu "System Settings / Display Settings" if the display of your SDM uses an 'LED Backlight'.

The quality of the Rechargeable Lithium Battery is still acceptable if the SDM runs for at least 4 hours before the battery management switches off the monitor automatically.

If the above-described functions do not operate properly, the SDM needs to be repaired. Refer to *section 4.2.4 "SDM-specific troubleshooting"* to further evaluate the problem.

### 3.2.16 Display, Alarm

Initiate a low priority alarm (e.g., by disconnecting the Sentec TC Sensor from the SDM). Verify that the corresponding status message is displayed in the status bar.

If the above-described functions do not operate properly, the SDM needs to be repaired. Refer to *section 4.2.4 "SDM-specific troubleshooting"* to further evaluate the problem.

### 3.2.17 Speaker, Alarm

Initiate a low priority alarm (e.g., by disconnecting the Sentec TC Sensor from the SDM). Verify that the audible component of a low priority alarm is audible (one burst of two pulses (1 dyad) repeated every 15 seconds).

If the above-described functions do not operate properly, the SDM needs to be repaired. Refer to [section 4.2.4 "SDM-specific troubleshooting"](#) to further evaluate the problem.

### 3.2.18 Nurse Call, Alarm

**Note:** This test is optional if the nurse call interface is not used.

**Tools**

- Nurse Call Cable

Verify that the menu parameter 'Interfaces / Nurse Call' is set to ON. Then initiate a low priority alarm (e.g., by disconnecting the Sentec TC Sensor from the SDM during a monitoring session). The Nurse Call feature is relay-based and can be tested with the Nurse Call Cable, [see section 8.3 "Testing Accessories and Spare Parts"](#).

**Note:** The nurse call function is not active if the auditory alarm signals of the SDM are paused or permanently switched off.

If the above-described functions do not operate properly, the SDM needs to be repaired. Refer to [section 4.2.4 "SDM-specific troubleshooting"](#) to further evaluate the problem.

## 3.3 Docking Station

### 3.3.1 Cleaning and Disinfection

Clean or disinfect the Docking Station (including the Docking Station gasket) as often as required per institutional ordinances (recommended weekly) using a cotton swab moistened with 70% isopropanol.

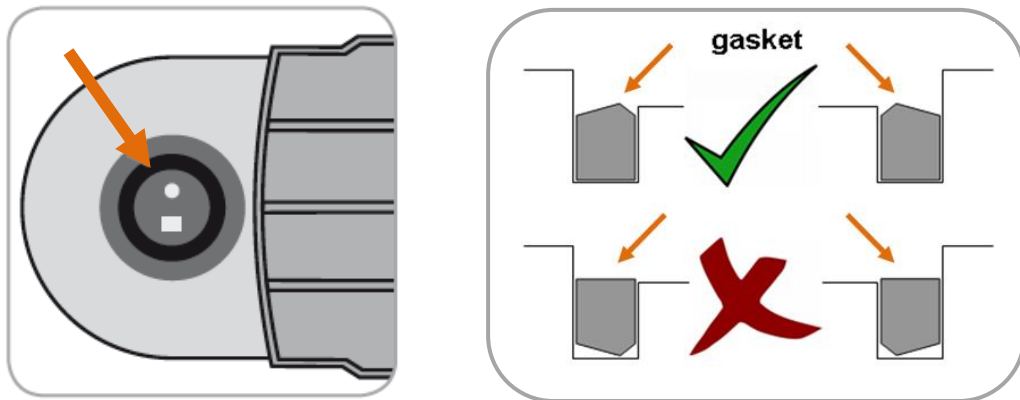
### 3.3.2 Visual Inspection

Inspect the Docking Station door and the gasket for mechanical damages. The closing mechanism must lock properly.

If you detect a possible damage, replace the defective part according to *section 5 "Repairs"*.

**Note:** We recommend changing the gasket of the Docking Station annually.

a)



b)



Figure 9 Correct orientation of the Docking Station Gasket

a) Gaskets sold up to 2022-07

b) Gaskets sold from 2022-07 on



### 3.3.3 Gas Level Indicator

**Tools**

- Full-Service *Gas* bottle

Check the functionality of the gas level indicator using a new gas bottle.

1. Screw in a new gas bottle and switch the SDM ON.
2. Insert the sensor in the Docking Station and verify that the "100% gas icon" displays in the status bar.
3. Remove the gas bottle from the SDM and verify that the yellow "0% gas icon" displays in the status bar.

If the expected result is not observed, refer to *section 4.2.4 "SDM-specific troubleshooting"* to further evaluate the problem.

## 3.4 Digital Sensor Adapter Cable

### 3.4.1 Cleaning and Disinfection

Clean or disinfect the 'Digital Adapter Cable' as often as required per institutional ordinances (recommended weekly). For cleaning and disinfection instructions refer to the *Technical Manual for the SDM* (HB-005752).

### 3.4.2 Visual Inspection

Check the Digital Sensor Adapter Cable for damages of the isolation. Check the Digital Sensor Adapter Cable connectors for damages.

If you detect damages, the Digital Sensor Adapter Cable needs to be replaced by a new Digital Sensor Adapter Cable.

## 3.5 Opening the Membrane Changer

If the sensor is blocked within the Membrane Changer at any position, it can be opened as follows:

Identify the 6 latches holding together top and bottom part of the Membrane Changer together (see Figure 10 Opening the Membrane Changer). Insert a screwdriver behind the latches and use it as leverage to break out the 6 latches.

**WARNING:** Wear protective goggles while breaking out the 6 latches.

**CAUTION:** This procedure will irreversibly destroy the Membrane Changer, but not harm the sensor if executed with care.

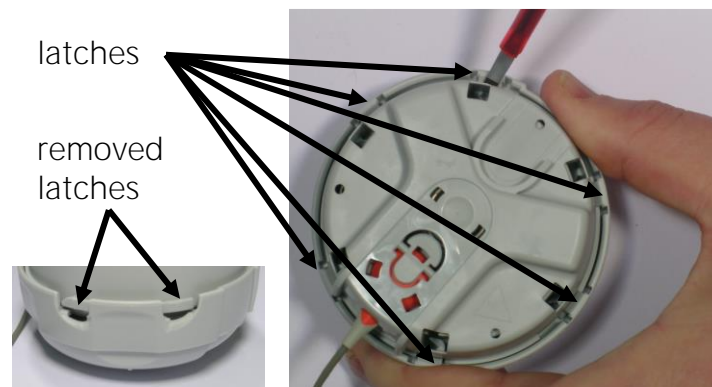


Figure 10 Opening the Membrane Changer

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# 4 Troubleshooting

This section describes problems, possible causes and recommended corrective actions. Repairs (without having to open the SDM cover) are described in *section 5 "Repairs"*. Repairs that require opening the cover of the SDM are to be performed by Sentec authorized service technicians only and are described in detail within the *Repair Manual*.

Prior to maintenance, service or repairs all components of the SDMS must be cleaned and disinfected. If equipment is sent to service personnel, a local Sentec representative or to Sentec AG a completed "*Certificate for Disinfection*" (see *section 8.8*) must be attached.

If you need to return devices for service or repair, follow the shipment instructions in *section 8.7 "Instructions for Shipment"*.

Send defective parts together with the completed "*Repair or Investigation Request Form*" to your local Sentec representative. The "*Repair or Investigation Request Form*" may be copied from *section 8.4 "Repair or Investigation Request Form"*.

## 4.1 How to use the troubleshooting list

The troubleshooting list describes possible defects of the device. The problems are numbered (PXXXX) unambiguously. Please reference the respective PXXXX code whenever applicable.



The trouble shooting list comprises up to three levels of recommended actions to be performed

- [1] by the **operator** (shaded in dark grey) and, if the problem persists,
- [2] by a **qualified technician** (shaded in light grey), i.e., troubleshooting at service level (according to this manual) and, if the problem persists,
- [3] by **Sentec authorized service technicians** only (no shading), i.e., troubleshooting at repair level (according to the *Repair Manual*).

**Note:** Consider that the operator might not have performed the corrective actions recommended at operator-level and/or might not have identified the problem correctly. Therefore, check other possible causes and problems.

The example in *Table 3 Example of a Troubleshooting Procedure* explains how to work with the troubleshooting list.

Table 3 Example of a Troubleshooting Procedure

Problem	Possible cause	Recommended action(s)	Trouble shooting level
POXXX  PCO2 too low	Wrong/instable barometric pressure during calibration	Verify that the barometric pressure reading of the SDM is stable during calibration and does not deviate from a known calibrated reference barometer by more than 5 mmHg (0.7 kPa). Otherwise contact qualified service personnel.	<b>a</b> (operator)
	SDM defective	If problem persists, contact Sentec authorized service personnel.	<b>b</b> (qualified technician)
	MPB /MPL (Multiparameterboard) defective	Replace MPB/MPL according to HB-005755, section 3.14.   <b>To be performed by Sentec authorized service technicians only.</b>	<b>c</b> (Sentec authorized technician)
	PCO2 sensitivity of the sensor too low	Test the PCO2 sensitivity (see section 3.1.8 PCO2 / PO2 Sensitivity & Calibration Duration). If the test is not passed, re-membrane the sensor and repeat the test. After a renewed missing of this difference, consult qualified service personnel.	<b>a</b> (operator)
		Clean the sensor as described in section 3.1.7 Cleaning / Inspecting without Membrane and perform the 'Sensitivity Test' as described in section 3.1.8. If problem persists, contact Sentec authorized service personnel.	<b>b</b> (qualified technician)
	Sentec TC Sensor defective	If problem persists, the sensor is defective. Replace it by original replacement parts.   <b>To be performed by Sentec authorized service technicians only.</b>	<b>c</b> (Sentec authorized technician)

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## 4.2 Troubleshooting List

This section describes problems, possible causes and recommended actions for troubleshooting.

**Note:** Shadings in the troubleshooting table reflect different levels of recommended actions, i.e. for the operator (dark grey), qualified service personnel (light grey) and Sentec authorized service technicians (no shading), see section 4.1 "How to use the troubleshooting list" for details.

### 4.2.1 Troubleshooting PCO<sub>2</sub> / PO<sub>2</sub> monitoring

When comparing PCO<sub>2</sub>/ PO<sub>2</sub> values displayed by the SDM with PaCO<sub>2</sub>/ PaO<sub>2</sub> values obtained from arterial blood gas (ABG) analysis, pay attention to the following points:

- Carefully draw and handle blood samples.
- Blood sampling should be performed in steady state conditions.
- The PaCO<sub>2</sub>/ PaO<sub>2</sub> value obtained from ABG analysis should be compared to the SDM's PCO<sub>2</sub>/ PO<sub>2</sub> reading at the time of blood sampling.
- In patients with functional shunts, the sensor application site and the arterial sampling site should be on the same side of the shunt.
- If the menu-parameter 'Severinghaus Correction Mode' is set to 'Auto', the PCO<sub>2</sub> values displayed by the SDM are automatically corrected to 37 °C (regardless of the patient's core temperature). When performing the ABG analysis, be sure to properly enter the patient's core temperature into the blood gas analyzer. Use the blood gas analyzer's '37 °C-PaCO<sub>2</sub>' value to compare with the SDM's PCO<sub>2</sub> value.
- Verify proper operation of the blood gas analyzer. Periodically compare the blood gas analyzer's barometric pressure against a known calibrated reference barometer.



**Note:** This section only is applicable for Sentec TC Sensors with PCO<sub>2</sub> and/ or PO<sub>2</sub> enabled.

Table 4 Troubleshooting PCO<sub>2</sub>/ PO<sub>2</sub> Monitoring

Problem	Possible Cause(s)	Recommended corrective action(s)
PO100 After sensor application or a 'TC artifact' PCO <sub>2</sub> values increase slowly or PO <sub>2</sub> values decrease slowly or do not stabilize within 10 minutes	Sensor loosely attached to patient (air between sensor and skin; no contact liquid)	<p>Verify that the sensor is securely attached and ensure that air gaps are eliminated between the skin and the sensor. If needed, reapply the sensor (on same or an alternate site). For instructions refer to the <i>Quick Reference Guide for the SDMS</i> or the <i>Instruction Manual for the SDMS</i>.</p> <p>Consider using the Staysite Adhesive (model SA-MAR) to complementary attach Multi-Site Attachment Rings if more secure sensor attachment is required, e.g., in high humidity environments, for patients who perspire profusely and/or in challenging patient motion conditions.</p> <p><b>Note:</b> Typically, PaCO<sub>2</sub> is &gt; 25 mmHg in humans and PCO<sub>2</sub> of ambient air &lt; 0.5 mmHg. If the contact between the sensor and skin is not hermetically sealed PCO<sub>2</sub> readings, consequently, may <u>increase slowly</u> after sensor application or a 'TC artifact' and be <u>too low</u> thereafter.</p> <p><b>Note:</b> Typically, PaO<sub>2</sub> is &lt; 100 mmHg in humans and PO<sub>2</sub> of ambient air &gt; 130 mmHg. If the contact between the sensor and skin is not hermetically sealed PO<sub>2</sub> readings, consequently, may <u>decrease slowly</u> after sensor application or a 'TC artifact' and be <u>too high</u> thereafter.</p> <p><b>Note:</b> Also refer to Status Messages 'Check sensor application', 'PCO<sub>2</sub> stabilizing', 'PO<sub>2</sub> stabilizing', or 'PCO<sub>2</sub>/ PO<sub>2</sub> stabilizing' (refer to the <i>Technical Manual for the SDM</i>).</p>
	Sensor applied to a measurement site that is inadequate / not recommended for PCO <sub>2</sub> / PO <sub>2</sub> monitoring	Apply sensor to a recommended measurement site with an appropriate Sensor Attachment Accessory. For instructions refer to the <i>Quick Reference Guide for the SDMS</i> or the <i>Instruction Manual for the SDMS</i> .
	Excessive use of contact liquid	Remove sensor. Clean sensor and measurement site with an alcohol pad. Reapply the sensor using only one drop of contact liquid.
	PCO <sub>2</sub> and/ or PO <sub>2</sub> part of the sensor is slow	Refer to PO304

Problem	Possible Cause(s)	Recommended corrective action(s)
PO101 PCO <sub>2</sub> too low OR PO <sub>2</sub> too high	Sensor loosely attached to patient (air between sensor and skin; no contact liquid)	Refer to identical 'Possible Cause' in PO100 for recommended corrective action(s)
	Sensor applied to a measurement site that is inadequate/ not recommended for PCO <sub>2</sub> / PO <sub>2</sub> monitoring	Refer to identical 'Possible Cause' in PO100 for recommended corrective action(s)
	Arterio-venous shunts, e.g., ductus arteriosus.	Ensure that the sensor site and the arterial sampling site are on the same side of the shunt
	PCO <sub>2</sub> part of the sensor unstable (causing drift)	Allow the sensor to stabilize for an additional 1 – 2 hours, i.e., store the sensor in the Docking Station with the monitor being switched on (refer to the <i>Technical Manual for the SDM</i> for additional sensor stabilization related information).  <b>Note:</b> After switching-on the monitor or after membrane change, it is recommended to store the sensor in the Docking Station with the monitor being switched on for the duration indicated by the yellow information message 'Recommended Sensor Stabilization [min]: on' the "Ready for use" screen and on the "Calibration" screen (see <i>Technical Manual for the SDM</i> ).
	Wrong / expired calibration gas was used during last calibration	Verify that Sentec Service Gas is used. If expired replace with a new gas bottle!
	Wrong / unstable barometric pressure during last calibration	Refer to PO408
	PCO <sub>2</sub> and or PO <sub>2</sub> sensitivity of the sensor low/ deteriorated	Refer to PO305
	PO <sub>2</sub> Measurement is influenced by high ambient light levels	Shield Sentec TC Sensor from strong ambient light.  <b>Note:</b> Refer to Status Message 'High ambient light' (with Status Code 'SA').

## 4 Troubleshooting

Problem	Possible Cause(s)	Recommended corrective action(s)
		<p>Clean/Inspect the sensor as described in <i>section 3.1.7 "Cleaning / Inspecting without Membrane"</i> and perform the 'Sensitivity Test' as described in <i>section 3.1.8 "PCO<sub>2</sub> / PO<sub>2</sub> Sensitivity &amp; Calibration Duration"</i>.</p> <p>If problem persists, contact Sentec authorized service personnel.</p>
	Significant PCO <sub>2</sub> drift	<p>Verify that the sensor is not affected by loose fit of the membrane, trapped air under the membrane. If needed perform an unrequested membrane exchange (activate the menu "Membrane Change"). After membrane exchange calibrate the sensor and allow the PCO<sub>2</sub> part of the sensor to stabilize for 4 hours.</p> <p>If no re-membraning is needed allow the sensor to stabilize for an additional 2 – 3 hours.</p>
	SDM defective	Contact Sentec authorized service personnel or our local Sentec sales representative.
	MPB /MPL (Multiparameter-board) defective	<p>Replace MPB/MPL according to the <i>Repair Manual for the SDMS</i>.</p> <p> <b>To be performed by Sentec authorized service technicians only.</b></p>
	Sentec TC Sensor defective	<p>Perform the PCO<sub>2</sub> Slope Test according to <i>section 3.1.9 "PCO<sub>2</sub> / PO<sub>2</sub> Sensitivity &amp; Calibration Duration"</i>. If the PCO<sub>2</sub> slope test fails replace sensor.</p> <p> <b>To be performed by Sentec authorized service technicians only.</b></p>



Problem	Possible Cause(s)	Recommended corrective action(s)
PO102 PCO <sub>2</sub> too high OR PO <sub>2</sub> too low	Low perfusion at the (hypoperfused) measurement site	<p>Limitation of the method. <b>Evaluate the patient status.</b> Shock, low cardiac index, hypothermia, and inadequate local vasodilatation are physiological limitations of the method. Avoid any mechanical pressure / stress on the measurement site. Verify that the <b>sensor temperature</b> is appropriately selected for the specific patient/ skin condition at the measurement site and the enabled parameters. When selecting/ increasing sensor temperature carefully balance <u>benefit</u> (more accurate measurements) versus <u>risk</u> (potential skin burns). Carefully read the section "Sensor Temperature &amp; Site Timer" in the <i>Technical Manual for the SDM</i>.</p> <p><b>Remember:</b> In most patients PO<sub>2</sub> monitoring requires higher temperatures than PCO<sub>2</sub> monitoring. In newborns, PO<sub>2</sub> correlates with PaO<sub>2</sub> almost in a one-to-one relationship at a sensor temperature of 43 to 44 °C, whereby the accuracy of PO<sub>2</sub> compared to PaO<sub>2</sub> is best up to PaO<sub>2</sub> = 80 mmHg (10.67 kPa), above which it increasingly tends to read lower than PaO<sub>2</sub> (especially in adults).</p>
	Sensor applied to a measurement site that is inadequate / not recommended for PCO <sub>2</sub> monitoring.	Refer to identical 'Possible Cause' in PO100 for recommended corrective action(s)
	Arterio-venous shunts, e.g., ductus arteriosus.	Ensure that the sensor site and the arterial sampling site are on the same side of the shunt
	Presence of hyperoxemia (PaO <sub>2</sub> > 100 mmHg)	<b>Remember:</b> In newborns, PO <sub>2</sub> correlates with PaO <sub>2</sub> almost in a one-to-one relationship at a sensor temperature of 43 to 44 °C, whereby the accuracy of PO <sub>2</sub> compared to PaO <sub>2</sub> is best up to PaO <sub>2</sub> = 80 mmHg (10.67 kPa), above which it increasingly tends to read lower than PaO <sub>2</sub> (especially in adults).
	PCO <sub>2</sub> part of the sensor unstable (causing drift)	Refer to identical 'Possible Cause' in PO101 for recommended corrective action(s)

Problem	Possible Cause(s)	Recommended corrective action(s)
	Wrong / expired calibration gas was used during last calibration	Refer to identical 'Possible Cause' in PO101 for recommended corrective action(s)
	Wrong / unstable barometric pressure during last calibration	Refer to PO408
	Undetected gas leak in Docking Station.	Refer to PO502
	PCO2 and or PO2 sensitivity of the sensor low/ deteriorated	Refer to PO305
	PO2 Measurement is influenced by high ambient light levels	Shield Sentec TC Sensor from strong ambient light. <b>Note:</b> Refer to Status Message 'High ambient light' (with Status Code 'SA') (see <i>Technical Manual for the SDM</i> ).
		Clean/Inspect the sensor as described in <i>section 3.1.7 "Cleaning / Inspecting without Membrane"</i> and perform the 'Sensitivity Test' as described in <i>section 3.1.8 "PCO2 / PO2 Sensitivity &amp; Calibration Duration"</i> . If problem persists, contact Sentec authorized service personnel.
	Docking Station door mechanically defective	Replace Docking Station door according to <i>section 5.5 "Replacement, Docking Station Door"</i> .
	Gasket defective	Replace gasket according to <i>section 5.6 "Replacement, Docking Station Gasket"</i> .
	SDM defective	Contact Sentec authorized service personnel or our local Sentec sales representative.
	Calibration Module defective	Replace Calibration Module according to the <i>Repair Manual for the SDMS</i> .  <b>⚠ To be performed by Sentec authorized service technicians only.</b>
	Docking Station Module defective	Replace Calibration Module according to the <i>Repair Manual for the SDMS</i> .  <b>⚠ To be performed by Sentec authorized service technicians only.</b>

Problem	Possible Cause(s)	Recommended corrective action(s)
PO103 PCO <sub>2</sub> and/ or PO <sub>2</sub> suddenly change / change very fast ('TC artifact')	Sensor loosely attached to patient (air between sensor and skin; no contact liquid)	Refer to identical 'Possible Cause' in PO100 for recommended corrective action(s)
	Adhesive pad of Ear Clip / Multi-Site Attachment Ring does not stick any more	Reapply the sensor with a new Ear Clip / Multi-Site Attachment Ring. Pay attention not to wet the adhesive. For instructions refer to the <i>Quick Reference Guide for the SDMS</i> or the <i>Instruction Manual for the SDMS</i> .  Consider using the Staysite Adhesive (model SA-MAR) to complementary attach Multi-Site Attachment Rings if more secure sensor attachment is required, e.g., in high humidity environments, for patients who perspire profusely and/or in challenging patient motion conditions.
	Electrocautery, HF surgery, defibrillation (mainly PCO <sub>2</sub> specific)	The values will come back to normal after electrocautery, HF surgery or defibrillation.
PO104 PCO <sub>2</sub> and/ or PO <sub>2</sub> changes very slowly	Sensor applied to a measurement site that is inadequate / not recommended for PCO <sub>2</sub> monitoring.	Refer to identical 'Possible Cause' in PO100 for recommended corrective action(s)
	Excessive use of contact liquid	Refer to identical 'Possible Cause' in PO100 for recommended corrective action(s)
	PCO <sub>2</sub> and/ or PO <sub>2</sub> part of the sensor is slow	Refer to PO304.

## 4.2.2 Troubleshooting SpO2 / PR monitoring

**Note:** This section is applicable for Sentec TC Sensors (if SpO2 / PR are enabled) and for Sentec's oximetry sensors.

Table 5 Troubleshooting SpO2/ PR Monitoring

Problem	Possible Cause(s)	Recommended action(s)
PO200 SpO2 and / or PR too low or too high	Venous pooling (e.g., Trendelenburg position)	Limitation of the method. For placement of the sensor on the earlobe, forehead, or cheek: avoid conditions where the head is positioned lower than the heart.
	Some cardiovascular pathologies (e.g., causing cardiac arrhythmias)	Limitation of the method.
	Inadequate local blood flow at the measurement site	Evaluate the patient status. Shock, low cardiac index, inadequate local vasodilatation are physiological limitations of the method.  Verify the sensor application and the appropriateness of the monitoring site.  Avoid any mechanical pressure / stress on the sensor or measurement site. Secure the sensor cable with adhesive tape and a clothing clip  <b>Note:</b> Refer to the Status Message 'SpO2 low signal' (see <i>Technical Manual for the SDM</i> ).
	Electrocautery, HF surgery, defibrillation	The values will come back to normal after electro-cautery, HF surgery or defibrillation.
	Sensor applied to a measurement site that is inadequate / not recommended for SpO2 monitoring.	Apply sensor to a measurement site recommended/ approved for SpO2/ PR monitoring with an appropriate Sensor Attachment Accessory. For instructions refer to the <i>Quick Reference Guide for the SDMS</i> or the <i>Instruction Manual for the SDMS</i> .
	Artifacts due to patient movements	Verify the sensor application and the appropriateness of the monitoring site. Secure the sensor cable with adhesive tape and a clothing clip.  <b>Note:</b> Refer to the Status Message 'SpO2 signal quality' (see <i>Technical Manual for the SDM</i> ).

Problem	Possible Cause(s)	Recommended action(s)
	SpO2/ PR Measurement is influenced by high ambient light levels	Shield Sentec TC Sensor from strong ambient light (e.g., lamps). <b>Note:</b> Refer to Status Message 'High ambient light' (with Status Code 'HA') (see <i>Technical Manual for the SDM</i> ).
	Dysfunctional hemoglobin	Physiological limitation of the method. In patients with high carboxyhemoglobin levels (e.g., smokers) functional saturation measured with a pulse oximeter will overestimate functional saturation determined with a CO-oximeter.
	Excessive use of contact liquid causing light shunting	Remove the Sentec TC Sensor. Clean sensor and measurement site with an alcohol pad. Reapply the sensor using only one drop of contact liquid.
	Intravascular dyes	Limitation of the method. Dyes used as tracer, contrast medium, etc. may absorb light at the same wavelength as the one used for pulse oximetry measurements.

### 4.2.3 Sensor-specific troubleshooting

Table 6 Sensor-specific troubleshooting


Problem	Possible Cause(s)	Recommended action(s)
P0300 Despite a Sentec TC Sensor is connected to the SDM the message 'Connect sensor' displays	Bad contact (cables not properly connected)	Verify connections (disconnect and reconnect all cables) and – if necessary – power cycle the SDM.
	Sentec TC Sensor and / or 'Digital Sensor Adapter Cable' defective	To identify the defective part, exchange the 'Digital Sensor Adapter Cable' or the Sentec TC Sensor and try again (if necessary, permute and try on a different SDM). In case of damage of the Sentec TC Sensor replace it by original replacement parts. In case of damage of the 'Digital Sensor Adapter Cable' replace it by original replacement parts.
	SDM defective	If problem persists, contact qualified service personnel.
	SDM defective	Refer to <a href="#">section 4.2.4 "SDM-specific troubleshooting"</a> to further evaluate the problem.

## 4 Troubleshooting

Problem	Possible Cause(s)	Recommended action(s)
P0301 Despite oximetry sensor is connected to the SDM the message 'Connect sensor' displays	Bad contact (cables not properly connected)	Verify connections (disconnect and reconnect all cables) and – if necessary – power cycle the SDM.
	Oximetry sensor and / or 'SpO2 Adapter Cable' defective	To identify the defective part, exchange the 'SpO2 Adapter Cable' or the oximetry sensor and try again (if necessary, permute and try on a different SDM).  In case of damage of the oximetry sensor replace it by original replacement parts.  In case of damage of the 'SpO2 Adapter Cable' replace it by original replacement parts.
	SDM defective	If problem persists, contact qualified service personnel.
	SDM defective	Refer to <i>section 4.2.4 "SDM-specific troubleshooting"</i> to further evaluate the problem.
P0302 Sensor's red LED does not light (message 'Connect sensor' <u>not</u> displayed)	As a safety precaution sensor or SDM did switch off all power consuming parts	Refer to Status Messages 'Temp. limiter active', 'Sensor problem 38', 'Sensor problem 42', 'Sensor fault 39', 'Sensor fault 43' (see <i>Technical Manual for the SDM</i> ).
	LED defective	Refer to messages 'SP20: Contact service' and 'SF21: Contact service' (see <i>Technical Manual for the SDM</i> ).
P0303 Message 'SP10: Contact Service'	Sentec TC Sensor defective/ low voltage potential is detected	If the problem persists, the Sentec TC Sensor is defect. Replace it with a new one.
	Calibration Module defective	Replace the Calibration Module according to the <i>Repair Manual for the SDMS</i> .  <b>⚠ To be performed by Sentec authorized service technicians only.</b>
	SDM defective	Refer to <i>section 4.2.4 "SDM-specific troubleshooting"</i> to further evaluate the problem.

Problem	Possible Cause(s)	Recommended action(s)
PO304 PCO2 slow (too slow) / Message 'SP11: Change sensor membrane/ SP14: Change sensor membrane'  OR  PO2 slow (too slow) / Message 'Sensor problem 74'	Membrane related (defective or dried up electrolyte) PCO2 electrode and/ or white PO2 sensing spot contaminated	Change the membrane: <ul style="list-style-type: none"> <li>- if it is damaged or missing, has a loose fit, or if there is trapped air or dry electrolyte under the membrane</li> <li>- sensor calibration takes almost 14 minutes or cannot be completed within 14 minutes</li> </ul> <p><b>Note:</b> If the PCO2 calibration takes 14 minutes the message 'PCO2 slow' displays and PCO2 subsequently will be flagged as questionable.</p> <p><b>Note:</b> If the PCO2 calibration cannot be finished within 14 minutes the message 'SP11: Change sensor membrane' displays and PCO2 subsequently will be flagged as invalid.</p> <p><b>Note:</b> If the calibration cannot be finished within approx. 30 minutes – due to failed extended calibration – the message 'SP14: Change sensor membrane' displays and PCO2 subsequently will be flagged as invalid.</p> <p><b>Note:</b> If the PO2 calibration cannot be finished within 14 minutes the message 'Sensor problem 74' displays and PO2 subsequently will be flagged as invalid.</p> <p>If after having changed the sensor membrane the calibration still takes almost 14 minutes or cannot be completed within 14 minutes, contact qualified service personnel to clean the sensor without membrane.</p> <p>Clean the sensor as described in <a href="#">section 3.1.7 "Cleaning / Inspecting without Membrane"</a>. Then calibrate the sensor.</p>
	Sentec TC Sensor defective	If the problem persists, the Sentec TC Sensor is defect. Replace it with a new one.

## 4 Troubleshooting

Problem	Possible Cause(s)	Recommended action(s)
PO305 PCO <sub>2</sub> sensitivity of the sensor low / Message 'SP12: Check membrane & gasket'  OR  PO <sub>2</sub> sensitivity of the PO <sub>2</sub> sensor low / Message 'Sensor problem 72'	Membrane related (defective or dried up electrolyte)	Change the membrane: <ul style="list-style-type: none"> <li>- if it is damaged or missing, has a loose fit, or if there is trapped air or dry electrolyte under the membrane</li> <li>- if the 'Sensitivity Test' fails.</li> </ul> Perform the 'Sensitivity Test' as described in <i>section 3.1.8 "PCO<sub>2</sub> / PO<sub>2</sub> Sensitivity &amp; Calibration Duration"</i> . <b>Note:</b> If the 'PCO <sub>2</sub> Sensitivity Test' fails the message 'SP12: Check membrane & gasket' displays and PCO <sub>2</sub> subsequently will be flagged as invalid <b>Note:</b> If the 'PO <sub>2</sub> Sensitivity Test' fails the message 'Sensor problem 72' displays and PO <sub>2</sub> subsequently will be flagged as invalid.
	PCO <sub>2</sub> electrode and/ or white PO <sub>2</sub> sensing spot contaminated	If after having changed the sensor membrane the 'Sensitivity Test' still fails, contact qualified service personnel to clean the sensor without membrane.  Clean/Inspect the sensor as described in <i>section 3.1.7 "Cleaning / Inspecting without Membrane"</i> and perform the 'Sensitivity Test' as described in <i>section 3.1.8 "PCO<sub>2</sub> / PO<sub>2</sub> Sensitivity &amp; Calibration Duration"</i> .
	Sentec TC Sensor defective	If problem persists, contact Sentec authorized service personnel.
	Docking Station Solenoid Valve defective  <b>Note:</b> Only for SMB 7.00 or lower.	If problem persists the Docking Station Solenoid Valve is defective. Replace it by original replacement parts according to the <i>Repair Manual for the SDMS</i> .   <b>To be performed by Sentec authorized service technicians only.</b>
PO306	Temperature of the Sentec TC Sensor is increased, e.g., because of warming lamps or electric blankets	Shield sensor from heat.
	Sentec TC Sensor defective	If the problem persists, the Sentec TC Sensor is defect. Replace it with a new one.










Problem	Possible Cause(s)	Recommended action(s)
Status Message 'Temp. limiter active' / Message 'Sensor problem 38-42'	SDM defective	Refer to <i>section 4.2.4 "SDM-specific troubleshooting"</i> to further evaluate the problem.
P0307 Sensor is blocked in Membrane Changer tool	Membrane change tool is blocked	Open the Membrane Change Tool as described in <i>section 3.5 "Opening the Membrane Changer"</i> .
P0308 Sentec TC Sensor calibration does not start	Sensor temperature is too low	Wait until the sensor temperature is less than 0.5 °C below the SET temperature. If problem persists, test the same sensor connected to another SDM using another extension cable.
	Sentec TC Sensor defective	If the problem persists, the Sentec TC Sensor is defect. Replace it with a new one.
	SDM defective	If problem (i.e. testing the sensor connected to another SDM) does not persist, then the problem is related to the SDM, refer to <i>section 4.2.4 "SDM-specific troubleshooting"</i> ; to further evaluate the problem.
P0309 OxiVenT™ Sensor connected to SDM, but PO2 measurement flagged to be invalid or not available	PO2 option of the SDM not activated or – if activated - PO2 not enabled in the menu of the SDM	Ensure that PO2 option of the SDM is activated and PO2 is enabled in the menu of the SDM. After doing so, verify that the off-centered white spot is illuminated in green-cyan color.
	LED of the PO2-module defective	The sensor can still be used for monitoring of the other parameters but PO2. Replace OxiVenT™ Sensor if you wish to continue monitoring PO2. <b>Note:</b> In this case, the SDM should display the message 'Sensor problem 70' (see <i>Technical Manual for the SDM</i> ).








Problem	Possible Cause(s)	Recommended action(s)
PO310 Message 'SP15: Change sensor membrane'	Membrane related (defective or dried up electrolyte)	Change the membrane: <ul style="list-style-type: none"> <li>- if it is damaged or missing, has a loose fit, or if there is trapped air or dry electrolyte under the membrane</li> <li>- if the 'Sensitivity Test' fails</li> </ul> Perform the 'Sensitivity Test' as described in section 3.1.8 "PCO <sub>2</sub> / PO <sub>2</sub> Sensitivity & Calibration Duration". <p><b>Note:</b> If the 'PCO<sub>2</sub> Sensitivity Test' fails, the message 'SP12: Check membrane &amp; gasket' appears and PCO<sub>2</sub> is subsequently flagged as invalid.</p> <p><b>Note:</b> If the 'PO<sub>2</sub> Sensitivity Test' fails, the message 'Sensor problem 72' appears and PO<sub>2</sub> is subsequently flagged as invalid.</p>
	PCO <sub>2</sub> electrode and/or white PO <sub>2</sub> sensing spot contaminated	If, after having changed the sensor membrane, the 'Sensitivity Test' still fails, contact qualified service personnel to clean the sensor without membrane.
		Clean/inspect the sensor as described in section 3.1.7 "Cleaning / Inspecting without Membrane" and perform the 'Sensitivity Test' as described in section 3.1.8 "PCO <sub>2</sub> / PO <sub>2</sub> Sensitivity & Calibration Duration".
Sentec Sensor defective	If the problem persists, contact qualified service personnel.	

#### 4.2.4 SDM-specific troubleshooting

Table 7 SDM-specific troubleshooting





Problem	Possible Cause(s)	Recommended action(s)
PO400 SDM not operational, SDM LEDs not illuminated	SDM switched off	Switch on SDM.
	SDM not connected to mains and battery depleted	Connect the SDM to the mains. Allow battery to charge.
	Mains power supply defective	Choose another mains power supply for connecting the SDM.
	SDM defective	Switch the SDM off and on again. If problem persists, contact qualified service personnel.
	Main fuses defective	Replace main fuses according to section 5.4 Replacement, main fuses.

Problem	Possible Cause(s)	Recommended action(s)
	SDM defective	Contact Sentec authorized service personnel.
	AC/DC Power Supply not connected	Connect AC/DC Power Supply according to the <i>Repair Manual for the SDMS</i> .  To be performed by Sentec authorized service technicians only.
	AC/DC Power Supply defective	Replace AC/DC Power Supply according to the <i>Repair Manual for the SDMS</i> .  To be performed by Sentec authorized service technicians only.
	SMBM (Motherboard) defective	Replace SMBM according to the <i>Repair Manual for the SDMS</i> .  To be performed by Sentec authorized service technicians only.
PO401 Display is dark, AC Power / Battery indicator (green / yellow LED) illuminated ON / OFF indicator (green LED) dark	SDM switched off	Switch on SDM. If problem persists, contact qualified service personnel.
	SDM defective	Contact Sentec authorized service personnel.
	Power ON/OFF Switch not connected	Connect Power ON/OFF Switch according to the <i>Repair Manual for the SDMS</i> .  To be performed by Sentec authorized service technicians only.
	Power ON/OFF Switch defective	Replace Power ON/OFF Switch according to the <i>Repair Manual for the SDMS</i> .  To be performed by Sentec authorized service technicians only.
	SMBC (Controller Board) defective	Replace SMBC according to the <i>Repair Manual for the SDMS</i> .  To be performed by Sentec authorized service technicians only.
	SMBM (Motherboard) defective	Replace SMBM according to the <i>Repair Manual for the SDMS</i> .  To be performed by Sentec authorized service technicians only.
PO402 fully charged Battery is	Battery defective	Contact qualified service personnel.
	SDM defective	Contact Sentec authorized service personnel.

Problem	Possible Cause(s)	Recommended action(s)
discharged after less than 4 h	Insufficient capacity of the rechargeable Lithium Battery	Replace Rechargeable Lithium Battery according to the <i>Repair Manual for the SDMS</i> .  To be performed by Sentec authorized service technicians only.
	Rechargeable Lithium Battery defective	Replace Rechargeable Lithium Battery according to the <i>Repair Manual for the SDMS</i> .  To be performed by Sentec authorized service technicians only.
	MPB /MPL (Multiparameter-board) defective	Replace MPB/MPL according to the <i>Repair Manual for the SDMS</i> .  To be performed by Sentec authorized service technicians only.
	SMBC (Controller Board) defective	Replace SMBC (Controller Board) according to the <i>Repair Manual for the SDMS</i> .  To be performed by Sentec authorized service technicians only.
	Docking Station Module defective	Replace Docking Station Module according to the <i>Repair Manual for the SDMS</i> .  To be performed by Sentec authorized service technicians only.
	SMBM/SMLM (Motherboard) defective	Replace SMBM/SMLM according to the <i>Repair Manual for the SDMS</i> .  To be performed by Sentec authorized service technicians only.
	Display Module defective	Replace Display Module according to the <i>Repair Manual for the SDMS</i> .  To be performed by Sentec authorized service technicians only.
PO403/ PO504 Display is dark, ON / OFF indicator is illuminated OR Display is not readable (dark)	SDM in Sleep Mode	Press any button. If the problem persists, switch the SDM off and on again. If problem persists, contact qualified service personnel.
	Brightness not adjusted correctly.	Switch the monitor off and on again. Then readjust the brightness ('UP/DOWN Buttons').
	SDM defective	Switch the SDM off and on again. If problem persists, contact qualified service personnel.

Problem	Possible Cause(s)	Recommended action(s)
	SDM defective	Contact Sentec authorized service personnel.
	Display Module not connected	Connect Display Module according to the <i>Repair Manual for the SDMS</i> .  ⚠ To be performed by Sentec authorized service technicians only.
	Display Module defective	Replace Display Module according to the <i>Repair Manual for the SDMS</i> .  ⚠ To be performed by Sentec authorized service technicians only.
	SMBC (Controller Board) defective	Replace SMBC according to the <i>Repair Manual for the SDMS</i> .  ⚠ To be performed by Sentec authorized service technicians only.
	SMBM (Motherboard) defective	Replace SMBM according to the <i>Repair Manual for the SDMS</i> .  ⚠ To be performed by Sentec authorized service technicians only.
PO405 POST screen does not disappear	POST failed	Write down the Error code, switch the SDM off and on again. If problem persists, contact qualified service personnel.
	SDM defective	Contact Sentec authorized service personnel.
	SMBC (Controller Board) defective	Replace SMBC according to the <i>Repair Manual for the SDMS</i> .  ⚠ To be performed by Sentec authorized service technicians only.
	SMBM/SMLM (Motherboard) defective	Replace SMBM/SMLM according to the <i>Repair Manual for the SDMS</i> .  ⚠ To be performed by Sentec authorized service technicians only.
PO406 SDM does not react if any button is pressed	Menu-Access disabled	Refer to PO420
	SDM software is not responding	Switch the monitor off and on again. If problem persists, contact qualified service personnel.
	SDM defective	Contact Sentec authorized service personnel.

Problem	Possible Cause(s)	Recommended action(s)
	Keyboard not connected	Connect Keyboard according to the <i>Repair Manual for the SDMS</i> .  ⚠ To be performed by Sentec authorized service technicians only.
	Keyboard defective	Replace Keyboard according to the <i>Repair Manual for the SDMS</i> .  ⚠ To be performed by Sentec authorized service technicians only.
	SMBC (Controller Board) defective	Replace SMBC according to the <i>Repair Manual for the SDMS</i> .  ⚠ To be performed by Sentec authorized service technicians only.
	SMBM/SMLM (Motherboard) defective	Replace SMBM/SMLM according to the <i>Repair Manual for the SDMS</i> .  ⚠ To be performed by Sentec authorized service technicians only.
PO407 'Watch battery low' displays	Internal watch / clock battery is low	Must be replaced, contact qualified service personnel.  <b>Note:</b> Refer to the sub-section 'POST' in the <i>Technical Manual for the SDM</i> and to Status Messages 'Watch battery low' and 'Set Date / Time'.
	SDM defective	Contact Sentec authorized service personnel.
	Internal battery on SMBC (Controller Board) low	Replace internal battery on SMBC according to the <i>Repair Manual for the SDMS</i> .  ⚠ To be performed by Sentec authorized service technicians only.
	SMBC (Controller Board) defective	Replace SMBC according to the <i>Repair Manual for the SDMS</i> .  ⚠ To be performed by Sentec authorized service technicians only.

Problem	Possible Cause(s)	Recommended action(s)
PO408 Wrong / unstable barometric pressure	Barometer chip defective	Verify that the barometric pressure reading of the SDM is stable during calibration and does not deviate from a known calibrated reference barometer by more than 3 mmHg (0.4 kPa). Otherwise contact qualified service personnel. <b>Note:</b> The 'Barometer Icon' only displays if PCO2 is enabled, and the Sentec TC Sensor is connected to the SDM and inside the Docking Station. <b>Note:</b> Also refer to Status Messages 'Atm. P. unstable' and 'Barometer fault'.
	SDM defective	Contact Sentec authorized service personnel.
	MPB /MPL (Multiparameter-board) defective	Replace MPB /MPL according to the <i>Repair Manual for the SDMS</i> .  <b>To be performed by Sentec authorized service technicians only.</b>
PO409 Fan is noisy	Fan defective or polluted	Remove mains connection and – if active – wait until fan operation stops, then clean ventilation slots. Contact qualified service personnel if problem persists.
	SDM defective	Contact Sentec authorized service personnel.
	Fan polluted	Clean case and fan according to the <i>Repair Manual for the SDMS</i> .  <b>To be performed by Sentec authorized service technicians only.</b>
	Fan defective	Replace Fan according to the <i>Repair Manual for the SDMS</i> .  <b>To be performed by Sentec authorized service technicians only.</b>
PO410 Fan is blocked	Fan defective or polluted	The fan must be able to rotate freely. Check ventilation slots if something is blocking the fan. If problem persists, contact qualified service personnel.
	SDM defective	Contact Sentec authorized service personnel.
	Fan not connected	Connect fan according to the <i>Repair Manual for the SDMS</i> .  <b>To be performed by Sentec authorized service technicians only.</b>


Problem	Possible Cause(s)	Recommended action(s)
	Fan polluted	Clean case and fan according to the <i>Repair Manual for the SDMS</i> .  ⚠ To be performed by Sentec authorized service technicians only.
	Fan defective	Replace fan according to the <i>Repair Manual for the SDMS</i> .  ⚠ To be performed by Sentec authorized service technicians only.
	SMBC (Controller Board) defective	Replace SMBC according to the <i>Repair Manual for the SDMS</i> .  ⚠ To be performed by Sentec authorized service technicians only.
	SMBM/SMLM (Motherboard) defective	Replace SMBM/SMLM according to the <i>Repair Manual for the SDMS</i> .  ⚠ To be performed by Sentec authorized service technicians only.
PO411 No sound	Auditory alarm signals are PAUSED or OFF	Reactivate auditory alarm signals (if necessary)
	Volume is on minimum	Adjust the volume in the menu "Alarm Settings".
	Speaker is defective	Verify that 3 beeps are audible during POST. If problem persists, contact qualified service personnel.
	SDM defective	Contact Sentec authorized service personnel.
	Speaker not connected	Connect speaker according to the <i>Repair Manual for the SDMS</i> .  ⚠ To be performed by Sentec authorized service technicians only.
	Speaker defective	Replace speaker according to the <i>Repair Manual for the SDMS</i> .  ⚠ To be performed by Sentec authorized service technicians only.
	SMBC (Controller Board) defective	Replace SMBC according to the <i>Repair Manual for the SDMS</i> .  ⚠ To be performed by Sentec authorized service technicians only.



Problem	Possible Cause(s)	Recommended action(s)
	SMBM/SMLM (Motherboard) defective	Replace SMBM/SMLM according to the <i>Repair Manual for the SDMS</i> .  ⚠ To be performed by Sentec authorized service technicians only.
PO412 It is not possible to connect the AC power cord in the SDM AC power connector	AC Power Cord is defective	Replace the AC Power Cord.
	Power Entry Module defective	Contact qualified service personnel.
	Fuse Holder not mounted correctly	Mount Fuse Holder correctly according to <i>section 5.4 "Replacement, main fuses"</i> .
	SDM defective	Contact Sentec authorized service personnel.
	AC Power Connector defective	Replace AC Power Connector according to the <i>Repair Manual for the SDMS</i> .  ⚠ To be performed by Sentec authorized service technicians only.
PO414 Wrong or no analog output	SDM defective or wrong / defective cable	Contact qualified service personnel.
	SDM defective	Contact Sentec authorized service personnel.
	SMBC (Controller Board) defective	Replace SMBC according to the <i>Repair Manual for the SDMS</i> .  ⚠ To be performed by Sentec authorized service technicians only.
	SMBM/SMLM (Motherboard) defective	Replace SMBM/SMLM according to the <i>Repair Manual for the SDMS</i> .  ⚠ To be performed by Sentec authorized service technicians only.
PO415 No communication over RS-232	Wrong serial communication protocol	Make sure to select appropriate serial protocol
	SDM defective or wrong / defective cable	Contact qualified service personnel.
	SDM defective	Contact qualified service personnel.
	SDM defective	Contact Sentec authorized service personnel.

## 4 Troubleshooting



Problem	Possible Cause(s)	Recommended action(s)
	SMBC (Controller Board) defective	Replace SMBC according to the <i>Repair Manual for the SDMS</i> .  ⚠ To be performed by Sentec authorized service technicians only.
	SMBM/SMLM (Motherboard) defective	Replace SMBM/SMLM according to the <i>Repair Manual for the SDMS</i> .  ⚠ To be performed by Sentec authorized service technicians only.
PO416 No alarm on speaker, nurse call	Auditory alarm is muted	Auditory alarm signals can be muted for 1 minute, 2 minutes or permanently with the Alarm Mute Button. Push the Alarm Mute Button. Refer to PO411.
	SDM defective	Contact qualified service personnel.
	SDM defective	Contact Sentec authorized service personnel.
	SMBC (Controller Board) defective	Replace SMBC according to the <i>Repair Manual for the SDMS</i> .  ⚠ To be performed by Sentec authorized service technicians only.
	SMBM/SMLM (Motherboard) defective	Replace SMBM/SMLM according to the <i>Repair Manual for the SDMS</i> .  ⚠ To be performed by Sentec authorized service technicians only.
PO417 Safety test does not comply	SDM defective	Contact Sentec authorized service personnel.
	Protective Earth Resistance is more than 0.2 Ω	Control the Protective Earth wiring between the AC Power Connector, the Equipotential Terminal, and the Gas bottle.  ⚠ To be performed by Sentec authorized service technicians only.
	Protective Earth wiring defective	If problem persists, replace Protective Earth according to the <i>Repair Manual for the SDMS</i> .  ⚠ To be performed by Sentec authorized service technicians only.
	Leakage current too high	Replace SMBM according to the <i>Repair Manual for the SDMS</i> .  ⚠ To be performed by Sentec authorized service technicians only.

Problem	Possible Cause(s)	Recommended action(s)
PO418 Gas Level Indicator shows wrong indication	Gas level indicator shows wrong results	Repeat the test with the same sensor connected to the same SDM using the Docking Station of another SDM (Both SDMs need to be switched on). Make sure the sensor is in the Docking Station and the door is closed correctly, wait 10 seconds. Contact qualified service personnel if the problem persists.
	SDM defective	Contact Sentec authorized service personnel.
	DS Module defective	Replace DS Module according to the <i>Repair Manual for the SDMS</i> .   To be performed by Sentec authorized service technicians only.
PO419 Despite a Sentec TC Sensor is connected to the SDM the message 'Connect sensor' displays	Refer to PO300	
PO420 SDM Menu cannot be accessed	Menu cannot be activated when pressing menu button, a long low tone is audible instead	Blocked menu access: Menu access has been deactivated by the Responsible Organization.

## 4.2.5 Docking Station-specific troubleshooting

Table 8 Docking Station-specific troubleshooting

Problem	Possible Cause(s)	Recommended action(s)
P0500 Docking Station door does not close properly	Sensor cable jammed in the door	Adjust cable and close the Docking Station door properly.
	Sensor not inserted properly in the Docking Station door.	Insert the sensor properly and close the door.
	Mechanical defect of the Docking Station door	Contact qualified service personnel.
	Mechanical defect of the Docking Station door	Replace Docking Station door according to <i>section 5.5 "Replacement, Docking Station Door"</i> .
	Gasket not placed correctly	Place gasket correctly in the chamber in the Docking Station according to <i>section 5.6 "Replacement, Docking Station Gasket"</i> .
	Docking Station door mechanically defective	Replace Support for Docking Station Door according to the <i>Repair Manual for the SDMS</i> .  ⚠ To be performed by Sentec authorized service technicians only.
P0501 Message 'Docking Station Fault' is displayed	Contaminations (e.g., gel residues) disturb the gas flow	Clean Docking Station and Sentec TC Sensor and then insert the sensor into the Docking Station. If problem persists, contact qualified service personnel. Note: Refer to the <i>Instruction Manual for the SDMS</i> .
	Docking Station defective	Contact Sentec authorized service personnel.
	Docking Station Module defective	Replace Docking Station Module according to the <i>Repair Manual for the SDMS</i> .  ⚠ To be performed by Sentec authorized service technicians only.
P0502 Message 'Docking Station Leak'	Sensor not properly positioned in Docking Station during last calibration.	Verify that the sensor is clean and is properly placed into the holder at the inside of the Docking Station door and that the door properly closes (refer to the <i>Instruction Manual for the SDMS</i> ).

Problem	Possible Cause(s)	Recommended action(s)
Check 'Gasket' is displayed or a gas leak is suspected (see Status Code DPO2 in memory dump)	Gasket of Docking Station contaminated	Clean the Docking Station gasket with a cotton swab with 70% isopropanol. Remove any residual threads and fibers and allow to dry. <b>Note:</b> Always clean the sensor before inserting it into the Docking Station.
	Gasket of Docking Station defective or missing	Carefully inspect the gasket and verify that it is present and well embedded in its notch. If damaged contact qualified service personnel.
	Docking Station door and / or closing mechanism defective	Carefully inspect the door and the closing mechanism for mechanical or functional damage. The closing mechanism must properly lock in place. If damaged contact qualified service personnel.
	Docking Station door mechanically defective	Replace Docking Station door according to <i>section 5.5 "Replacement, Docking Station Door"</i> .
	Gasket defective / missing	Place gasket correctly in the chamber in the Docking Station according to <i>section 5.6 "Replacement, Docking Station Gasket"</i> .
	SDM defective	Contact Sentec authorized service personnel.
	Calibration Module defective	Replace Calibration Module according to the <i>Repair Manual for the SDMS</i> .  <b>To be performed by Sentec authorized service technicians only.</b>
	Docking Station Module defective	Replace Docking Station Module according to the <i>Repair Manual for the SDMS</i> .  <b>To be performed by Sentec authorized service technicians only.</b>
<b>Note:</b> Also refer to messages 'Docking Station Leak: Check Gasket', 'Leak test in progress' described in the <i>Technical Manual for the SDM</i> .		
PO503 Service Gas bottle cannot be installed properly	Plastic lid of the new Service Gas bottle not removed	Remove the plastic lid and install the Service Gas bottle.
	Foreign body in the slot for the Service Gas bottle	Switch off the SDM, disconnect it from the mains supply and remove the foreign body from the slot on the rear panel of the SDM.

## 4 Troubleshooting

Problem	Possible Cause(s)	Recommended action(s)
	Thread of the Service Gas bottle is damaged	Use a new Service Gas bottle and install it as described in <i>Instruction Manual for the SDMS</i> .
	SDM is defective	Contact qualified service personnel.
	SDM defective	Contact Sentec authorized service personnel.
	Docking Station Module defective	Replace Docking Station Module according to the <i>Repair Manual for the SDMS</i> .  ⚠ To be performed by Sentec authorized service technicians only.
PO504 Consumption of the Service Gas is higher than usual (message 'Docking Station Leak: Check Gasket' does not display)	Low pressure side residual gas flow too high	Verify whether DPO1 status code is flagged. Contact qualified service personnel.
	High pressure part of the Docking Station Module is leaky	Contact qualified service personnel.
	Unstable sensor requiring too many calibrations	Re-membrane sensor and observe gas consumption. If problem persists, contact qualified service personnel.
	SDM defective	Contact Sentec authorized service personnel.
	Gasket in the Docking Station Module thread for the Service Gas is polluted or damaged	Clean gasket in the Docking Station Module thread according to the <i>Repair Manual for the SDMS</i> .  ⚠ To be performed by Sentec authorized service technicians only.
	Docking Station Solenoid Valve defective	If problem persists, the Docking Station Solenoid Valve is defect. Replace it by original replacement parts according to the <i>Repair Manual for the SDMS</i> .  ⚠ To be performed by Sentec authorized service technicians only.

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Problem	Possible Cause(s)	Recommended action(s)
P0505 Sensor calibration does not start, Sensor LED is illuminated	Refer to P0308	
P0506 Gas Level Indicator shows wrong indication	Refer to P0418	

## 5 Repairs of the SDM

Repairs described in this chapter do not require opening the SDM's cover and shall be carried out by qualified service personnel only.

Repairs that require opening the cover of the SDM are to be performed by Sentec authorized service technicians only (i.e., trained by Sentec AG or accredited partners) and are described in detail within the *Repair Manual*.

Prior to maintenance, service or repairs all components of the SDMS must be cleaned and disinfected. If equipment is sent to service personnel, a local Sentec representative or to Sentec AG a completed "*Certificate for Disinfection*" (see section 8.8) must be attached.

If you need to return devices for service or repair, follow the shipment instructions in section 8.7 "*Instructions for Shipment*".

Send defective parts together with the completed "*Repair or Investigation Request Form*" to your local Sentec representative. The "*Repair or Investigation Request Form*" may be copied from section 8.4 "*Repair or Investigation Request Form*".

To ensure traceability – a regulatory requirement – Sentec AG needs to know the serial and LOT numbers as well as software versions of all components of the SDMS. **This means, if you replace parts of the SDM or if you perform a software update you must report the serial number of the respective SDM and the serial and LOT numbers of the replaced parts using the "*Repair Reporting Form*" see section 8.5 to your local distributor.**

For spare parts and test tools refer to in section 8.3 "*Testing Accessories and Spare Parts*".

### Tools

- Screwdriver small slotted 2 mm
- A pair of pointed tweezers
- A pair of normal tweezers



**WARNING:** Maintenance and repairs requiring removal of the case or covers may only be carried out by Sentec authorized service personnel trained by Sentec AG or accredited partners.



**WARNING:** Use only accessories and spare parts supplied or recommended by Sentec AG. Do not perform other service and repair activities than specified and described by Sentec AG. Failure to comply may result in physical injury, inaccurate measurements, and/or damage to the device.





**WARNING:** Before replacing fuses of the SDM, disconnect the device from the AC power.



**CAUTION:** Follow ESD (Electrostatic discharge) precautions when working with the SDM, especially when disassembling and reassembling the SDM and when handling any of the components. Use an ESD protective wrist-strap and tablemat connected to Earth while working with the electronics.



## 5.1 Prior to Repair

1. Prior to repair all components of the SDMS must be cleaned and disinfected as described in the corresponding section of the *Technical Manual for the SDM*. Check that the sender completed and enclosed the "Disinfection Certificate" (see section 8.8).
2. If necessary, clean and disinfect the device as described in the corresponding section of the *Technical Manual for the SDM*.
3. Set the ON/OFF Switch of the SDM to OFF.
4. Disconnect all connections on the rear panel of the device.

## 5.2 Replacement, Tip-up Foot

1. Follow the procedure described in section 5.1 "Prior to Repair".
2. Fold out the tip-up foot. Expand it on one side to release the first pin from the positioning hole. Then remove the whole Tip-up foot.
3. Fix the new tip-up foot (see section 8.3 "Testing Accessories and Spare Parts") by inserting one pin into the positioning hole on one side. Enlarge the tip-up foot and engage the second pin on the other side.

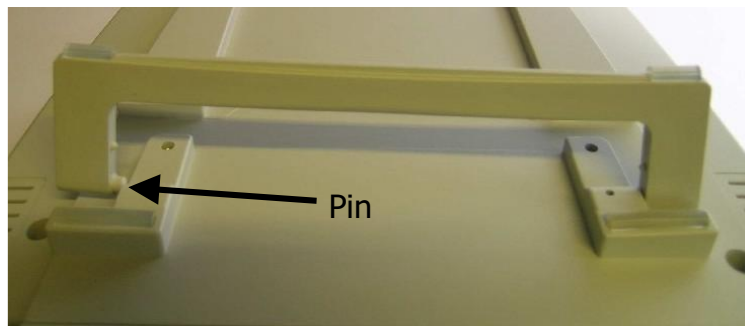


Figure 11 Replacement, Tip-up Foot

## 5.3 Replacement, Silicon Foot

1. Follow the procedure described in *section 5.1 "Prior to Repair"*.
2. Clean the groove for the silicon foot with a cotton swap soaked with 70% isopropanol.
3. Put one drop of silicon glue (see *section 8.3 "Testing Accessories and Spare Parts"*) in the groove.
4. Insert the new silicon foot into the groove by pressing firmly.
5. Allow the glue to dry.



Figure 12 Replacement, Silicon Foot

## 5.4 Replacement, main fuses

1. Follow the procedure described in *section 5.1 "Prior to Repair"*.
2. Remove the fuse holder from the AC Power Connector by disengaging the tab and pulling out the fuse drawer according to *Figure 13 Replacement, Main Fuses*.
3. Replace the defective fuses with time delay, high breaking capacity fuses, by fuses with rated current as specified on the SDM rear panel (see *section 8.3 "Testing Accessories and Spare Parts"*)
4. Reinsert the holder into the AC Power Connector.

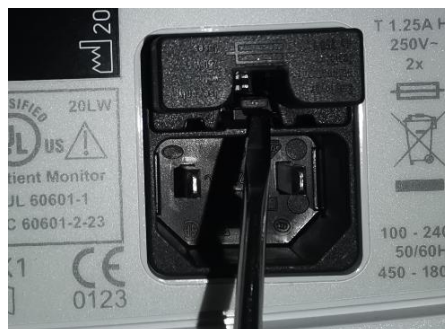


Figure 13 Replacement, Main Fuses

## 5.5 Replacement, Docking Station Door

1. Follow the procedure described in *section 5.1 "Prior to Repair"*.
2. Open the Docking Station Door to an angle of approximately 120° (see *Figure 14 Docking Station Door removal*).
3. Lift the mounting link for the hinge and remove the Docking Station Door by pulling it out and pressing it down at the same time.
4. Insert the new Docking Station Door with an aperture angle of the door of 45° (see *Figure 15 Docking Station Door insertion*). The door must not be closed further, as this could damage the pressure spring. First press on the bottom, then on the top of the door to insert the hinge into the mounting link (see *section 8.3 "Testing Accessories and Spare Parts"*).
5. Switch on the monitor.
6. Put the sensor into the Docking Station to calibration the sensor. After calibration wait 6 minutes to verify that the message 'Docking Station Leak: Check Gasket' does not display.

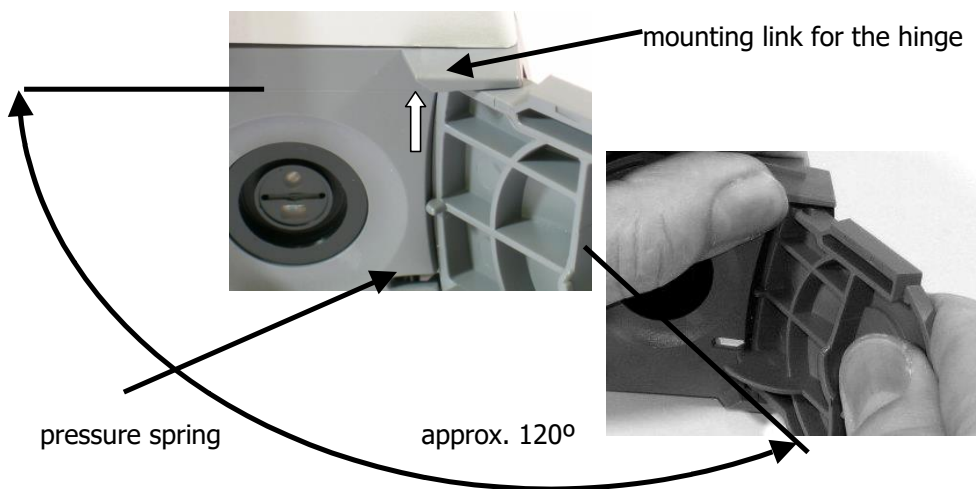


Figure 14 Docking Station Door removal

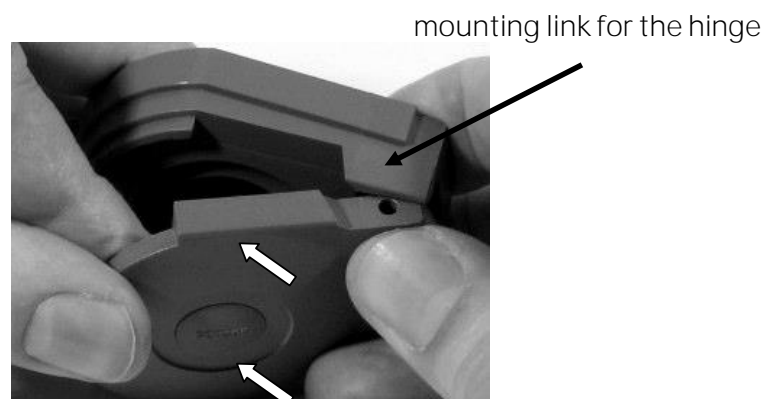


Figure 15 Docking Station Door insertion

## 5.6 Replacement, Docking Station Gasket

1. Follow the procedure described in *section 5.1 "Prior to Repair"*.
2. Open the Docking Station door.
3. Remove the defective gasket using tweezers. Take care not to damage the lining groove.
4. Clean the lining groove using a cotton swab soaked with 70% isopropanol, allow to dry.

**Note:** Do not use grease or talcum powder for pre-treatment of gasket before inserting it. Clean especial carefully the lining groove, as described above, if grease or talcum powder has been used before.

5. Insert a new (**asymmetric**) gasket (see *Figure 16 Replacement, Docking Station Gasket* and *Figure 17 Positioning of the Docking Station Gasket*) by pressing it with a cotton swab soaked with 70% isopropanol into the lining groove. Make sure that no cotton fibers remain on the gasket as this might cause leak problems.
6. Allow to dry.
7. Switch on the monitor.
8. Put the sensor into the Docking Station to calibration the sensor. After calibration wait 6 minutes to verify that the message "Docking Station Leak: Check Gasket" does not display.

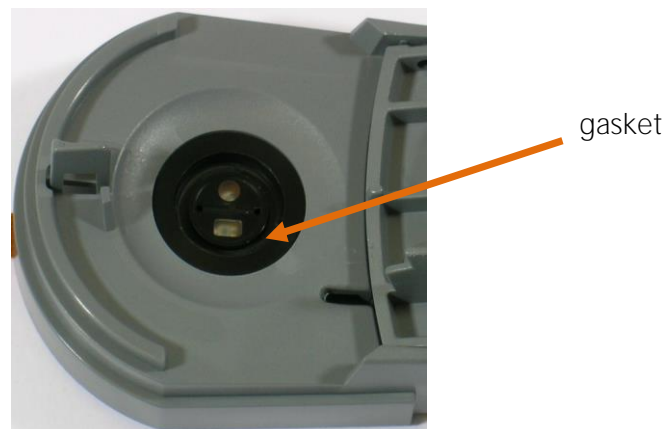


Figure 16 Replacement, Docking Station Gasket

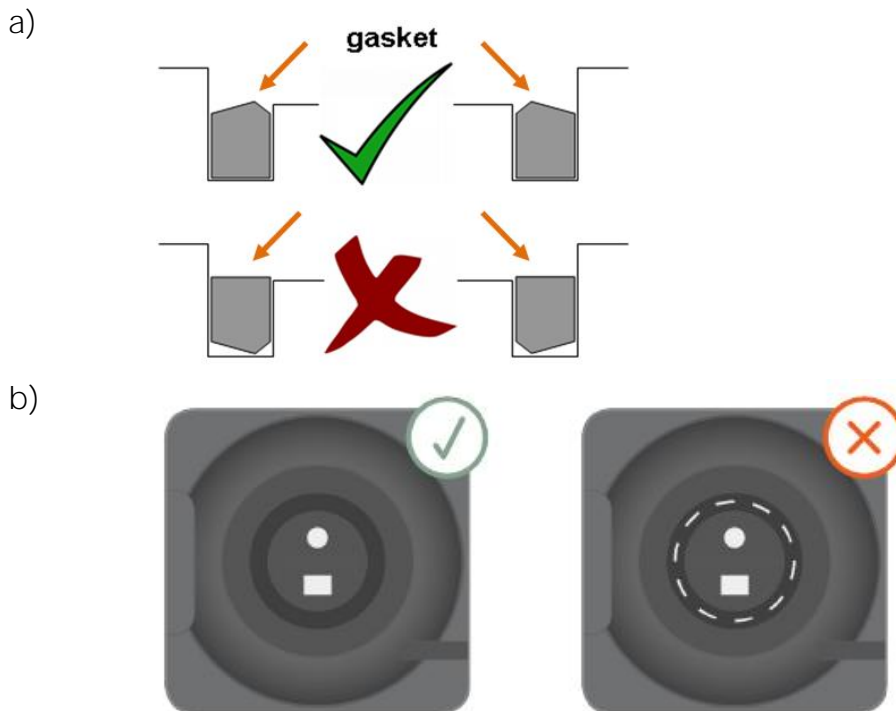


Figure 17 Positioning of the Docking Station Gasket  
a) Gaskets sold up to 2022-07  
b) Gaskets sold from 2022-07 on

Sentec's tutorial video "How to resolve a Gas Leak in Docking Station", available on [www.sentec.com/education/tutorial-videos](http://www.sentec.com/education/tutorial-videos), provides a step-by-step guide on the procedure described in this chapter.

## 6 Software Updates

The field-upgradable software of the SDM consists of multiple items:

1. SMBC – Controller Board software (User Interface, Memory, and Interface management)
2. Signal analysis board – Multiparameterboard software (Signal Analysis Algorithm), MultiParameter Link (SDM with serial number 320000 or above)
3. Docking Station software (SDM with serial number 320000 or above)

The above-mentioned boards and Docking Station can be updated by flashing a new version in the flash memory of the existing boards (note: detailed instructions are included in separate documents).

**WARNING:** Software updates must be reported to Sentec by using the Repair Reporting Form, *see section 8 "Appendix"*, to ensure traceability.



## 7 Disposal

The SDMS is manufactured with environment-friendly material. It contains electronic printed circuit boards, a display, cables, and lithium batteries.

Do not incinerate equipment or gas bottles.

**WEEE Disposal:** European consumers are obliged by law to dispose Waste Electrical and Electronic Equipment (WEEE) according to the WEEE Directive:

1. All electrical and electronic waste, must be stored, collected, treated, recycled, and disposed of separately from other waste
2. Consumers are obliged by law to return electrical and electronic devices at the end of their service lives to the public collection points set up for this purpose or point of sale. Details to this are defined by the national law of the respective country.

**Note:** By recycling materials or other forms of utilizing old devices, you are making an important contribution to protecting our environment.

### 7.1 Sentec Digital Monitor

Return the SDM to your local Sentec representative or dispose it according to local regulations.

### 7.2 Cables

Dispose the cables according to local regulations. The copper contained can be recycled.

### 7.3 Sentec TC Sensors

Return the Sentec TC Sensors to your local distributor.

### 7.4 Service Gas Bottle

Dispose the gas bottles according to local regulations for aluminum containers. Make sure that only empty gas bottles are disposed.

Gas may be discharged from the container by **carefully** opening the container valve. Ensure that the container is positively supported. Open the container valve **slowly** to permit gas discharge at an appropriate rate.

**CAUTION:** Ensure that the operation is carried out in a well-ventilated area and vented gases may disperse. Noise level should be controlled to meet local regulations.



**WARNING:** Pressurized container. Protect from sunlight and do not expose to temperatures exceeding 50°C (122°F). Do not pierce or burn, even after use. Do not spray on a naked flame or any incandescent material.



## 7.5 Consumables

All material used is considered "non-critical". The consumables may be disposed with the regular garbage collection.



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## 8 Appendix

**Note:** A selection of below-mentioned forms can be found on [www.sentec.com/ifu](http://www.sentec.com/ifu).

### 8.1 Software Update

Please refer to the document:

**HB-006815**

### 8.2 Protocol for Safety & Functionality Test

This protocol is intended to be used by qualified service personnel.

Please refer to the document:

**HB-005638**

### 8.3 Testing Accessories and Spare Parts

**WARNING:** Use only testing accessories and spare parts supplied or recommended by Sentec AG. Use of other than supplied or recommended parts may result in physical injury, inaccurate measurement and/or damage to the device.



Contact Sentec authorized service personnel.

### 8.4 Repair or Investigation Request Form

Please refer to the document:

**HB-005643**

### 8.5 Repair Reporting Form

Please refer to the document:

**HB-005729**

### 8.6 Customer Feedback Form

Please refer to the document:

**HB-006872**

### 8.7 Instructions for Shipment

Please refer to the document:

**HB-005891**

## 8.8 Certificate of Disinfection

Please refer to the document:

HB-005637

## 8.9 SDMS Maintenance Checklist

This checklist is intended to be used by the operator.

Please refer to the document:

HB-007601

## 8.10 Interfaces - Pin Assignment

**WARNING:** The mains power supply of the Sentec Digital Monitor (SDM) is separated by two Means of Patient Protection (MOPPs) between the sensor port (for the applied part, the sensor) and the interface connectors. The three interface connectors - serial data port, Multipurpose I/O port (analog outputs, nurse call), LAN port - of the SDM are not separated from each other. If at a time accessory equipment is connected to only one of the three interface connectors no additional safety measures are necessary to comply with the requirements of IEC 60601-1. If, however accessory equipment is simultaneously connected to two or three of the SDM's interface connectors additional safety measures may be required to be compliant with the requirements of IEC 60601-1. In case of doubt consult qualified technicians.



## 8.10.1 Sensor Connection Port

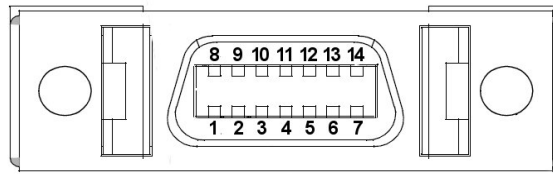


Figure 18 Sensor Connection Port

Table 9 Pin Assignment, Sensor Connection Port

Pin(s)	Signal
1 – 3	(reserved)
4	Signal Ground
5	Received Data (RX, from Sensor)
6	Transmitted Data (TX, to Sensor)
7 – 9	(reserved)
10	5 V, for sensor supply only
11	Supply Ground
12	3.3 V, for sensor supply only
13 – 14	(reserved)

## 8.10.2 Serial Data Port (RS-232)

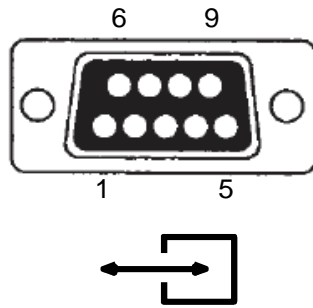


Figure 19 Serial Data Port (RS-232)

Table 10 Pin Assignment, Serial Data Port (RS-232)

Pin(s)	Signal
1	(reserved)
2	Transmitted Data (TX, from SDM)
3	Received Data (RX, to SDM)
4	(reserved)
5	Signal Ground
6-9	(reserved)

## 8.10.3 Multipurpose I/O Port

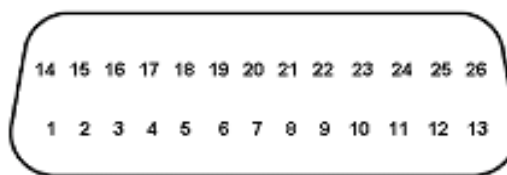


Figure 20 Multipurpose I/O Port

Table 11 Pin Assignment, Multipurpose I/O Port

	Pin(s)	Signal	Signal Range	Voltage
Analog Output	1	Pleth Signal	Voltage: 0 – 1.05 V	Parameter Range: min – max (not selectable)
	2	Pleth Ground		
	3	PR Signal	Voltage: 0 – 1.05 V	Parameter Range: 30–80, 30–125, 50–120, 100–250, 30–250 (bpm)
	4	PR Ground		
	5	SpO2 Signal	Voltage: 0 – 1.05 V	Parameter Range: 0-100, 50-100, 70-100, 85-100 (%)
	6	SpO2 Ground		
	7	PCO2 Signal	Voltage: 0 – 1.05 V	Parameter Range: 10-50, 25-55, 25-75, 35-100, 60-140, 75-200, 120-200, 0-75, 0-100, 0-200 [mmHg] / 1.5-7, 3.5-7.5, 3.5-10.0, 4.5-15.0, 8-18.0, 10.0-27.0, 16.0-27.0, 0-10.0, 0-15.0, 0-27.0 [kPA]
	8	PCO2 Ground		
	9 – 13	(reserved)		
	14	Ground		
	15 - 16	(reserved)		
	17	Ground		
	18 - 19	(reserved)		
	20 - 21	Ground		
	22	3.3 V, max. 15 mA		
	23	Ground		
Nurse Call	24	Common lead for Nurse Call relays 1 + 2	-	-
	(24 + 25)	Nurse Call relay 1	open, close	<u>closes</u> upon SDM audible alarm
	(24 + 26)	Nurse Call relay 2	close, open	<u>opens</u> upon SDM audible alarm

**Note:** Output of PO2, PI and HP data via the Analog Output is currently not supported.

### 8.10.4 Network Port (LAN)

The LAN port of the SDM is used to communicate with external computer-based data collection systems. The LAN port is located on the rear panel of the SDM. The LAN port is a standard 10Base-T Ethernet connector. Use Category 3 (Cat3) or preferably Category 5 (Cat5) Ethernet cables for connection of the monitor to a network hub or switch. You may also use a cross-over Ethernet cable for direct connection of the monitor to a computer without a hub or switch.

**Note:** While trend data are downloaded via the LAN interface the serial interface of the SDM is inactivated. Once data download via the LAN interface is completed the serial interface is reactivated.

## 8.11 Technical Specifications

See the corresponding section of the *Technical Manual for the SDM*.

## 8.12 Contact

Phone: +41 61 726 97 60

Monday to Friday, 08:30 - 12:00 und 14:00 - 17:00 (GMT +01:00)

e-Mail: [service@sentec.com](mailto:service@sentec.com)



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