



# Service Manual



## For the LuMon™ System

GUI software 1.0.x.x/TIC software 1.6.x.xxx

LuMon™ Belts sizes 47 and smaller / SensorBelts

## Warranty

The manufacturer warrants to the initial purchaser that each new component of the LuMon™ System 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 component – for which the manufacturer acknowledges the warranty cover – with a replacement component.

## 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 LuMon™ Technicians*.

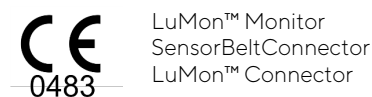
**Design/patents related to the LuMon™ System:** Please refer to the specification sheets for the LuMon™ System: [www.sentec.com/education/eit/plpm-eit](http://www.sentec.com/education/eit/plpm-eit)

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## Manufacturer:

SenTec AG | Kantonsstrasse 14 | 7302 Landquart | Switzerland | [www.sentec.com](http://www.sentec.com)

## EU Representative:

SenTec GmbH | Carl-Hopp-Straße 19A | 18069 Rostock | Germany

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## 1 INTRODUCTION

### 1.1 About this Service Manual

This Service Manual contains information and instructions on servicing the LuMon™ System – i.e. maintenance, safety, functionality tests, troubleshooting and repairs. Procedures that do **not require opening the housing of the device**.

- Maintenance/safety and functionality tests for the LuMon™ System (LMS) intended for qualified technicians only (3).
- Troubleshooting for the LuMon™ System (4). The troubleshooting list covers three levels of recommended troubleshooting procedures: **A** for the operator, **B** for qualified technicians, and **C** for *SenTec Authorized LuMon™ Technicians* only.
- Repair procedures that do not require opening the cover of the LMS intended for *SenTec Authorized LuMon™ Technicians* only (5).



#### NOTE

Statements and instructions in this Service Manual are only applicable for LuMon™ Monitors with the software versions indicated on the cover page, where “x” can be any number. The software versions of the LuMon™ Monitor – GUI and TIC – are displayed in the ‘system settings’ area of ScoutView [1]. If your LuMon™ Monitor has other software versions than those indicated on the cover page, please refer to the corresponding version of the Service Manual.



#### NOTE

This manual is intended for qualified technicians and *SenTec Authorized LuMon™ Technicians* and must be read carefully prior performing service and repair. Section ‘safety information’ of the User’s Guide for the LuMon™ System [1] must be read and understood.



#### NOTE

Repairs that require opening the LuMon™ Monitor cover are described within the Repair Manual for the LuMon™ Monitor [3] (which is distributed to *SenTec Authorized LuMon™ Technicians* only).

### 1.2 Related documents/forms

To perform service you must know how to operate the LuMon™ System (2.1). Refer to the following manuals and directions for use:

- [1] The **User’s Guide for the LuMon™ System** provides detailed information on the LuMon™ System for health care practitioners. It is available in several languages and can be downloaded from SenTec’s webpage: [www.sentec.com/education/eit/plpm-eit](http://www.sentec.com/education/eit/plpm-eit)
- [2] The **Service Manual for the LuMon™ System** (1.1) is available in English and can be downloaded from SenTec’s webpage: [www.sentec.com/education/eit/plpm-eit](http://www.sentec.com/education/eit/plpm-eit)
- [3] The **Repair Manual for the LuMon™ Monitor** describes repair procedures that require opening the housing of the monitor for *SenTec Authorized LuMon™ Technicians*. This manual is distributed to *SenTec Authorized LuMon™ Technicians* only.
- [4] The **Product Catalogue for the LuMon™ System** provides information related to Product Numbers and purchase of LMS related accessories, key spare parts and documents. It is available in English and can be downloaded from SenTec’s webpage: [www.sentec.com/education/eit/plpm-eit](http://www.sentec.com/education/eit/plpm-eit)
- [5] The **Protocol for Safety and Functionality Test – LuMon™ Monitor** is a checklist for guiding qualified service personnel through the complete safety and functionality tests and documenting its results (9).
- [6] The **Certificate of Disinfection** is a form serving as proof of disinfection before shipment. It **must** be completed and provided to SenTec AG and **must** accompany the shipment (outside the package box). A PDF-copy of this form and the RGA – Return Good Authorization – number are available from SenTec AG upon request ([info-eit@sentec.com](mailto:info-eit@sentec.com)).
- [7] The **Repair or Investigation Request Form – LuMon™ System** is a form used to return material to SenTec AG for service, investigation or repair. A PDF-copy of this form and the RGA – Return Good Authorization – number are available from SenTec AG upon request ([info-eit@sentec.com](mailto:info-eit@sentec.com)).
- [8] The **Technical Service Report Form – LuMon™ System** is a form that **must** be completed and provided to SenTec AG after software updates and after repairs performed by a *SenTec Authorized LuMon™ Technician*. A PDF-copy of this form is available from SenTec AG upon request ([info-eit@sentec.com](mailto:info-eit@sentec.com)).
- [9] The **LuMon™ System – Price List for Special Services** is a complete list of services and spare parts that is available from SenTec AG upon request ([info-eit@sentec.com](mailto:info-eit@sentec.com)).

[10] The **Instruction to update the LuMon™ Monitor software** provides instruction how to update the software. A PDF-copy of this document and instruction to download the software PDF-copy of this form is available from SenTec AG upon request ([info-eit@sentec.com](mailto:info-eit@sentec.com)).

### 1.3 Terminology

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For symbols used on devices labels and packaging, terminology and abbreviations used in this Service Manual refer to the User's Guide for the LuMon™ System [1].

SenTec EIT related terms are described in the User's Guide [1]. Notice that those terms being italicized and/or capitalized in section 'terminology' of the User's Guide [1] are italicized and/or Capitalized throughout the entire Service Manual.

### 1.4 Safety information

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A comprehensive list of warnings and cautions is provided in the User's Guide [1] section 'safety information'. Notes are provided in sections where applicable. Carefully read all safety information in the User's Guide [1] before operating the device or performing service/repairs.

2 SYSTEM OVERVIEW

2.1 LuMon™ System

The LuMon™ System comprises LuMon™ Monitors (2.1), belt connectors (2.3) to link SenTec’s textile EIT belts being available in various sizes to the LuMon™ Monitor, as well as SenTec’s contact agents serving as a medium for impedance coupling between a belt and the patient’s skin. Measuring tapes permit the user to determine the recommended belt size, i.e. the size of the belt best fitting the respective patient.

The LuMon™ System is available in two configurations

- (I) for adults and children illustrated in Table 2-1 with a family of belts supporting an underbust girth range of approximately 76 to 128 cm (abbreviated as LMS-A).
- (II) for neonates and infants illustrated in Table 2-2 with a family of belts supporting an underbust girth range of approximately 17 to 52 cm (abbreviated as LMS-N).

Table 2-1: LuMon™ System – Adults/Children configuration (I)

LuMon™ Monitor – Adult	SensorBeltConnector	SensorBelt	ContactAgent
			

Table 2-2: LuMon™ System – Neonates/Infants configuration (II)

LuMon™ Monitor – Neo	LuMon™ Connector	LuMon™ Belt	NeoContactAgent
			

## 2.2 LuMon™ Monitor

Figure 2-1: LuMon™ Monitor – front panel (here a LuMon™ Monitor – Adult)

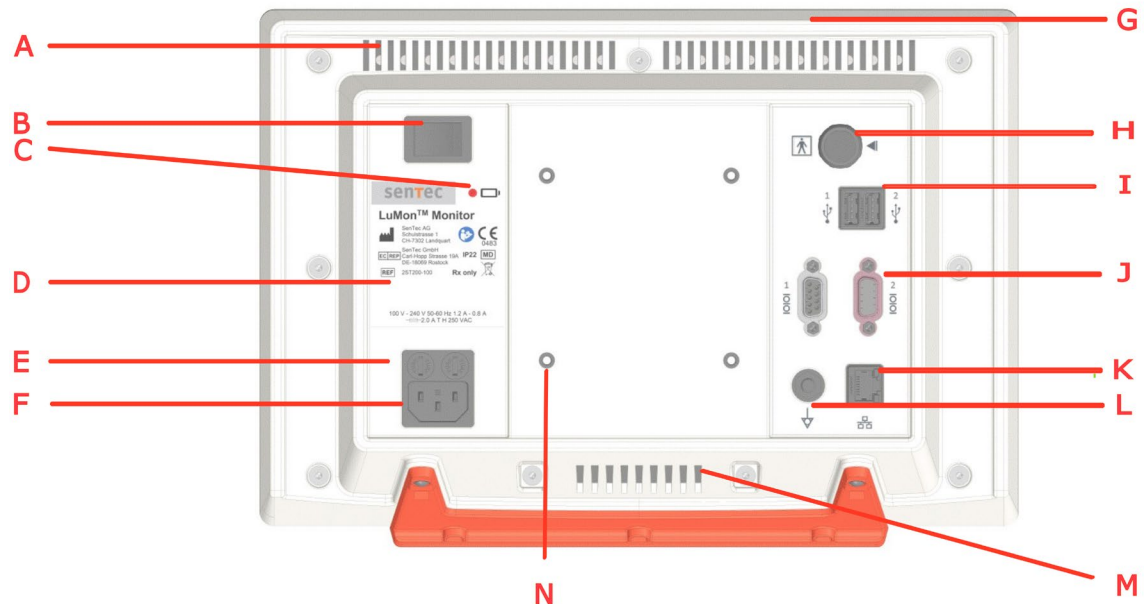


- A. Touch screen based Graphical User Interface – GUI
- B. Support foot indicating the LuMon™ Monitor's configuration:  
**LuMon™ ADULT** identifies the LuMon™ Monitor – Adult;  
**LuMon™ NEO** identifies the LuMon™ Monitor – Neo.

### NOTE

The LuMon™ Monitor performs a calibration of its touch screen after it is switched on. To not disturb the calibration of the touch screen, do not touch the screen the first few seconds after startup.

Figure 2-2: LuMon™ Monitor – rear panel



- A. Ventilation slot
- B. ON/OFF switch
- C. AC Power/Battery indicator
- D. Type label
- E. Fuse holders (2x)
- F. AC power inlet
- G. Integrated carrying handle
- H. Belt connector socket
- I. USB ports (2x) – only for use with memory devices without external power supply
- J. Serial ports (2x) – factory use only
- K. Ethernet port – factory use only
- L. Equipotentiality terminal connector
- M. Ventilation slot
- N. VESA 75 compatible mounting holes (4x)

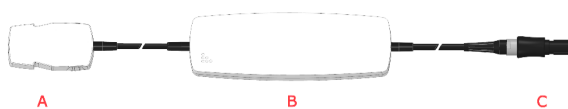
## 2.3 Belt connectors

The belt connectors are designed to link belts to LuMon™ Monitors. Belt connectors control the injection of very weak alternating currents into the patient's thorax and the measurement of the voltages (electrical potentials) resulting at the skin of the patient's thorax.

### 2.3.1 SensorBeltConnector

The SensorBeltConnector (Figure 2-3) links a SensorBelt to a LuMon™ Monitor – Adult. The position sensor embedded in its MatchBox permits the LuMon™ System to measure and display the patient's position (*rotation* and *inclination*). If the SensorBeltConnector is properly connected to a LuMon™ Monitor in on-state, the status indicator LED of its MatchBox continuously lights green if a SensorBelt is connected.

Figure 2-3: SensorBeltConnector



- A. MatchBox (includes a position sensor and a status indicator LED) – connects to SensorBelts
- B. ControlBox (with integrated electronics and status indicator LED)
- C. Monitor plug – connects to the belt connector socket on the LuMon™ Monitor

### 2.3.2 LuMon™ Connector

The LuMon™ Connector (Figure 2-4) links a LuMon™ Belt to a LuMon™ Monitor – Neo.

In contrast to the MatchBox of the SensorBeltConnector (2.3.1) the MatchBox of the LuMon™ Connector contains neither a position sensor nor a status indicator LED.

Figure 2-4: LuMon™ Connector



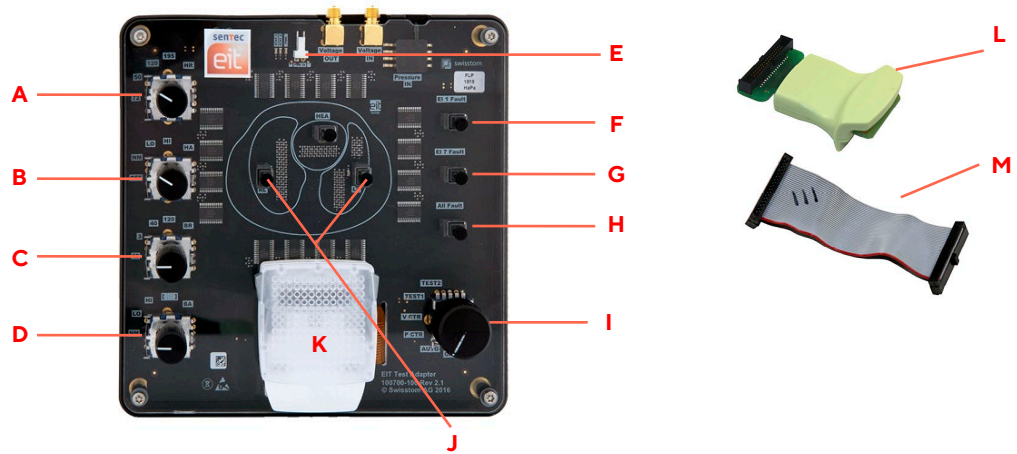
- A. LuMon™ MatchBox – connects to LuMon™ Belts
- B. ControlBox (with integrated electronics and status indicator LED)
- C. Monitor plug – connects to the belt connector socket on the LuMon™ Monitor



## 2.4 EIT Advanced Interface Set

Several tests require an EIT Advanced Interface Set.

Figure 2-5: EIT Advanced Interface Set



- A. HR control (HR – Heart Rate)
- B. HA control (HA – Heart Amplitude)
- C. BR control (BR – Breath Rate)
- D. BA control (BA – Breath Amplitude)
- E. Voltage in: Connection for external AC/DC Power Supply
- F. EIT 1 Fault
- G. EIT 7 Fault
- H. Too many failing electrodes – SensorBeltConnector only
- I. Modes Switch
- J. Manual breathing control (RL – Right lung / LL – Left lung)
- K. Matchbox for SensorBeltConnector

### Use with LuMon™ Connector only:

- L. LuMon™ EIT Advanced Interface Adapter
  - M. Ribbon Cable Medium (10 cm)
- AC-Adapter 12V (for EIT Advanced Interface)

### 3 MAINTENANCE/SAFETY AND FUNCTIONALITY TESTS

At normal use there is no internal adjustment or calibration of the LuMon™ System required. However, to guarantee continuous performance, reliability and safety of the LuMon™ System, 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 and instructions for cleaning and/or disinfecting the LuMon™ Monitor and the belt connectors, are provided in the User's Guide for the LuMon™ System [1].

It is recommended that qualified service personnel performs the maintenance and a complete safety and functionality tests as specified in this manual at regular intervals (recommended every 12 months but at least every 24 months). Use the Protocol for Safety and Functionality Test (9) to guide you through the complete safety and functionality tests and to document your test results. To perform a complete safety and functionality test all tests described in this chapter MUST be performed.



#### NOTE

If safety or functionality test fail, the respective problem must be fixed before the equipment is returned to the user.



#### NOTE

Prior to maintenance, service or repair all components of the LuMon™ System must be cleaned and disinfected. More details can be found in section 'cleaning and disinfection' of the User's Guide for the LuMon™ System [1].



#### NOTE

If equipment is sent to a *SenTec Authorized LuMon™ Technician*, local SenTec representative or SenTec AG please refer to section 'instructions for repackaging and shipping' of the User's Guide [1].

A complete 'Certificate of Disinfection' [6] and, if applicable, the 'Repair or Investigation Request Form' [7] must be provided.

#### 3.1 Belt connector

##### 3.1.1 Cleaning and Disinfection

For cleaning and disinfection procedures for the SensorBeltConnector and the LuMon™ Connector refer to section 'cleaning and disinfection' of the User's Guide [1].

##### 3.1.2 Visual Inspection

Visually inspect the belt connector body, cable and plug for damage.



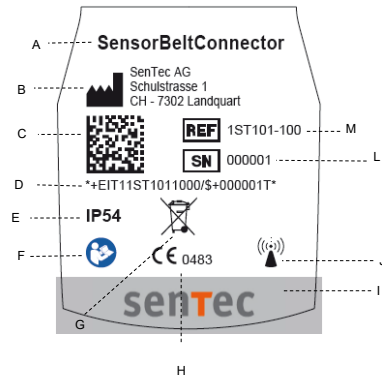
#### NOTE

If any of the components of the belt connector is damaged, replace the belt connector with a new LuMon™ Connector or SensorBeltConnector (8.1).

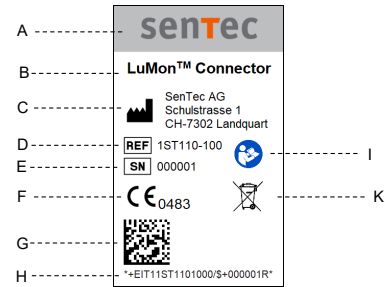
### 3.1.3 Labeling

Check presence/legibility of the label on the belt connectors.

The type label can be found on the MatchBox part of the belt connectors (2.3). Example labels are shown below.



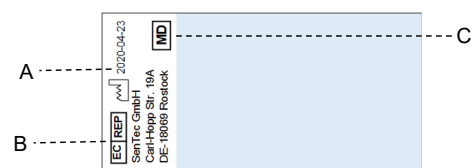
- A. Product name
- B. Manufacturer symbol and address
- C. UDI data matrix code
- D. UDI human readable
- E. IP (ingress protection class) code
- F. Follow instruction for use
- G. Dispose of according to Council Directive 2012/19/EU symbol
- H. CE ("Conformité Européenne") label and notified body number
- I. SenTec logo
- J. Radio frequency symbol
- K. -
- L. Serial number symbol and number
- M. Reference symbol and number



- A. SenTec logo
- B. Product name
- C. Manufacturer symbol and address
- D. Reference symbol and number
- E. Serial number symbol and number
- F. CE ("Conformité Européenne") label and notified body number
- G. UDI data matrix code
- H. UDI human readable
- I. Follow instruction for use
- J. -
- K. Dispose of according to Council Directive 2012/19/EU symbol

The EU Authorized Representative (EC REP) label can be found on the cable close to the Redel connector (Figure 2-2)

Figure 2-2)



- A. Symbol for manufacturing date and manufacturing date
- B. Symbol for EC Representative and the address
- C. Medical device symbol

#### NOTE:

If the label is not present/legible then contact *SenTec Authorized LuMon™ Technicians*.

### 3.1.4 Status indicator LEDs - SensorBeltConnector

Connect the SensorBeltConnector to the LuMon™ Monitor and switch on the monitor. During the power-up verify, that the Status LEDs in the ControlBox and MatchBox show the following sequence: MatchBox (Figure 2-3) LED blue → ControlBox LED green → MatchBox LED red flashing → all LEDs off.

#### NOTE

Any deviation from this sequence – e.g. ControlBox LED lighting up blue or flashing red or MatchBox LED flashing blue – indicates that the SensorBeltConnector is defective and must be replaced (8.1).

### 3.1.5 Status indicator LEDs – LuMon™ Connector

Connect the LuMon™ Connector to the LuMon™ Monitor and switch on the monitor. During the power-up verify that the Status LED in the ControlBox lights up green → LED off.

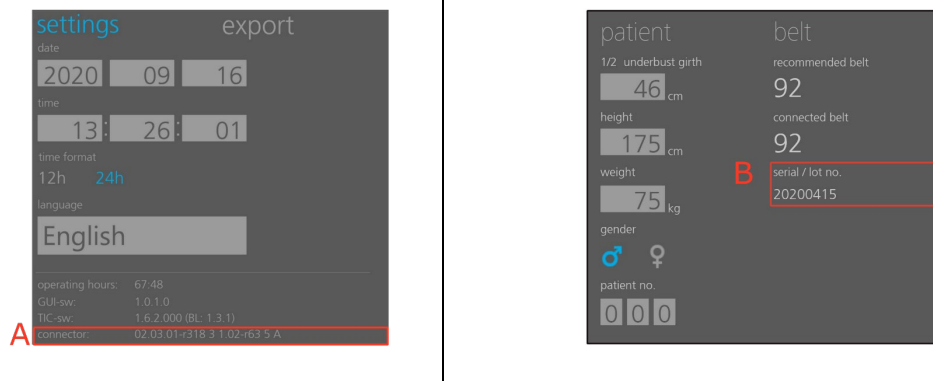
#### NOTE

Any deviation from this sequence – e.g. ControlBox LED lighting up blue or flashing red – indicates that the LuMon™ Connector is defective and must be replaced (8.1).

### 3.1.6 Function Test – SensorBeltConnector

1. Connect the SensorBeltConnector to the LuMon™ Monitor and verify that the hardware and software version of the belt connector (A/ Figure 3-1) is displayed correctly in the 'system settings' area of ScoutView [1]: 02.01.07-r288 4.1.02-r63 6. **The numbers may vary but all numbers shall be present.**
2. Connect the SensorBeltConnector to the EIT Advanced Interface (2.4). The indicator LED in the MatchBox shall light up green indicating that the belt detection works properly. Verify that the 'serial / lot no.' (B/ Figure 3-1) on 'patient & belt' area on ScoutView [1] is displayed: e.g. 'ETAV50200311-000129', numbers may vary.
3. Rotate the EIT Advanced Interface left or right and verify on ScoutView that the displayed rotation changes accordingly.

Figure 3-1: Function Test – Belt connector



### 3.1.7 Function Test – LuMon™ Connector

1. Connect the LuMon™ Connector to the LuMon™ Monitor and verify that the hardware and software version of the belt connector (A/ Figure 3-1) is displayed correctly in the 'system settings' area of ScoutView [1]: 02.03.03-r335 4 3.15-r83 13. **The numbers may vary but all numbers shall be present.**
2. Connect the LuMon™ Connector to the EIT Advanced Interface using the LuMon™ Advanced Interface Adapter, the ribbon cable and the AC-Adapter (2.4). Verify that the 'serial / lot no.' (B/ Figure 3-1) on 'patient & belt' area on ScoutView [1] is displayed: e.g. 'ETAV50200311-000129', numbers may vary).
3. Rotate the MatchBox part of the belt connector – LuMon™ Advanced Interface Adapter – left or right and verify on ScoutView that the displayed rotation changes accordingly.

## 3.2 LuMon™ Monitor

### 3.2.1 Cleaning and Disinfection

For cleaning and disinfection procedures for the LuMon™ Monitor refer to section 'cleaning and disinfection' of the User's Guide [1].

### 3.2.2 Visual Inspection

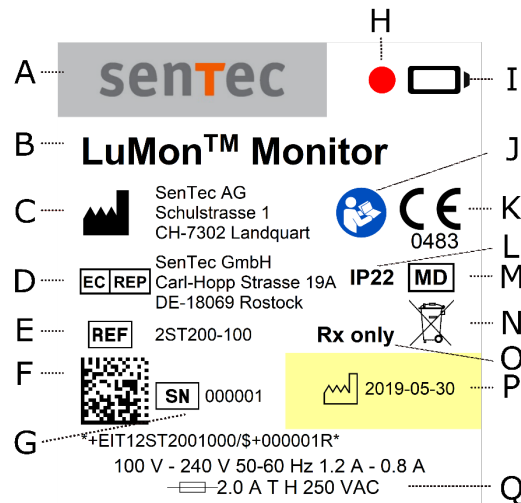
Visually check the entire LuMon™ Monitor for possible damages.

**NOTE**  
If you detect damage, the LuMon™ Monitor needs to be repaired. Contact *SenTec Authorized LuMon™ Technicians*.

### 3.2.3 Labeling

Check presence/legibility of the label on the rear panel (Figure 2-2): Labels of all ports, connectors and ON/OFF switch and the marking plate. Example labels are shown below.

Figure 3-2: Labeling – LuMon™ Monitor



- |  |  |
|--|--|
| A. SenTec logo                             | K. CE ('Conformité Européenne') label and notified body number |
| B. Product name                            | L. IP (ingress protection class) code                          |
| C. Manufacturer symbol and address         | M. Dispose of according to Council Directive 2012/19/EU        |
| D. EU Authorized Representative            | N. Medical Device symbol                                       |
| E. Reference symbol and number             | O. Prescription Device   |
| F. UDI data matrix code and human readable | P. Date of manufacture symbol and manufacturing date           |
| G. Serial number symbol and number         | Q. Power inlet information                                     |
| H. Cut out (window for battery status LED) |  |
| I. Battery symbol                          |  |
| J. Follow instructions for use             |  |

**NOTE**  
If the label is not present/legible then contact *SenTec Authorized LuMon™ Technicians*.

### 3.2.4 Electrical Safety Check

The LuMon™ System has been designed to comply with the IEC 60601-1 standard:

- Safety approvals and applied part BF: IEC 60601-1 (3<sup>rd</sup> edition)
- Electromagnetic compatibility (EMC): IEC 60601-1-2 (4<sup>th</sup> edition)

To ensure electrical safety of the equipment it is recommended that qualified service personnel performs the electrical safety check once a year (but every two years the latest) and after repair.

The electrical safety check for the LuMon™ System must be performed in accordance with the **IEC 62353:2014** standards for medical electrical equipment classified as Class 1 and Applied Part Type BF.

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.



#### NOTE

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

- The LuMon™ Monitor 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 62353 (e.g. Rigel 288, Fluke ESA615 or Gossen Metrawatt Secutest)



#### NOTE

If the required equipment is not available, send the LuMon™ Monitor to a *SenTec Authorized LuMon™ Technician*, your local SenTec representative or SenTec AG for testing.



#### NOTE

If equipment is sent to a *SenTec Authorized LuMon™ Technician*, your local SenTec representative or SenTec AG please refer to section 'instructions for repackaging and shipping' of the User's Guide for the LuMon™ System [1].

A complete 'Certificate of Disinfection' [6] and, if applicable, the 'Repair or Investigation Request Form' [7] must be provided.



#### NOTE

Prior to maintenance, service or repair, all components of the LuMon™ System must be cleaned and disinfected. More details can be found in section 'cleaning and disinfection' of the User's Guide for the LuMon™ System [1].



#### NOTE

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



#### NOTE

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



#### NOTE

If safety or functionality test fails, the respective problem must be fixed before the equipment is returned to the user.

The belt and the belt connector are an applied part of Type BF. The interface ports of the LuMon™ Monitor are isolated with 2 MOPP to the belt connector socket and 1 MOPP to the mains input. There is no isolation between the individual interface ports.

The electrical safety check is performed according to IEC 62353. The following connections must be tested:

- Protective Earth Resistance Test: Earth wire of the AC power cord, Equipotentiality terminal connector (ground). The resistance between two of these must be **less than 0.3 Ω**.
- Earth Leakage Current: The current must be **below 5'000 µA (normal condition) / 10'000 µA (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 µA (normal condition) / 500 µA (single fault condition)** see IEC 60601-1 Figure 15.

- Patient Leakage Current caused by an external voltage on the Patient Connection (Type BF). The current must be **below 5000  $\mu$ A** see IEC 60601-1 Figure 16.
- Insulation Resistance Test: L, N of AC power inlet – housing (equipotentiality terminal). The resistance must be **more than 2 M $\Omega$  @500V DC**.
- Patient Insulation Resistance: Belt connector socket (insulation test cable) – housing (equipotentiality terminal). The resistance must be **more than 2 M $\Omega$  @500V DC**.

Figure 3-3: Connections for safety test, protective earth resistance and leakage current

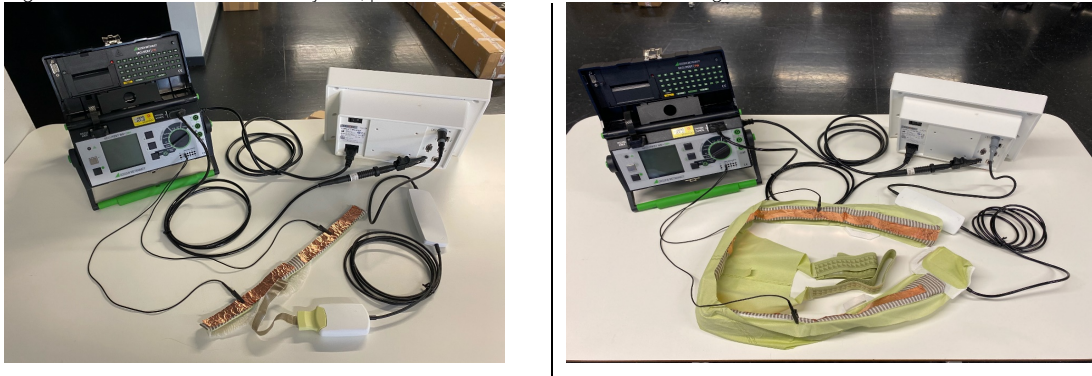
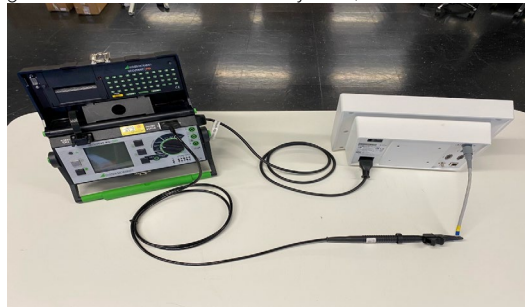


Figure 3-4: Connections for safety tests, insulation resistance



**NOTE**

If the above described tests do not meet the corresponding acceptance criteria, the LuMon™ Monitor needs to be repaired. Refer to section 4.2.4 to further evaluate the problem.

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

**NOTE**

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 (8.1).

### 3.2.5 Touchscreen

Switch on the LuMon™ Monitor and wait until the default ScoutView is displayed.

1. Press the button 'system settings' to enter 'system settings' area and press it again to return to 'patient & belt' area.
2. In 'patient & belt' area press 'weight' and select a different setting and press 'OK'.
3. Enter LuFuView, press 'trend' and move the 'T1' and 'T2' flags to different positions.
4. Enter VentView 'trend' and check if 'T1' and 'T2' flags are as set in LuFuView.

**NOTE**

The LuMon™ Monitor performs a calibration of its touch screen after it is switched on. To not disturb the calibration of the touch screen, do not touch the screen the first few seconds after startup.

**NOTE**

If the above described functions do not operate properly contact a *SenTec Authorized LuMon™ Technician*, your local SenTec EIT representative or SenTec AG.

**NOTE**

If you need to return devices for service or repair follow the shipment instructions in the User's Guide [1] section 'instructions for shipment'.

**NOTE**

Send defective parts together with the completed "Repair or Investigation Request Form" [7] to a *SenTec Authorized LuMon™ Technician*, your local SenTec EIT representative or SenTec AG.

### 3.2.6 Clock settings

Verify that the clock settings are correct. If necessary, adjust date and time in the 'system settings' area of ScoutView. Refer to User's Guide [1] section 'ScoutView'. Power cycle the LuMon™ Monitor and check date and time.

**NOTE**

If the above described functions do not operate properly refer to section 4.2.4 to further evaluate the problem.

### 3.2.7 Display and AC Power/Battery indicator

Check LED of 'AC Power/Battery indicator' (Figure 2-2) and the display for defects:

1. Connect the LuMon™ Monitor to AC power. Switch the LuMon™ Monitor OFF and ON again: The 'AC Power/Battery indicator' LED lights up yellow (battery charging) or green (battery full).
2. Enter VentView and check the readability of the following critical areas: 'AC Power/Battery' icon on status bar, *Plethysmogram* and *Global Dynamic Image*, RRI numerical display.

**NOTE**

If the above described functions do not operate properly, the LuMon™ Monitor needs to be repaired. Refer to section 4.2.4 to further evaluate the problem.

### 3.2.8 Fan

The fan should briefly activate during Power-on Self-test. The fan should rotate freely and without causing unusual noises.

**NOTE**

If the above described functions do not operate properly, the LuMon™ Monitor needs to be repaired. Refer to section 4.2.4 to further evaluate the problem.

### 3.2.9 Capacity of rechargeable Lithium Ion battery

1. Connect the LuMon™ Monitor to AC power and wait until the battery is completely charged. Verify: 'AC Power/Battery indicator' on the rear panel of the LuMon™ Monitor (Figure 2-2) lights up green.
2. Connect the EIT Advanced Interface to the LuMon™ Monitor via a belt connector (2.4).
3. Disconnect the LuMon™ Monitor from AC power and press the 'event' button [1].
4. Wait until the LuMon™ Monitor fully depletes its battery and shuts down automatically.
5. Connect the LuMon™ Monitor to AC power and wait until it starts up automatically again.
6. Connect a USB memory device to the LuMon™ Monitor, wait for a couple of seconds and then disconnect it.
7. Connect the USB memory device to a PC. Locate and extract the contents of the file 'eitMonitorLog.zip'
8. Open the 'eitMonitor.log' file with a text viewer (e.g. notepad.exe).
9. Locate the last entry corresponding to the 'event': "[StorageMediator] User pressed Event" and note down the corresponding time stamp of this event as Time1.



10. Scroll to the end of the file, and locate the following entry: "[App] \*\*\*\*\* EIT MONITOR STARTING UP... \*\*\*\*\*"
11. Scroll up to locate the last entry of the log file and note down the corresponding time stamp of this entry as Time2.
12. Scroll further up and locate the following entry: "[HardwareMediator] ++ Hardware Info. Battery %: 100.00 Battery QCount: 16235 ..." and note down the value for QCount.

Time1 corresponds to the time when the battery was full and Time2 corresponds to the time when the battery was empty leading to the shutdown. The run-time of the battery can be computed as the difference between Time2 - Time1.

The quality of the rechargeable Lithium Ion battery is **still acceptable if the LuMon™ Monitor runs for at least 1 hour** before the battery management switches off the monitor automatically or the last entry of the QCount value is less than 26000 or the built in battery not older than 5 years (see the manufacturing date on the rear panel of the LuMon™ Monitor (Figure 2-2, 3.2.3).

**NOTE**

If the above described requirements are not met, the LuMon™ Monitor needs to be repaired. Refer to section 4.2.4 to further evaluate the problem.

## 4 TROUBLESHOOTING

This section describes problems, possible causes and recommended corrective actions. Repairs (without having to open the housing of the LuMon™ Monitor) are described in section 5. Repairs that require opening the housing of the LuMon™ Monitor are to be performed by *SenTec Authorized LuMon™ Technicians* only and are described in details within the Repair Manual for the LuMon™ Monitor [3].

**NOTE**  
Prior to maintenance, service or repairs all components of the LuMon™ System must be cleaned and disinfected. If equipment is sent to a *SenTec Authorized LuMon™ Technician*, your local SenTec EIT representative or SenTec AG a completed 'Certificate for Disinfection' [6] must be attached.

**NOTE**  
If you need to return devices for service or repair follow the shipment instructions in the User's Guide [1] section 'instructions for shipment'. RGA – Return Good Authorization – number is available from SenTec AG upon request.

**NOTE**  
Send defective parts together with the completed 'Repair or Investigation Request Form' [7] to a *SenTec Authorized LuMon™ Technician*, your local SenTec EIT representative or SenTec AG.

### 4.1 How to use the troubleshooting list

The troubleshooting list describes problems, possible causes and recommended actions for troubleshooting of the system. The problems are numbered (EITXXXX) unambiguously. Please reference the respective EITXXXX code whenever applicable.

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

#### 4.1.1 Levels of recommended actions

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

- A. by the operator (shaded in dark grey) and, if the problem persists,
- B. by a qualified technician (shaded in light grey), i.e. troubleshooting at service level (according to this manual) and, if the problem persists,
- C. by *SenTec Authorized LuMon™ Technicians* only (no shading), i.e. troubleshooting at repair level (according to the Repair Manual [3]).


#### 4.1.2 Abbreviations used in this section


In this sub-section the abbreviations used in this section are described. For a detailed list of abbreviations refer to the User's Guide for the LuMon™ System [1].

SB	SensorBelt	Belts
LMB	LuMon™ Belt	
SBC	SensorBeltConnector	Belt connectors
LMC	LuMon™ Connector	
LMM	LuMon™ Monitor	Monitor

## 4.2 Troubleshooting list

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


	<b>NOTE</b> Concerning equipment, accessories, disposable and parts refer to section 'warnings and cautions' of the User's Guide for the LuMon™ System [1].
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	<b>NOTE</b> Shadings in the troubleshooting table reflect different levels of recommended actions, i.e. for the operator (dark grey), qualified technicians (light grey) and <i>SenTec Authorized LuMon™ Technicians</i> (no shading), see 4.1 for details.
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### 4.2.1 Troubleshooting EIT monitoring

If you suspect a problem with any individual measurement, read the User's Guide for the LuMon™ System [1] and double-check that you or the operator have set up the system correctly. In particular, verify proper setup and adequacy of the selected *Analysis Mode*. To resolve the problem(s) that may be associated with a displayed status message, refer to section 'status messages' of the User's Guide for the LuMon™ System [1].

Table 4-1: Troubleshooting EIT monitoring

Problem	Possible cause(s)	Recommended action(s)
EIT0100 Inclination displayed on GUI— inclination status icon AND inclination image – does not suit patient's inclination	DockingStation of SB not parallel to sternum of the patient. Position sensor is placed in the Matchbox of the SBC.	Verify belt positioning and a snug fit of the belt on the skin [1] section 'checking the proper setup'. Consider to adjust the routing of the SBC-cable or the DockingStation.
	Position sensor placed behind the 'bear' in the LMB not parallel to sternum of the patient.	Verify belt positioning and a snug fit of the belt on the skin [1] section 'checking the proper setup'. Consider to adjust the LuMon™ Belt to align the 'bear' with the sternum of the patient. In such case the belt displacement needs to be measured and entered to patient data on monitor, again.
EIT0101 Rotation displayed on GUI – Belt-connection/ Skin-contact/ Rotation status icon AND all images – does not suit patient's rotation.	DockingStation of SB not parallel to sternum of the patient. Position sensor placed in the Matchbox of the SBC.	Verify belt positioning and a snug fit of the belt on the skin [1] section 'checking the proper setup'. Consider to adjust the routing of the SBC-cable or the DockingStation.
	Position sensor placed behind the 'bear' in the LMB not placed close to the midline of the patient.	Verify belt positioning and a snug fit of the belt on the skin [1] section 'checking the proper setup'. Consider to adjust the LuMon™ Belt, positioning the 'bear' on the sternum. In such case the belt displacement needs to be measured and entered to patient data on monitor, again.
EIT0102 Status icon 'Belt Time' displays 'belt time elapsed'	SB/LMB has been used for longer than the factory-preset duration a belt can be used.	Remove and dispose of the old belt and obtain a new belt of the same size to continue monitoring for the same patient.
EIT0103 Global Dynamic Image and Plethysmogram fluttering (Plethysmogram full of irregular spikes).	Interference from other devices (e.g. patient monitors, high-frequency surgical equipment or devices emitting strong electromagnetic fields).	In case of interferences from other devices – e.g. respiratory rate measurement through ECG electrodes – try to place the electrodes of the device as far from the belt as possible.
		 <b>Note:</b> Concerning interferences with or from other devices refer to section 'warnings and cautions' of the User's Guide for the LuMon™ System [1]. If the interference cannot be eliminated Contact a <i>SenTec Authorized LuMon™ Technician</i> , your local SenTec EIT representative or SenTec AG.
EIT0104 Indices not reflecting patient situation - over or underestimated	Belt applied too far caudally. If applied too far caudally the measurements may be influenced by the diaphragm.	Verify belt positioning and a snug fit of the belt on the skin [1] section 'checking the proper setup'. Consider to adjust the belt.
	Belt applied too far cranially.	
EIT0105 Global Dynamic image is not inside the Lung ROIs.	Patient and/or belt parameter not set properly. Thorax and Lung ROIs models do not correspond to the patient constitution and consequently causing either over- or underestimated measurements.	If necessary, adjust the respective entries in the 'patient & belt' area of ScoutView. Enter actual (not lean or ideal) body weight [1] section 'belt application and initiating monitoring'.
EIT0106 LuFuView's indices and images not visible	BB <i>Analysis Mode</i> selected and breaths not detected.	Verify the adequacy of the selected <i>Analysis Mode</i> [1] section 'checking the adequacy of the selected Analysis Mode'. Consider to change <i>Analysis Mode</i> .
	Black vertical lines displaying the end of expiration and the end of inspiration are not visible on <i>Plethysmogram</i> .	

Problem	Possible cause(s)	Recommended action(s)
	Impedance change is too small.  Black vertical lines displaying the <i>Analysis Interval</i> are not visible on <i>Plethysmogram</i> .	
EIT0107 LuFuView's 'silent spaces' and 'stretch' areas not accessible	TB-II <i>Analysis Mode</i> selected.  LuFuView's 'silent spaces' and 'stretch' areas not accessible when TB-II <i>Analysis Mode</i> is selected.	Verify the adequacy of the selected <i>Analysis Mode</i> [1] section 'checking the adequacy of the selected <i>Analysis Mode</i> '. Consider to change <i>Analysis Mode</i> .
EIT0108 LuFuView's indices and images are not stable	Patient is breathing irregularly.	Verify the adequacy of the selected <i>Analysis Mode</i> [1] section 'checking the adequacy of the selected <i>Analysis Mode</i> '. Consider to change <i>Analysis Mode</i> .
EIT0109 Respiratory Rate not visible	Patient is breathing irregularly or the breath amplitude is too small.	-
EIT0110 EELi/ EILI trend not visible or only partly visible	BB <i>Analysis Mode</i> selected and breaths not detected.  Black vertical lines displaying the end of expiration and the end of inspiration are not visible on <i>Plethysmogram</i> .  Impedance change is too small.  Black vertical lines displaying the <i>Analysis Interval</i> are not visible on <i>Plethysmogram</i> .	Verify the adequacy of the selected <i>Analysis Mode</i> [1] section 'checking the adequacy of the selected <i>Analysis Mode</i> '. Consider to change <i>Analysis Mode</i> .
EIT0111 Aeration not visible	Aeration is visible in TB-II <i>Analysis Mode</i> only.	Enter ScoutView and select TB-II <i>Analysis Mode</i> [1] section 'ScoutView'.

## 4.2.2 Belt-specific troubleshooting

Table 4-2: Belt-specific troubleshooting

Problem	Possible cause(s)	Recommended action(s)
EIT0200 Despite a belt is connected to SBC/LMC and LMM the status message 'connect belt' is displayed.	Bad contact (SBC/LMC not properly connected)	Verify connections (disconnect and reconnect belt connector) and – if necessary – power cycle the monitor.
	SB/LMB defective	To identify the defective part, exchange the belt connector and try again – if necessary, permute and try on a different monitor. In case of damage of the belt replace it (8).
	SBC/LMC defective	In case of damage of the belt connector replace it.
	LMM defective	Refer to 4.2.3 to further evaluate the problem.
EIT0201 MatchBox part of the SBC cannot be inserted into the DockingStation of the SB.	SB defective	In case of damage of the belt replace it (8).
EIT0202 Status message 'belt fault'	SB/LMB defective	To identify the defective part, exchange the belt connector and try again – if necessary, permute and try on a different monitor. In case of damage of the belt replace it (8).
EIT0203 Status message 'insufficient skin contact'	Incorrect positioning of the SB/LMB on the skin	If necessary, adjust the belt and tighten it fit. If tightening the fit of the belt, ensure not to restrict breathing. See User's Guide [1] section 'Belt application and initiating monitoring'.
	Contact medium is not applied or incorrectly applied	Apply contact medium to the belt striped fabric on the patient-facing side. Repeat the spraying until the striped fabric is wetted evenly and entirely. See User's Guide [1] section 'Belt application and initiating monitoring'.
	SB/LMB defective	To identify the defective part, exchange the belt connector and try again – if necessary, permute and try on a different monitor. In case of damage of the belt replace it (8).

### 4.2.3 Belt connector-specific troubleshooting

Table 4-3: Belt connector-specific troubleshooting

Problem	Possible cause(s)	Recommended action(s)
EIT0300 Despite an SBC/LMC is connected to the LMM the message 'connect connector' is displayed	Bad contact (SBC/LMC not properly connected)	Verify connections (disconnect and reconnect the belt connector) and – if necessary – power cycle the monitor
	SBC/LMC defective	In case of damage of the belt connector replace it (8).
	LMM defective	Refer to 4.2.4 to further evaluate the problem.
EIT0301 SBC's MatchBox status indicator LED continuously flashed blue or red OR SBC/LMC's ControlBox status indicator LED continuously blinks blue or red	SBC/LMC defective	In case of damage of the belt connector replace it (8).
EIT0302 Message 'connector fault'	Bad contact (SBC/LMC) not properly connected)	Verify connections (disconnect and reconnect belt connector) and – if necessary – power cycle the monitor.
	SBC/LMC defective	In case of damage of the belt connector replace it (8).
	LMM defective	Contact <i>SenTec Authorized LuMon™ Technicians</i> .

### 4.2.4 LuMon™ Monitor-specific troubleshooting

Table 4-4: LuMon™ Monitor-specific troubleshooting

Problem	Possible cause(s)	Recommended action(s)
EIT0400 Monitor not operational, AC Power/Battery indicator on the rear panel of the monitor not illuminated	LMM switched off	Switch on the monitor
	LMM not connected to mains and battery depleted	Connect the monitor to the mains. Allow battery to charge.
	Mains power supply defective	Choose another mains power supply for connecting the monitor
	Main fuses defective	Replace main fuses according to 5.
	LMM defective	Contact <i>SenTec Authorized LuMon™ Technicians</i> .
	AC/DC Power Supply not connected	Connect AC/DC Power Supply according to the Repair Manual [3]. ⚠ To be performed by <i>SenTec Authorized LuMon™ technicians only</i> .
	AC/DC Power Supply defective	Replace AC/DC Power Supply according to the Repair Manual [3]. ⚠ To be performed by <i>SenTec Authorized LuMon™ technicians only</i> .
EIT0401 Display is dark, AC Power/Battery indicator on the rear part of the monitor (green/yellow LED) is illuminated.	LMM switched off	Switch on LMM.
	LMM defective	Contact <i>SenTec Authorized LuMon™ Technicians</i> .
	Power ON/OFF Switch not connected	Connect Power ON/OFF Switch according to the Repair Manual [3]. ⚠ To be performed by <i>SenTec Authorized LuMon™ technicians only</i> .
	Power ON/OFF Switch defective	Replace Power ON/OFF Switch according to the Repair Manual [3]. ⚠ To be performed by <i>SenTec Authorized LuMon™ technicians only</i> .
EIT0402 Fully charged battery is discharged after less than 1 h	Battery defective	Contact <i>SenTec Authorized LuMon™ Technicians</i> .
	LMM defective	Contact <i>SenTec Authorized LuMon™ Technicians</i> .
	Insufficient capacity of the rechargeable Lithium Ion battery	Replace rechargeable Lithium Ion battery according to the Repair Manual [3]. ⚠ To be performed by <i>SenTec Authorized LuMon™ technicians only</i> .
	Rechargeable Lithium Ion battery defective	Replace rechargeable Lithium Ion battery according to the Repair Manual [3]. ⚠ To be performed by <i>SenTec Authorized LuMon™ technicians only</i> .
	Display module defective	Replace Display Module according to the Repair Manual [3]. ⚠ To be performed by <i>SenTec Authorized LuMon™ technicians only</i> .
EIT0403 AC Power/Battery status icon displays an unknown battery	Battery completely depleted since the last charge	Connect the monitor to the mains. Allow battery to charge for at least 6 hours. If problem persists contact <i>SenTec Authorized LuMon™ Technicians</i> .

Problem	Possible cause(s)	Recommended action(s)
status.	Battery defective	Contact <i>SenTec Authorized LuMon™ Technicians</i> .
	LMM defective	Contact <i>SenTec Authorized LuMon™ Technicians</i> .
EIT0404 Display is dark, AC Power/Battery indicator on the rear part of the monitor (green/yellow LED) illuminated OR Display is not readable (dark)	LMM defective	Switch the LMM off and on again. If problem persists contact <i>SenTec Authorized LuMon™ Technicians</i> .
	LMM defective	Contact <i>SenTec Authorized LuMon™ Technicians</i> .
	Display Module not connected	Connect Display Module according to Repair Manual [3]. ⚠ To be performed by <i>SenTec Authorized LuMon™ technicians</i> only.
	Display Module defective	Replace Display Module according to the Repair Manual [3]. ⚠ To be performed by <i>SenTec Authorized LuMon™ technicians</i> only.
EIT0405 LMM stuck at start screen	Power on start failed	Switch the monitor off and on again. If problem persists contact <i>SenTec Authorized LuMon™ Technicians</i> .
	LMM defective	Contact <i>SenTec Authorized LuMon™ Technicians</i> .
EIT0406 LMM does not react if any button is pressed	LMM software is not responding	Switch the monitor off and on again. If problem persists contact <i>SenTec Authorized LuMon™ Technicians</i> .
	LMM defective	Contact <i>SenTec Authorized LuMon™ Technicians</i> .
	Touch controller not connected	Connect Touch Controller according to the Repair Manual [3]. ⚠ To be performed by <i>SenTec Authorized LuMon™ technicians</i> only.
	Touch controller defective	Replace Touch controller according to the Repair Manual [3]. ⚠ To be performed by <i>SenTec Authorized LuMon™ technicians</i> only.
EIT0407 Wrong time displayed	Date/time are not synchronized to institution's date and time.	Enter ScoutView system setting's area – User's Guide [1] section ScoutView and set date and time.
	Internal watch/clock battery is low	Contact <i>SenTec Authorized LuMon™ Technicians</i> .
	LMM defective	Contact <i>SenTec Authorized LuMon™ Technicians</i> .
	Internal battery on LM-MIO low	Replace internal battery on LM-MIO according to the Repair Manual [3]. ⚠ To be performed by <i>SenTec Authorized LuMon™ technicians</i> only.
	LM-MIO (PC Board) defective	Replace LM-MIO according to the Repair Manual [3]. ⚠ To be performed by <i>SenTec Authorized LuMon™ technicians</i> only.
EIT0408 Fan is noisy	Fan defective or polluted	Disconnect monitor from AC mains power wait until fan operation stops, then clean ventilation slots.
	LMM defective	Contact <i>SenTec Authorized LuMon™ Technicians</i> .
	Fan polluted	Clean case and fan according to the Repair Manual [3]. ⚠ To be performed by <i>SenTec Authorized LuMon™ technicians</i> only.
	Fan defective	Replace fan according to the Repair Manual [3]. ⚠ To be performed by <i>SenTec Authorized LuMon™ technicians</i> only.
EIT0409 Fan is blocked	Fan defective or polluted	The fan must be able to rotate freely. Check ventilation slots if something is blocking the fan.
	LMM defective	Contact <i>SenTec Authorized LuMon™ Technicians</i> .
	Fan not connected	Connect fan according to the Repair Manual [3]. ⚠ To be performed by <i>SenTec Authorized LuMon™ technicians</i> only.
	Fan polluted	Clean case and fan according to the Repair Manual [3]. ⚠ To be performed by <i>SenTec Authorized LuMon™ technicians</i> only.
	Fan defective	Replace fan according to the Repair Manual [3]. ⚠ To be performed by <i>SenTec Authorized LuMon™ technicians</i> only.
	LM-MIO Board defective	Replace LM-MIO according to the Repair Manual [3]. ⚠ To be performed by <i>SenTec Authorized LuMon™ technicians</i> only.
EIT0410 It is not possible to connect the AC power cord to the LMM AC power inlet	AC power cord is defective	Replace the AC power cord.
	Power entry module defective	Contact <i>SenTec Authorized LuMon™ Technicians</i> .
	LMM defective	Contact <i>SenTec Authorized LuMon™ Technicians</i> .
	AC power inlet defective	Replace AC Power Connector according to the Repair Manual [3]. ⚠ To be performed by <i>SenTec Authorized LuMon™ technicians</i> only.
EIT0411	LMM defective	Contact <i>SenTec Authorized LuMon™ Technicians</i> .

Problem	Possible cause(s)	Recommended action(s)
Electrical Safety Check is not passed	Protective earth resistance is more than 0.3Ω	Control the protective earth wiring between the AC power connector and the equipotential terminal according to the Repair Manual [3]. ⚠ To be performed by <i>SenTec Authorized LuMon™ technicians</i> only.
	Protective earth wiring defective	If problem persists, replace protective earth according to the Repair Manual [3]. ⚠ To be performed by <i>SenTec Authorized LuMon™ technicians</i> only.
	Leakage current too high	Replace TIC Module or the AC/DC power supply according to the Repair Manual [3]. ⚠ To be performed by <i>SenTec Authorized LuMon™ technicians</i> only.
EIT0412 Despite an SBC/LMC is connected to the LMM the message 'Connect connector' displays	TIC Module not connected	Connect TIC Module according to the Repair Manual [3]. ⚠ To be performed by <i>SenTec Authorized LuMon™ technicians</i> only.
	TIC Module defective	Replace TIC Module according to the Repair Manual [3]. ⚠ To be performed by <i>SenTec Authorized LuMon™ technicians</i> only.
EIT0413 Message 'Tech Error 0001'	Invalid measurements due to excessive patient movement or insufficient skin contact	If the message is displayed intermittently, than verify belt positioning and a snug fit of the belt on the skin [1] section 'checking the proper setup'.
	SB/LMB defective	To identify the defective part, exchange the belt connector and try again – if necessary, permute and try on a different monitor. In case of damage of the belt replace it (8).
	SBC/LMC defective	To identify the defective part, exchange the belt connector and try again – if necessary, permute and try on a different monitor. In case of damage of the belt replace it (8).
	LMM defective	Contact <i>SenTec Authorized LuMon™ Technicians</i>
EIT0414 Message 'Tech Error 0002'	LMM defective	Contact <i>SenTec Authorized LuMon™ Technicians</i>
EIT0415 Message 'monitor fault'	LMM defective	Contact <i>SenTec Authorized LuMon™ Technicians</i>

## 5 REPAIRS OF THE LU-MON™ MONITOR

Repairs described in this section do not require opening the LuMon™ Monitor's cover and shall be carried out by qualified service personnel only.

Repairs that require opening the cover of the LuMon™ Monitor are to be performed by *SenTec Authorized LuMon™ Technicians* only (i.e. trained by SenTec AG or accredited partners) and are described in detail within the Repair Manual [3].

### NOTE

Prior to maintenance, service or repair all components of the LuMon™ System must be cleaned and disinfected. More details can be found in section 'cleaning and disinfection' of the User's Guide for the LuMon™ System [1].

### NOTE

If equipment is sent to a *SenTec Authorized LuMon™ Technician*, local SenTec representative or SenTec AG please refer to section 'instructions for repackaging and shipping' of the User's Guide [1].

A complete 'Certificate of Disinfection' [6] and, if applicable, the 'Repair or Investigation Request Form' [7] must be provided

### NOTE

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 LuMon™ System.

This means, if you replace parts of the LuMon™ System or if you perform a software update you must report the serial number of the respective LuMon™ Monitor and the serial and LOT numbers of the replaced parts to your local distributor using the 'Technical Service Report Form' [8]. For spare parts and test tools refer to section 8.1.

**Tools:** T10 Torx screwdriver and Slotted 4mm screwdriver

### 5.1 Prior to repair

Prior to repair, all components of the LuMon™ System must be cleaned and disinfected. Refer to section 'cleaning and disinfection' of the User's Guide [1].

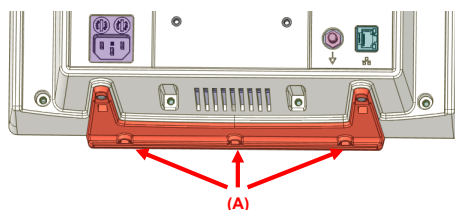
Set the ON/OFF switch of the LuMon™ Monitor to OFF and disconnect all connections on the rear panel of the device.

### 5.2 Replacement – support foot

Follow the procedure described in section 5.1.

1. Remove the three screws with a T10 Torx screwdriver as shown on Figure 5-1.
2. Slide out the damaged foot and slide in the replacement part. Only use the foot which is matching the LuMon™ Monitor configuration: **LuMon™ ADULT** identifies Adults/Children configuration and **LuMon™ NEO** identifies the Neonates/Infants configuration.
3. Fasten the three screws with a T10 Torx screwdriver as shown on Figure 5-1.

Figure 5-1: LuMon™ Monitor's support foot



### NOTE

After repair verify that the replaced support foot matches the configuration of the LuMon™ Monitor.



### 5.3 Replacement – main fuses

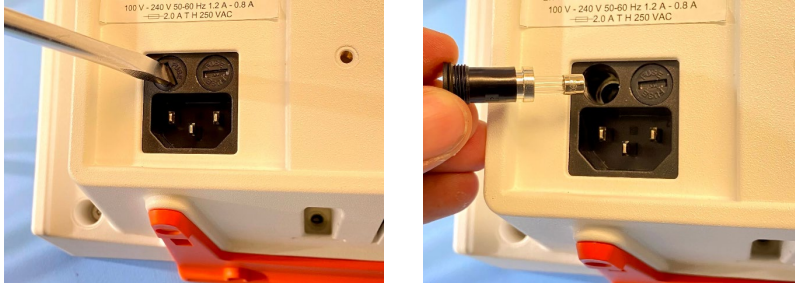
---

Follow the procedure described in section 5.1.

Before replacing the fuses of the LuMon™ Monitor, switch the LuMon™ Monitor off and disconnect the LuMon™ Monitor from AC mains power.

To replace the fuses, open the fuse holder (Figure 5-2.) with a screwdriver and replace the fuses with specified fuses only (8.1).

Figure 5-2: Main fuses



## 6 SOFTWARE UPDATES

The field-upgradable software of the LuMon™ Monitor consists of two items:

1. TIC software – Tomographic imaging creation Module (EIT image calculation and signal analysis algorithm)
2. GUI software – Embedded PC (user interface, memory and interface management)

The TIC and GUI software can be updated over the USB port using an installer software. Detailed instructions are included in separate documents [\[10\]](#).

**NOTE**

Software updates must be reported to SenTec AG by using the 'Technical Service Report Form' [\[8\]](#) to ensure traceability.

## 7 DISPOSAL

Dispose all parts of or removed from the LuMon™ System according to your institution's protocol and/or local regulations. Products containing electronic parts (LuMon™ Monitor, its power cord, belt connectors, and belts) require special disposal. Incorrect disposal may lead to serious environmental pollution.

### NOTE

SenTec is dedicated to helping protect the natural environment and to helping ensure the continued safe and effective use of this product through proper support, maintenance, and training. Therefore, SenTec's products are designed and manufactured to comply with relevant guidelines for environmental protection. If the product is properly operated and maintained, it presents no environmental risks. However, the product may contain materials that could be harmful to the environment if disposed of incorrectly. Use of such materials is essential to performing the functions of the product, and to meeting statutory and other requirements.

### 7.1 LuMon™ Monitor

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Return the LuMon™ Monitor to your local SenTec representative or dispose it according to local regulations.

### NOTE

If equipment is sent to a *SenTec Authorized LuMon™ Technician*, local SenTec representative or SenTec AG please refer to section 'instructions for repackaging and shipping' of the User's Guide [1].

A complete 'Certificate of Disinfection' [6] and, if applicable, the 'Repair or Investigation Request Form' [7] must be provided.

### 7.2 Belt connectors

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Dispose the belt connectors according to local regulations.

### NOTE

The copper contained can be recycled.

### 7.3 Belts

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Dispose the belt according to local regulations.

### 7.4 Contact medium

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Dispose ContactAgent pressurized spray cans and NeoContactAgent spray bottles according to local regulations. Make sure that only empty pressurized cans are disposed.

## 8 APPENDIX I

### 8.1 Spare parts and maintenance tools

For belts, belt connector, power cords, VESA Screw Set, Fuses for the LuMon™ Monitor and EIT Advanced Interface Set refer to the Product Catalogue for the LuMon™ System [4].

A complete list of services and spare parts is available from SenTec AG upon request ([info-eit@sentec.com](mailto:info-eit@sentec.com)) [9].



#### NOTE

Concerning equipment, accessories, disposable and parts refer to section 'warnings and cautions' of the User's Guide for the LuMon™ System [1].

### 8.2 Interfaces - Pin assignment

The mains power supply of the LuMon™ Monitor is separated by two Means of Patient Protection (MOPPs) between the belt connector socket (for the applied part, the belt) and the interface connectors.

The interface connectors (serial ports, USB ports, Ethernet port) of the LuMon™ Monitor are not separated from each other. If at a time accessory equipment is connected to only one of the 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 more of the LuMon™ Monitor'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.**

#### 8.2.1 Belt connector socket (Redel)

Figure 8-1: Belt connector socket



Table 8-1: Belt connector port - signals

Pin(s)	Signal	Description
1	ETH RX+	Received Data
2	ETH RX-	Received Data
3	ETH TX+	Transmitted Data
4	ETH TX-	Transmitted Data
5	n.c.	-
6	GND	Signal ground
7	SHIELD	Shielding
8	+6V	+6V power supply
9	n.c.	-
10	+6V	+6V power supply
11	SYNC_IN	eit frame synchronization input
12	SYNC_OUT	eit frame synchronization output
13	-6V	-6V power supply



#### NOTE

The belt connector port shall be used with SensorBeltConnector or LuMon™ Connector only.

### 8.2.2 USB ports

The USB port is a standard USB 2.0 Type A port supporting USB-IF BC1.2 downstream charging with 1A current limit. The USB ports of the LuMon™ Monitor is designed to be used with memory devices without external power supply. For service use also keyboard/mouse can be connected.

### 8.2.3 Serial port 1 (RS-232)

Figure 8-2: Serial port 1

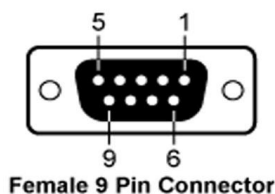


Table 8-2: Serial port 1 - signals

Pin(s)	Signal	Description
1	+5V	+5V, max 1A for sensor supply only, controlled by LuMon™ Monitor
2	RXD_TIC	Received Data (RX, to LuMon™ Monitor)
3	TXD_TIC	Transmitted Data (TX, from LuMon™ Monitor)
4	SYNC OUT	Digital 0V – 5V eit frame synchronization output
5	GND	Signal ground
6	UI CH3	Digital 0V – 3.3V I/O (reserved)
7	+12V	+12V, max 0.4A for sensor supply only, controlled by LuMon™ Monitor
8	UI CH2	Digital 0V – 3.3V I/O (reserved)
9	SYNC IN	Digital 0V – 5V eit frame synchronization input with built-in pull-up resistor

#### NOTE

The current software does not support any functionality over this interface. This interface is reserved for factory use only.

### 8.2.4 Serial port 2 (RS-232)

Figure 8-3: Serial port 2

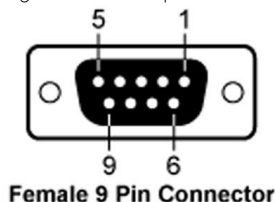


Table 8-3: Serial port 2 - signals

Pin(s)	Signal	Description
1	GPIO 3	Digital 0V – 3.3V I/O (reserved)
2	RXD	Received Data (RX, to LuMon™ Monitor)
3	TXD	Transmitted Data (TX, from LuMon™ Monitor)
4	DTR	Data Terminal Ready
5	GND	Signal ground
6	DSR	Data Set Ready
7	RTS	Request to Send
8	CTS	Clear to Send
9	GPIO 7	Digital 0V – 3.3V I/O (reserved)

#### NOTE

The current software does not support any functionality over this interface. This interface is reserved for factory use only.

### 8.2.5 Ethernet port (LAN)

The LAN port of the LuMon™ Monitor is designed to communicate with external computer-based data collection systems. The LAN port is located on the rear panel of the LuMon™ Monitor. The LAN port is a standard 100Base-TX Ethernet connector. Use 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**

The current software does not support any functionality over this interface. This interface is reserved for factory use only.

## 8.3 Technical specification

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See the corresponding section of the User's Guide for the LuMon™ System [1].

## 8.4 Contact

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SenTec AG | Kantonsstrasse 14 | 7302 Landquart | Switzerland | [www.sentec.com](http://www.sentec.com) |

Phone: +41(0)81 330 09 70 | Fax: +41(0)81 330 09 71 | [info-eit@sentec.com](mailto:info-eit@sentec.com)

## 9 APPENDIX II – PROTOCOL FOR SAFETY & FUNCTIONALITY TEST

See next page.

# Protocol for Safety & Functionality Test – LuMon™ System

The LuMon™ System has been designed to comply with the IEC 60601-1 standard. For safety reasons it is recommended that the LuMon™ System undergoes a technical safety check once a year (but every two years the latest) and after repair. Please fill in this form (one form per monitor).

Record the serial number and the hard- and software specific information of the tested items. You will find this information in ScoutView 'system settings' area.

The LMS safety and functionality test consists of several tests of the following equipment:

- LuMon™ Monitor
- SensorBeltConnector / LuMon™ Connector

## TEST SUMMARY:

### Product identification

- |   |             |              |
|---|-------------|--------------|
| <input type="checkbox"/> LuMon™ Monitor – Adult | SN:         |              |
| <input type="checkbox"/> LuMon™ Monitor – Neo   | SW version: | TIC version: |
| <input type="checkbox"/> SensorBeltConnector    | SN:         |              |
| <input type="checkbox"/> LuMon™ Connector       | Version     |              |

### Test tools

- |   |     |
|---|-----|
| <input type="checkbox"/> EIT Advanced Interface | SN: |
| <input type="checkbox"/> Safety analyzer        |     |
| <input type="checkbox"/> Other:                 |     |

LuMon™ Monitor	Not passed <input type="checkbox"/>	Passed* <input type="checkbox"/>
SensorBeltConnector/LuMon™ Connector	Not passed <input type="checkbox"/>	Passed* <input type="checkbox"/>

\*all test items passed

### Safety & Functionality test:

Not passed ☐      Passed ☐

Date of the next safety related test:

Organization:

Location:

Qualified technician (name):

Place, date:

Signature:



Completely fill in the tables below.

Confirm that the tests have been performed successfully. If required, note test results. Confirm successfully passed tests with your signature or a check mark.

#### BELT CONNECTOR

Test	Results	Passed
Visual inspection		<input type="checkbox"/>
Labeling		<input type="checkbox"/>
Indicator LED		<input type="checkbox"/>
Function test		<input type="checkbox"/>
Other observations		

#### LU MON™ MONITOR

Test	Results	Passed
Visual inspection		<input type="checkbox"/>
Labeling		<input type="checkbox"/>
Safety test according to IEC 62353: According to Service Manual for the LuMon™ System.		<input type="checkbox"/>
Touchscreen		<input type="checkbox"/>
Clock settings		<input type="checkbox"/>
Display and AC Power/Battery indicator		<input type="checkbox"/>
Fan		<input type="checkbox"/>
Capacity of rechargeable Lithium Ion battery	Runtime until shut down:      h      min	<input type="checkbox"/>
Other observations		