

5 FUNCTIONAL CHECK


These instructions include complete procedures for **functional check** (FC) for Datex-Ohmeda Light Monitors. The functional check is recommended to be performed after monitor installation and after long storage.

The first part of the instructions contains check procedures that are done through the service menu. These checks are especially recommended if the monitor has been stored for a long time without using it.

When installing a new monitor, the **performance checks** with a simulator and accessories are typically enough to ensure the correct function of the monitor. We recommend however always performing the complete check to confirm that no hardware failures occurred during transportation.

The instructions are planned for the maximum functional configuration. Perform the procedures in the ascending order and skip the items that do not correspond to your monitor configuration.

The instructions include a **check form** (Appendix A) to be filled in when performing the corresponding procedures.

The symbol  in the instructions means that the performed procedure should be signed in the checklist.

All menu selections related to  Datex-Ohmeda products are written in following typeface:

Monitor Setup - Install/Service (password 16-4-34) -
Service (password 26-23-8) - **Modules - ESTP - ECG**

Menu selections related to other products e.g. simulators are written in following typeface:

RESP - WAVE - NORM
- RATE - 20

Recommended tools:

Tool	Order No.
Simulator capable of simulating ECG, RESP and invBP	-
SpO ₂ finger probe	SAS-F4
Adult NIBP cuff	572435
Adult NIBP hose	877235
MemCard- Data (only for monitors with data card option)	
Temperature test plug set	884515
Mainstream CO ₂ sensor (only for monitors with CO ₂ option)	902300
Mainstream CO ₂ airway adapter (only for monitors with CO ₂ option)	902301/902302/902303

5.1 General functional inspection

1. Connect the power cord to the power adapter and the power adapter cable to the Light Monitor.
Check that the green LED turns on in the power adapter and the LED in the lower right-hand corner of the monitor turns on or starts flashing.
If the monitor contains a battery module, check that both battery charge status LEDs turn on or start flashing.

2. Switch the monitor on. Check that the monitor starts up properly, i.e.
 - both alarm LED's turn on and off
 - the fan starts running
 - the start-up sound is heard from the loudspeaker
 - the normal monitoring screen appears
 - no error messages appear on the screen *)
 - If the monitor contains a recorder, two lines of start-up information should be recorded
 - check that the time and date are correct, adjust if necessary
 - if the monitor contains an F-LBAT or N-LBB, check that the battery symbol is displayed

*) NOTE: "Check network connectors" will appear if the N-LNET or N-LDNET option is installed.

3. Check the loudspeaker by adjusting the alarm volume in the **Alarms Setup** menu:

Press the **Menu** button.

Select **Alarms Setup - Alarm Volume**

Test the whole volume scale from 1 to 10 by turning the ComWheel and check that the alarm volume changes correspondingly. The alarm sound should be clear and audible at all settings.

Select **Main Menu**

4. Select **Service View - Keyboard - Dummy Press**.
Press the function keys one by one. Check that each key generates a sound from the loudspeaker and the corresponding text.
5. Check that the time and date are correct, adjust if necessary.

Select **Monitor Setup - Set Time and Date**

NOTE: You cannot change the monitor's time settings after a case has started. This prevents losing the trend data.

NOTE: If the clock shows time 0:00 continuously after start-ups, the SRAM/Timekeeper's battery on the CPU board needs to be replaced.

Return to **Main Menu** by selecting **Previous Menu - Main Menu**

6. Check the battery (If F-LBAT or N-LBB option included):

Disconnect the power cord (without switching the monitor to standby).

Check that the monitor continues to run normally with battery. The battery indicator should appear in the upper right hand corner of the screen:

Reconnect the power cord and check that during charging, the charging symbol is displayed and the Battery charge status LED starts flashing:



5.1.1 Recorder test

7. Open the paper compartment cover. Check that the message “Recorder: Cover open” appears on the screen, then close the cover.
8. Select **Main Menu - Record/Print- Record Wave** and check that the recorder starts recording. Select **Stop Wave** to stop recording. Check that the quality of the recordings is acceptable.




5.1.2 PCMCIA card test

9. Insert the Memory card labeled “Data” in the DataCard slot. Check that the message “Data Card inserted” appears in the message field and the white data card symbol in the upper right hand corner of the screen appears within one minute.



5.1.3 Network test

10. Connect the Mon-Net cable and the Identification plug to the monitor.
11. Check that the monitor connects to the Datex-Ohmeda Network, i.e. the network symbol  is displayed on the upper right-hand corner of the screen.

A message regarding the connection to Datex-Ohmeda Information Center should appear in the message field on the screen.

12. Press the **Menu** button to enter the **Network** service menu:

Monitor Setup - Install/Service (Password 16-4-34) -
Service View (Password 26-23-8) - **Monitor - Communication**

Check that:

- the "location ID number" matches with the ID plug connected to X3
- the packets and bytes IN is increasing slowly
- the packets and bytes OUT is increasing quickly.
- the "connections" shows the names of the connected networks
- the counters for data errors ("CRC", "Frame", "Transm.") are stable

NOTE: The counters may show values greater than 0. However, any values increasing continuously indicate a problem.

13. Check that the counters for hardware errors ("Intern.", "Missed", "FIFO", "Overrun") all show 0. If any of the counters show a value greater than 0, it indicates a problem on the CPU board.

Return to the **Monitor Setup** menu by selecting **Previous Menu** repeatedly.



5.1.4 ECG board tests

14. Enter the **ESTP : ECG** service menu:

Press the **Menu** button and select:

Monitor Setup - Install/Service (Password 16-4-34) -

Service View (Password 26-23-8) - **Modules - ESTP : ECG**

Check from the Service Data that:

- the “Timeouts”, “Bad checksums” and “Bad c-s by mod” values are not increasing faster than by 50 per second.
 - the ECG/RESP board memories have passed the internal memory test, i.e. “RAM”, “ROM” and “EEPROM” all state **OK**.
15. Check that the module mains power frequency “Power Freq” value has been set according to the supply frequency. If necessary, change the setting by selecting **Power Freq**.
16. Check that the “Resp Available” and “Resp measurement” both show **ON**.

NOTE: The Resp measurement shows **OFF**, if **Resp** is not selected to the screen setup. To setup the screen, press the **Menu** key and select: **Monitor Setup - Waveform Fields** or **Digit Fields**.



5.1.5 STP board tests

17. Enter the **ESTP : STP** service menu:

- Check that the “Timeouts”, “Bad checksums” and “Bad c-s by mod” values are not increasing faster than by 50 per second.
- Check that the STP board memories have passed the internal memory test, i.e. “RAM”, “ROM” and “EEPROM” all show OK.

18. Check that the protection for temperature calibration is on:

“Protect key” text in the menu should state **OFF**.

“Protect mode” text should state **ON**.

If necessary, change the protection mode in the **Calibrations** menu.



5.1.6 NIBP board test

19. Enter the **NIBP** service menu:

Check that the “Timeouts”, “Bad checksums” and “Bad c-s by mod” values are not increasing faster than by 50 per second.

Check that the NIBP board memories have passed the internal memory test, i.e. “RAM”, “ROM” and “EEPROM” all show **OK**.



5.1.7 Mainstream CO₂ test

20. Enter the **CO2** service menu:

Press the **Menu** button and select:

Monitor Setup - Install/Service (Password 16-4-34) -

Service View (Password 26-23-8) - **Modules - CO2**

Check from the Service Data that: “Timeouts”, “Bad checksums” and “send queue full” values are not increasing faster than by 50 per second.

A value increasing faster than this indicates a failure in Module Bus communication.



5.2 Performance checks

1. Connect a 5-lead cable to the monitor. Configure the monitor screen so that all parameter information is displayed, for example for the maximum configuration:

Press the **Menu** button to enter the **Main Menu** and select:

Monitor Setup - Waveform Fields/Digit Fields

Waveform Fields	Digit Fields
Field 1 - ECG1	Field 1 -Temp
Field 2 - P1	Field 2 - NIBP
Field 3 - P2	Field 3 - Pleth
Field 4 - Resp	Field 4 - CO₂

Return to **Normal Screen**.

Connect the patient simulator and check that all parameter information is displayed as configured on the screen.

NOTE: InvBP waveforms are not shown without a patient simulator.

Preset measurement settings for parameters, for example as follows:

ECG & Resp - ECG Setup - HR Source - AUTO
- Resp Setup - Size - 1.0
- Resp Rate Source - AUTO
- Detection Limit - AUTO

NOTE: The RESP waveform or Digit Field has to be selected on the screen before the respiration measurement can be turned on.

NIBP & Inv. Press - P1 Setup&Alarm - Label - ART
- P2 Setup&Alarm - Label - CVP

Press the **Menu** button to enter the **SpO2 & Temp** and select
- Pleth Scale - AUTO



2. Connect the patient simulator to the ECG and InvBP connectors, SpO₂ probe to the SpO₂ connector and temperature test plug to the Temp connector. Attach the SpO₂ probe on your finger and check that:
 - the simulated waveforms are good
 - the SpO₂ value is in expected range
 - the Pleth waveform is normal.



3. Set the InvBP simulator to +100 mmHg static pressure. Push the Zero All button and check that:
 - the InvBP waveforms set on the baseline
 - the digital values go to zero

Set the simulator to 0 mmHg and press **Zero All** button. After the monitor has completed the zeroing, turn the simulator to dynamic mode and check that the waveform is normal.



4. Check that the message “No probe” is displayed when there is no SpO₂ sensor connected. Connect a SpO₂ finger probe to the monitor and check that the message “Probe off” is displayed when the probe is not connected to finger.



5. Attach the SpO₂ sensor to your finger and check that after the message “Pulse search” the pleth waveform is displayed and the SpO₂ value is in the expected range (95-99 %). Check that the HR value is calculated from SpO₂ when ECG and InvBP (P1) cables are not connected.



6. Remove the SpO₂ sensor from your finger and check that the message “Probe off” is displayed. Disconnect the sensor from the monitor and check that “No probe” message is displayed.



7. Attach an adult NIBP cuff onto your arm and perform one NIBP measurement. Check that the module identifies the cuff, i.e. the text “Adult” appears in the NIBP digit field for a short time.

Check that the module gives a reasonable measurement result.



8. Check that the message “No CO₂ sensor” is displayed when there is no CO₂ sensor connected. Connect a CO₂ sensor to the monitor and check that the message “warming” is displayed.



9. Wait until the “warming” message disappears and the CO₂ value appears on the screen. Breathe at least 5 times to the CO₂ sensor adapter and make sure that the measured values are reasonable and the Respiratory value is calculated.



- Fill in all necessary documents.

6 SERVICE CHECK

6.1 General service information

Field service of the Light Monitor is limited to replacing faulty printed circuit boards or mechanical parts. Faulty printed circuit boards should be returned to GE Healthcare for repair.

GE Healthcare is always available for service advice. Please provide the unit serial number, full type designation, and a detailed description of the fault.

The instructions are planned for the maximum functional configuration. Perform the procedures in the ascending order and skip the items that do not correspond to your monitor configuration.

CAUTION Only trained personnel with appropriate equipment should perform the tests and repairs outlined in this section. Unauthorized service may void warranty of the unit.

6.2 Service check procedure

These instructions include complete procedures for service check. **The service check is recommended to be performed after any service repair**, however, the service check procedures can be used also for determining possible failures.


The procedures should be performed in ascending order.

The instructions include a **check form** (Appendix B) which should be filled in when performing the procedures.

Names of the keys are written in bold Helvetica typeface, for example **Normal Screen**.

Selectable menu items are written in bold and italic typeface, for example ***Previous Menu***.

Informative messages displayed on the screen are written in normal typeface, but separated with quotation mark, for example 'Please wait'.

The mark  in the instructions means that the performed procedure should be signed in the check form.

The procedures are designed for monitors with monitor software of level 894727-4.1. However, for the most part they apply to monitors with older monitor software as well.

Recommended tools

Tool	Order No.
Patient simulator for ECG, Impedance Resp and BP	-
Pressure manometer	-
Temperature test set	884515
3- and 5-lead ECG cable	-
SpO ₂ finger probe	OXY-F4-N
InvBP transducer	78000
Adult NIBP cuff	572435
Adult NIBP hose	877235
Infant NIBP hose	877514
Infant NIBP cuff	877407
Mainstream CO ₂ sensor (only for monitors with	902300

Tool	Order No.
C02 option)	
Mainstream C02 airway adapter (only for monitors with C02 option)	902301/902302/ 902303
Screwdriver -Pozidrive- type	
MemCard- Data (only for monitors with data card option)	

Recommended parts

Part	Order No.	Notes
Fan filter	886841	
Recorder paper	74205	if N-LREC option installed

6.2.1 Visual inspection

- Switch the monitor to standby
 - Disconnect all the connection cables from the monitor's rear panel.
1. Check internal parts:
 - Make visual inspection for all external parts of the monitor. Check e.g. that the power cord receptacle is intact in the power adapter.
 - Connect the power cord to the power adapter and check the supply voltage from the power adapter's connector. PIN 1 voltage must be 12.7 V without load (Figure 1). If necessary, adjust the 12.7 V with trimmer R23 (Figure 2).

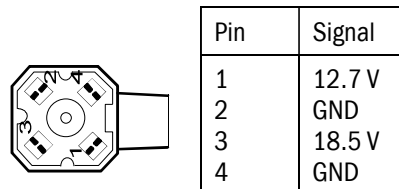


Figure 1 Power adapter's voltages

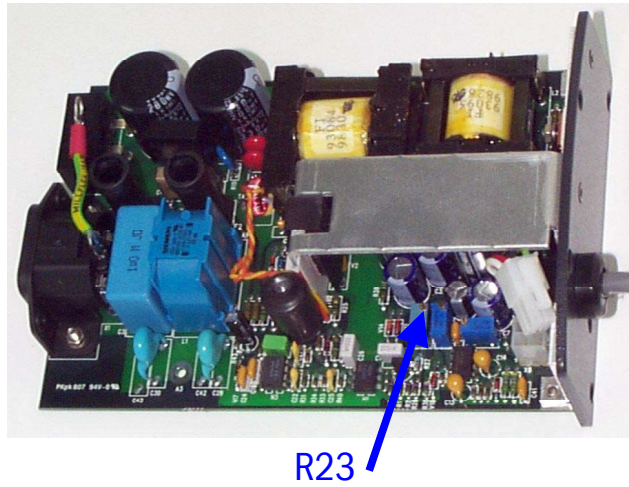


Figure 2 Adjustment trimmer R23 in N-LPOW

- Clean or replace the fan filter.
- Clean the recorder unit, if necessary.
- Check that all shielding flaps (6 pcs) are properly closed. (Figure 3)

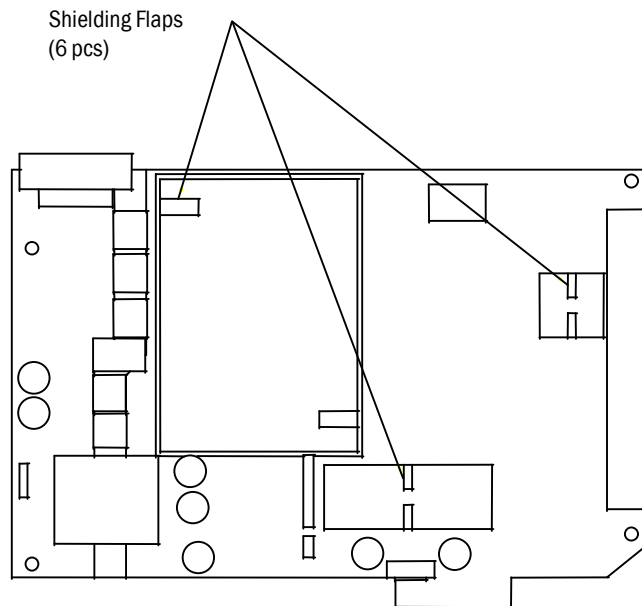


Figure 3 LM1-STP board EMC covers



2. Check external parts:
 - the patient panel sticker is intact
 - all connectors are intact and attached properly

- both screws on the patient panel are tightened properly



3. General functional inspection

- Connect the power cord to the Power Adapter and the Power Adapter cable to the Light Monitor.
Check that the green LED turns on in the power adapter and the LED on the lower right-hand corner of the monitor turns on or starts flashing.
Check that both Battery charge status LEDs turn on or start flashing.
- Switch the monitor on. Check that the monitor starts up properly, i.e.
 - both alarm LEDs turn on and off
 - the fan starts running
 - the start-up sound is heard from the loudspeaker
 - the normal monitoring screen appears
 - no error messages appear on the screen *)
 - if the monitor contains a recorder, two lines of start-up information should be recorded
 - check that the time and date are correct, adjust if necessary
 - if the monitor contains an F-LBAT or N-LBB, check that the battery symbol is displayed:



*) NOTE: "Check network connectors" will appear if the N-LNET or N-LDNET option is installed.

- Enter the service menu and select Dummy Press.
Press the function keys one by one. Check that each key generates a sound from the loudspeaker and the corresponding text.



4. Screen setup

- Configure the monitor screen according to the monitor configuration so that all necessary parameter information is displayed, for example as follows:

Menu - Monitor Setup- Waveform Fields - Field 1 - ECG1

- **Field 2 - P1**

- **Field 3 - P2**

- **Field 4 - Resp**

- **Digit Fields - Lower Field 1 - NIBP**

- **Lower Field 2 - CO2**

- **Lower Field 3 - Pleth**

- **Lower Field 4 - Temp**

- Connect the patient simulator to the monitor and check that all needed parameter information is shown on the screen.

NOTE: The RESP waveform or Digit Field has to be selected on the screen before the respiration measurement can be turned on.

5. Preset ECG, Respiration, InvBP and SpO₂ measurement settings:

ECG & Resp - **ECG Setup - Hr Source - Auto**
- **Pacemaker - Show**
- Resp Setup - Size - 1.0
- **Resp Rate Source - Auto**
- **Measurement - On**
- **Detection Limit - Auto**

NIBP & Inv. Press - **P1 Setup&Alarm - Label - Art**
P2 Setup&Alarm - Label - Cvp

SpO₂ & Temp - **Pleth Scale - Auto**

6. Press the **Menu** button and check the loudspeaker by adjusting the alarm volume in the **Alarms Setup** menu:
- Test the whole volume scale from 1 to 10 by turning the ComWheel and check that the alarm volume changes correspondingly. The alarm sound should be clear and audible at all settings.
7. Select **Service View – Keyboard – Dummy Press**. Press the function keys one by one. Check that each key generates a sound from the loudspeaker and the corresponding text.



8. Check that the time and date are correct, adjust if necessary:
Menu – Monitor Setup – Set Time and Date
- NOTE: You cannot change the monitor's time settings after a case has started. This prevents losing the trend data.
 - NOTE: If the clock shows time 0:00 continuously after start-ups, the SRAM/Timekeeper's battery on the CPU board needs to be replaced.
9. Check the battery (If F-LBAT or N-LBB option included):
Disconnect the power cord (without switching the monitor to standby).

Check that the monitor continues to run normally with battery. The battery indicator should appear in the upper right hand corner of the screen:



Reconnect the power cord and check that during charging, the charging symbol is displayed and the Battery charge status LED starts flashing:



6.2.2 Recorder test

10. Open the paper compartment cover. Check that the message "Recorder: Cover open" appears on the screen, then close the cover.
11. Select **Main Menu - Record/Print- Record Wave** and check that the recorder starts recording. Select **Stop Wave** to stop recording. Check that the quality of the recordings is acceptable.




6.2.3 PCMCIA card test

12. Insert the Memory card labeled "Data" in the DataCard slot. Check that the message "Data Card inserted" appears in the message field and the white data card symbol in the upper right hand corner of the screen appears within one minute.



6.2.4 Network test

13. Connect the Mon-Net cable and the Identification plug to the monitor.
14. Check that the monitor connects to the Datex-Ohmeda Network, i.e. the network symbol  is displayed on the upper right-hand corner of the screen.

A message regarding the connection to Datex-Ohmeda Information Center should appear in the message field on the screen.

15. Press the **Menu** button to enter the **Network** service menu:

Monitor Setup - Install/Service (Password 16-4-34) -
Service View (Password 26-23-8) - **Monitor - Communication**

Check that:

- the "location ID number" matches with the ID plug connected to X3
- the packets and bytes IN is increasing slowly
- the packets and bytes OUT is increasing quickly.
- the "connections" shows the names of the connected networks
- the counters for data errors ("CRC", "Frame", "Transm.") are stable

NOTE: The counters may show values greater than 0. However, any values increasing continuously indicate a problem.

16. Check that the counters for hardware errors ("Intern.", "Missed", "FIFO", "Overrun") all show 0. If any of the counters show a value greater than 0, it indicates a problem on the CPU board.

Return to the **Monitor Setup** menu by selecting **Previous Menu** repeatedly.



6.2.5 ECG measurement

17. Enter the service menu:

Menu - Monitor Setup - Install/Service (Password 16-4-34) -
Service View (Password 26-23-8)

Take down the information regarding monitor software and unit id by selecting **Scroll Vers** and turning the ComWheel or choose **Record Vers** if the recorder is installed.



18. Enter the **ESTP : ECG** service menu:

Menu - Monitor Setup - Install/Service (Password 16-4-34) -
Service View (Password 26-23-8) - **Modules - ESTP : ECG**

Check that the "Timeouts", "Bad checksums" and "Bad c-s by mod" values are not increasing faster than by 50 per second. Check also that the ECG/RESP board memories have passed the internal memory test, i.e. the "RAM", "ROM" and "EEPROM" state all OK.

19. Check that the power frequency value has been set according to the current mains power frequency. Change the setting by selecting **Power Freq**, if necessary.
20. Connect a 5-lead ECG cable to the module. Check that the "Cable type" shows 5 lead. If it shows 3 lead, make sure the used 5-lead ECG cable contains the necessary wiring for cable recognition (pins 0, 8 and 9 connected together).
21. Check that all the electrodes show OFF in the service menu and the message "Leads Off" is shown on the screen.

Connect all the leads together, for example to a suitable screwdriver. Check that all the electrodes show ON and the message "Asystole" appears.

Disconnect one of the leads and check that the corresponding electrode in the service menu shows OFF within 10 seconds from the disconnection, then reconnect the lead. Check the rest of the leads using the same method.

NOTE: When the ground lead (black) is disconnected all the electrodes should show OFF.

NOTE: The asystole and different leads off -messages are shown using certain priority, so even if only one of the leads is disconnected, the lead related leads off -message may not appear on the screen.



22. Connect a 3-lead cable to the monitor.
Connect the leads together (e.g. to a screwdriver).
Select one lead (I, II or III) for display.

Detach a lead from the screwdriver, and see that the monitor responds as described in the table below. Connect the lead again and check that "Leads off" message disappears.

Lead selection	Lead to be detached	Message
Lead I	L/LA R/RA N/LL	Leads off Leads off Leads off
Lead II	L/LA R/RA N/LL	Leads off Leads off Leads off
Lead III	L/LA R/RA N/LL	Leads off Leads off Leads off

Check that in any case the correspondence electrode (RA, LA or LL) shows off. Electrodes V and RL show off all the time. In cases I and N, II and R, III and L all electrodes show off.

23. Connect the leads to a patient simulator.
The settings and checks with Dynatech Nevada MedSim 300 Patient Simulator:

ECG - BASE - BPM - 160
PACE - WAVE - NSR

Check that normal ECG waveform is shown, the HR value is 160 (± 5) and the "Pacer count" value is not increasing in the service menu

ECG - PACE - WAVE - ASNC

Check that pacemaker spikes are shown on the ECG waveform, the HR value changes to 75 (± 5) and the "Pacer count" value is increasing according to shown pacemaker spikes.

Set the pacemaker option off:

ECG - PACE - WAVE - NSR



6.2.6 Respiration measurement

24. Check that the "Resp Available" and "RESP Measurement" show both ON in the **ESTP : ECG** service menu.
Do the following settings:
Menu - ECG & Resp - ECG Lead - II
and use a 3-lead ECG cable.
25. Check the respiration measurement with a patient simulator.

The settings and checks with Dynatech Nevada MedSim 300 Patient Simulator:

BASELINE IMPEDANCE -switch - 500
LEAD SELECT-switch - II/RL-LL

RESP - WAVE - NORM
RATE - 20
OHMS - 1.0

RATIO - 1/1
APNEA - OFF
SHIFT - OFF

Check that the Resp waveform is shown and the RR value is 20 (± 5). Change the position of the BASELINE IMPEDANCE -switch and check that appropriate RESP waveform and RR value are shown again within 30 seconds.

RESP - APNEA - 32 S

Check that the monitor gives the APNEA alarm.

NOTE: Make sure that only the ECG leads are connected to the simulator during the apnea test. If other cables are connected at the same time, the respiration signal from the simulator may be disturbed, and therefore, the APNEA alarm may not be activated.

NOTE: When you have the **ECG** service menu open, spikes will appear on the respiration waveform. These spikes represent the threshold level for detecting inspiration and expiration.



6.2.7 Temperature measurement

26. Enter the **ESTP : STP** service menu:

Modules - ESTP : STP

Check that the “Timeouts”, “Bad checksums” and “Bad c-s by mod” values are not increasing faster than by 50 per second. Check also that the STP board memories have passed the internal memory test, i.e. the “RAM”, “ROM” and “EEPROM” show all OK.

27. Check that the “Cable” and “Probe” show OFF for channel T1 when no probe is connected.
- Connect a temperature test plug into the connector T1. Check that the “Cable” and “Probe” for T1 show ON and the corresponding temperature value appears on the monitor screen.
28. Check the temperature calibrations using temperature test plugs. If the deviation on a temperature reading on the screen is more than 0.1 °C, calibrate the temperature channels according to the instructions in the Technical Reference Manual.
29. Activate the temperature test by selecting **Temp Test** from the menu and pressing the ComWheel twice. When the message “Performing temp test” disappears from the digit field, check that no error messages appear and “Temp error” shows OFF for both channels in the service menu.
30. Check that the module configuration has been set correctly. The configuration in use is shown beside the text “Configuration” in the service menu and it can be either STP, ST or TP. Change the configuration in the **Calibrations** menu, if necessary.

6.2.8 Invasive blood pressure measurement

31. Check that the “Cable” and “Probe” for P1 show OFF. Plug a cable with an invasive blood pressure transducer into the front panel connector P1 and check that the “Cable” and “Probe” show ON and the corresponding pressure waveform appears on the screen.
- Perform the same check also for the InvBP channel P2.
32. Calibrate the InvBP channels P1 and P2 according to the instructions in the Technical Reference Manual.

33. Check the InvBP channels with a patient simulator.

The settings and checks with Dynatech Nevada MedSim 300 Patient Simulator:

SENSITIVITY -switch - 5 μ V/V/mmHg

ECG - BASE - BPM - 60 - BP - 1 - WAVE - ATM
2 - WAVE - ATM

Restore the normal monitoring screen by pressing the key **Normal Screen**.

Connect cables from the channels BP1 and BP2 to the patient connectors P1 and P2. Zero the InvBP channels by pressing the ZERO ALL button on the monitor front panel.

BP - 1 - WAVE - ART
2 - WAVE - CVP

Check that appropriate InvBP waveforms are shown and the InvBP values are approximately 120/80 (\pm 3 mmHg) for the channel P1 and 15/10 (\pm 2 mmHg) for the channel P2.

Check that the HR value is calculated from P1 when ECG is not measured (ECG cable disconnected).



6.2.9 SpO₂ measurement

34. Check that the message "No probe" is shown when no SpO₂ sensor is connected to the module. Connect an SpO₂ finger probe to the module. Check that the message "Probe off" is shown when the probe is not connected to a finger.
35. Connect the SpO₂ probe onto your finger. Check that the reading of 95-99 and SpO₂ waveform appear. Check that the HR value is calculated from SpO₂ when ECG and InvBP (P1) are not measured.



6.2.10 Non Invasive Blood Pressure measurement

36. Enter the **NIBP** module service menu:

Monitor Setup - Install/Service (Password 16-4-34) -
Service (Password 26-23-8) - **Modules - NIBP**

Check that the "Timeouts", "Bad checksums" and "Bad c-s by mod" values are not increasing faster than by 50 per second. Check also that the NIBP board memories have passed the internal memory test, i.e. the "RAM", "ROM" and "EEPROM" show all OK.

37. Check the pump and valves.

Highlight **Pneumatics** from the NIBP menu. Connect a pressure manometer to the NIBP module cuff connector.

Select **Start Pump** and press the ComWheel. Check that the pump turns on and the pressure inside the tubing system starts to increase. Stop the pump by pressing the ComWheel again when the pressure reaches 280 mmHg.

Highlight **Open Exh1**. Press the ComWheel and check that the pressure inside the tubing system starts to drop, then press the ComWheel again. Check the other exhaust valve in the same way by selecting **Open Exh2** from the menu.

If necessary, turn the pump on again for a moment to increase the pressure inside the tubing system.

Highlight **SET VALVE**. Press the ComWheel and set the value under the text "Pulse Valve" to number 120 by turning the ComWheel. Press the ComWheel again and check that the pressure inside the tubing system starts to drop. Finish the test by selecting **Previous Menu**.

38. Check the NIBP tubing system for leakages.

Select **Calibrations** from the **NIBP** service menu.

Connect the pressure manometer to the NIBP module cuff connector. Start the active leak test from the menu by pressing the ComWheel. The module pumps a pressure of about 265 mmHg and then the pump stops.

Wait for 15 seconds for the pressure to stabilize, then check that the pressure does not drop more than 6 mmHg per one minute. Release the pressure by pressing the ComWheel once more.

39. Calibration check.

Recalibrate the NIBP measurement. Remember to set the calibration protection back on after calibration.

Disconnect the pressure manometer. Select **Calibrations** and then highlight **Calibration Check**. Press the ComWheel and take down the zero offset values for both pressure transducers, B1 and B2. The values should be within ± 10 mmHg.

Connect the pressure manometer to the cuff connector and check the calibration with pressures 100 mmHg, 200 mmHg and 260 mmHg. The zero offset value must be added to

the displayed pressure value in order to determine the real pressure.

40. Check the watchdog timer activation pressure.

Select **Pneumatics** from the **NIBP** service menu.

Keep the pressure manometer connected to the cuff connector. Pump up the pressure very slowly and note the value on the manometer when you hear a signal from the loudspeaker. The pressure at where the watchdog timer should activate with an audible signal is

13 mmHg (11...15 mmHg).

Adjust the limit with the trimmer on the NIBP board, if necessary.

41. Check the watchdog timer.

Select **Watchdog** from the **NIBP** service menu.

Check the watchdog timer in the adult mode. Activate the timer by highlighting **Test Adult** and then pressing the ComWheel. Check that the time beside the text "Watchdog Interval" starts to run. Wait until you hear a signal from the loudspeaker and then check the time again. The time from the adult test should fall within 120-140 seconds.

Check the watchdog timer also in the infant mode by first selecting **Test Infant** from the menu. The time from the infant test should fall within 60-70 seconds.

42. Check the safety valve.

Select **Safety Valve** from the **NIBP** service menu.

Keep the pressure manometer connected to the cuff connector.

NOTE: Make sure your pressure manometer can be used to measure pressures over 300 mmHg. If such a pressure manometer is not available, perform the check with an adult cuff that is connected around some round object, for example a calibration gas bottle.

Highlight **Start Test**. Start the adult safety valve test by pressing the ComWheel. Wait until the pump stops and the pressure is deflated. Check the pressure values "Max press" and "2 s after stop" for both transducers. All the values should be within 290 - 330 mmHg.

Highlight **Adult**. Press the ComWheel and check that the text changes now to INFANT. Select **Start Test** and wait until the pump stops and the pressure values on the screen have been updated. Check that the values "Max press" and "2 s after stop" are all now within 154...165 mmHg.

Return to the normal monitoring mode by pressing **Normal Screen**.

43. Connect an adult NIBP cuff to the cuff connector and disconnect one of its hoses. Start NIBP measurement by pressing the key **NIBP**, highlight **Start Manual** and press the ComWheel and check that the message "Cuff loose" appears on the screen within 30 seconds. Reconnect the hose and then bend it with your fingers. Restart the measurement and check

that the message “Cuff occlusion” appears on the screen within 30 seconds.

Check that automatic inflation limits are in use:

Menu – NIBP & Inv.Press - NIBP Setup&Alarm - Inflation Limits – Auto Previous Menu

44. Connect the cuff onto your arm, highlight START VEN.STASIS in the **NIBP & Inv.Press** menu and press the ComWheel. Check the module identifies the cuff, i.e. the text “Adult” appears in the NIBP digit field for a short moment.

Keep the pressure inside the cuff for about half a minute in order to see that the cuff is not leaking, then press the ComWheel again. Select **Normal Screen**.

45. Keep the cuff on your arm and perform one NIBP measurement. Check that the monitor gives a reasonable measuring result.
46. Connect an infant cuff to cuff connector and wrap it around your fingers. Start NIBP measurement and check that the module identifies the cuff, i.e. the text “Infant” appears in the NIBP digit field. Cancel the measurement after the cuff identification.



6.2.11 Mainstream CO₂ measurement

47. Enter the **CO2** service menu and check that the “Timeouts”, “Bad checksums” and “send queue full” values are not increasing faster than by 50 per second.
48. Check that the message “No CO2 sensor” is displayed when there is no CO2 sensor connected. Connect a CO2 sensor to the monitor and check that the message “warming” is displayed.
49. Wait until the “warming” message disappears and the CO2 value appears on the screen. Breathe at least 5 times to the CO2 sensor adapter and make sure that the measured values are reasonable and the Respiratory value is calculated.
50. Perform the CO2 calibration check, if necessary.



6.2.12 For Light Monitor

51. Perform electrical safety check and leakage current test.



52. Check that the monitor functions normally after the performed electrical safety check.



53. Clean the monitor with suitable detergent.



- Fill in all necessary documents.

7 ADJUSTMENTS AND CALIBRATIONS

7.1 Pressure safety level detection “OFFSET”

Check from the service view (**Modules - NIBP**) that $ADO = 0 \pm 1$. If it is not: remove the back panel and adjust the trimmer located NIBP boards upper edge ADO to zero. Pump up the pressure very slowly and check that the value of AD5 changes from negative value to positive value under pressure 11..15 mmHg.

7.2 NIBP calibrations

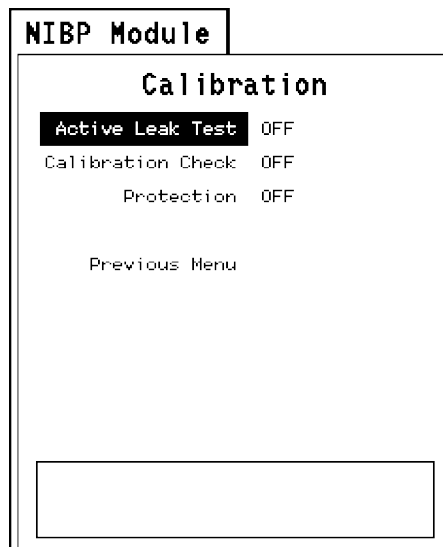
The electronics of NIBP pressure measurement is calibrated at the factory. Zeroing pressure is automatically maintained by the processor. If the zero point of the pressure transducer drifts more than specified, an error message is given and the NIBP board should be recalibrated or replaced.

The calibration can be checked and recalibrated in the **NIBP** service menu.

The calibration of the primary pressure channel can also be checked from the NIBP setup menu (NIBP, NIBP Setup, Calibration Check). In this case the auto zeroing is performed at start - remove hose before entering to ensure atmospheric pressure to the pressure transducers - the primary pressure is displayed. The zero-offset value should then be zero.

7.2.1 Calibration check

1. Enter **Calibration** menu.



2. Select **Calibration Check** and press the ComWheel.
3. Connect an external precision manometer to the monitor.

- Pump the following pressures to manometer and check the difference between the manometer and monitor pressure display:

Table 2 NIBP calibration check pressures

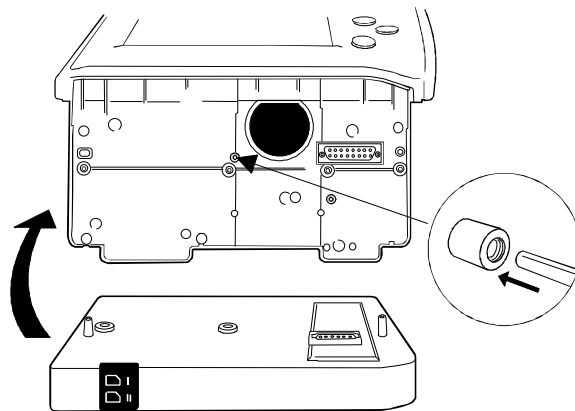
Pressure	Max. error	Example
0 mmHg	±9 mmHg (=zero offset)	-2
100 mmHg	100 + zero offset ±2 mmHg	98 ±2
200 mmHg	200 + zero offset ±3 mmHg	198 ±2

If the error of pressure channel B1 is larger than specified above, the module should be recalibrated. The error of B2 is allowed to be even twice as large because it has no effect on blood pressure measurement accuracy. However, it is recommended to recalibrate the module also when the error of B2 is larger than specified above to ensure best possible operation.

7.2.2 Calibration

- Enter **Calibration** menu.
- Remove hoses from front panel connector to enable proper zeroing.
- Select **Calibration**. If it is not available, perform the steps A, B, and C.

NOTE: If there is the battery module in the monitor, remove it before calibration.



- Push the switch at the bottom (marked with the **N** letter) of the device to enable the calibration. This enables menu selection “Protection”. The message “Calibration switch ON!” appears.
 - Select **Protection OFF** in the Calibration menu and push the ComWheel while pressing the calibration switch.
 - Release the switch. Menu selection “Calibration” is now enabled, and “Protection” is disabled. When the calibration is enabled, a message “Calibration not protected” appears.
- Start Calibration by pressing the ComWheel. Messages “ZEROING” and “ZEROED” will appear in the NIBP message field. After this a pressure bar will appear.

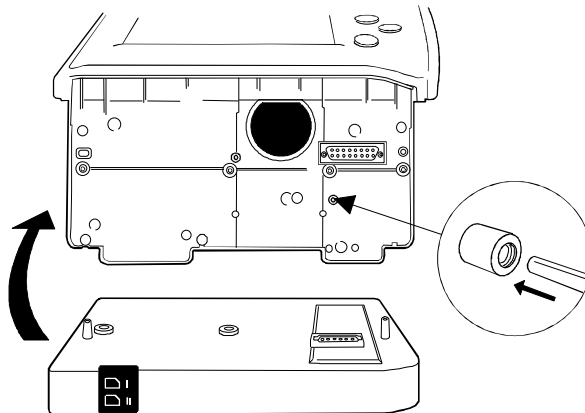
- Connect an external mercury manometer with pump to device through the both tubes of the hose - both transducers B1 and B2 must be calibrated simultaneously. Pump up to a pressure about 200 mmHg according to the manometer. Calibration is possible in the range 150 to 300 mmHg.
- Verify that both pressure values in the prompt field match the manometer reading. If not, adjust by turning the ComWheel. When the values of the pressure bar and the manometer are equal, press the ComWheel to confirm the calibration. The message “Calibrating” will appear in the NIBP digit field. After a few seconds it is followed by “Calibrated”, which means that the calibration has succeeded, and the new calibration data has been saved into EEPROM.
 - To set the protection on:
Push the calibration switch to the bottom and keep it at the bottom. Select “Protection” ON, push the ComWheel and release the switch.
- Switch off the monitor and then turn it on. Then perform Calibration Check (see the preceding page) to verify the new calibration.

7.3 Temperature calibration

NOTE: For the temperature calibration, separate, accurate test plugs (25 °C and 45 °C) are needed. A test set of two plugs is available from GE Healthcare, order code 884515.

Calibrate temperature when measured test values deviate more than ± 0.1 °C, and always after LM-STP board replacement.

1. Enter **ESTP : STP** service menu.
(**Monitor Setup - Install/Service** (password 16-4-34), **Service** (password 26-23-8), **Modules**).
2. Enter **Calibrations** menu.
3. Press the protect button at the bottom of the monitor and choose OFF in protect mode. Release the button.



4. Select **Calibrate T1** in the service view.
5. Insert calibration plug (25 °C) into Temp connector.
6. Press the ComWheel two times.
7. Insert calibration plug (45 °C) into Temp connector.

8. Press the ComWheel two times.
9. Press in the protect button at the bottom of the module and choose ON in protect mode. Release the button.

7.4 Invasive pressure calibration

Calibrate invasive pressure when the pressure transducer (probe) is replaced with a different type of transducer, and when LM-STP board is replaced.

1. Enter **ESTP : STP** service menu.
(Monitor Setup - Install/Service (password 16-4-34) - **Service** (password 26-23-8) - **Modules**).
2. Enter **Calibrations** menu.
3. Connect a pressure transducer with a pressure manometer to the P1/P2 connector. Choose Calibrate P1 or Calibrate P2. Leave the transducer to room air pressure.
4. Press the ComWheel to start zeroing.
5. Supply a pressure of 100 mmHg to 300 mmHg to the transducer. The recommended pressure is 200 mmHg.
6. Set the pressure on the display to match the pressure reading on the manometer and press the ComWheel. A tolerance of ± 1 mmHg is allowed.

The text "Calibrated" will appear in the display.