

3 SERVICE PROCEDURES

3.1 General service information

Field service of the hemodynamic modules is limited to replacing faulty printed circuit boards or mechanical parts. Faulty printed circuit boards should be returned to Datex-Ohmeda for repair.

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

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

3.2 Service check

These instructions include complete procedures for a service check. The service check should be performed after any service repair; however, the service check procedures can also be used for determining possible failures.

The procedures should be performed in ascending order.

The instructions include a check form, which should be filled in when performing the procedures.

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

3.2.1 Recommended tools

Tool	Order No.	Notes
Patient simulator	-	
Pressure manometer	-	
Temperature test set	884515	
Multi-link 3-leadwire set		
Multi-Link 5-leadwire set V2-V6		
Multi-Link 5-leadwire set C2-C6		
Multi-Link 12-lead ECG trunk cable		
SpO ₂ finger probe	OXY-F4-N or SAS-F4	
InvBP transducer		
Adult NIBP cuff & hose		
Infant NIBP cuff & hose		
Screwdriver		

3.2.2 Recommended parts

Part	Order No.	Notes
NIBP pump filter	57142	

All modules

Detach the module box by removing the two screws from the back of the module. Be careful with loose latch and spring pin for locking.

1. Check internal parts:
 - screws are tightened properly
 - cables are connected properly
 - all IC's that are on sockets are attached properly
 - EMC covers are attached properly
 - there are no loose objects inside the module



2. Check external parts:
 - the front cover and the front panel sticker are intact
 - all connectors are intact and are attached properly
 - the module box, the latch and the spring pin are intact



3. Replace the NIBP pump filter in PRESTN/RESTN/PRETN modules, if necessary.



- Reattach the module box and check that the latch is moving properly.
- Switch the monitor on and wait until the monitoring screen appears. Configure the monitor screen so that all the needed parameters are shown, for example as follows:

Monitor Setup - Waveform Fields -

Field 1 - ECG1

Field 2 - ECG2

Field 3 - P1

Field 4 - P2

Field 5 - Pleth

Field 6 - Resp

Digit Fields - Lower Field 2 - NIBP

Lower Field 3 - T1+T2

4. Plug in the module. Check that it goes in smoothly and locks up properly



5. Check that the module is recognized, i.e. all needed parameter information, except invasive blood pressure, starts to show on the screen.



Preset ECG, Respiration, InvBP and SpO₂ measurement settings:

ECG - ECG Setup - Hr Source - Auto
Pacemaker - Show

Others - Resp Setup - Size - 1.0
Resp Rate Source - Auto
Measurement - On
Detection Limit - Auto

Invasive Pressures - P1 'Art' Setup - Label - Art
P2 'Cvp' Setup - Label - Cvp

Pulse Oximetry - Pleth Scale - Auto

ECG measurement

6. Enter the service menu:

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

Take down the information regarding module software by selecting **Scroll Vers** and turning the ComWheel.



7. Enter the ESTP: ECG service menu:

Check that the 'Timeouts', 'Bad checksums' and 'Bad c-s by mod' values are not increasing faster than by 5 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.



8. Check that the power frequency value is set according to the current mains power frequency. Change the setting by selecting **Power Freq**, if necessary.



9. Connect a 12-lead ECG trunk cable without a lead set to the module. Check that the message "Leads off" is displayed on the screen.



10. Connect both 5-leadwire sets to the trunk cable. Connect limb lead electrodes and one electrode from the chest lead set to the same potential. Check that the 'Cable type' shows 10 lead.



11. Change the 3-leadwire set to the trunk cable. 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, and 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 when one of the leads is disconnected, the lead related 'Leads off' message may not appear onto the screen.

NOTE: When RA, LA or LL electrode is disconnected, all six V electrodes show OFF.

NOTE: With PRESTN/RESTN/PRETN modules and 5 lead cable the state of V2, V3, V4, V5 and V6 electrodes follow the state of the V electrode.

Connect the leads to a patient simulator.

Perform 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



Respiration measurement

12. Check that the 'Resp Available' and 'RESP Measurement' show both ON in the ESTP: ECG service menu.



13. 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 activates 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 ECG service menu open, spikes will appear on the respiration waveform. These spikes represent the threshold level for detecting inspiration and expiration.



Temperature measurement

14. Enter the ESTP: STP service menu:

Parameters - ESTP : STP

Check that the 'Timeouts', 'Bad checksums' and 'Bad c-s by mod' values do not increase faster than by 5 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.



15. Check that the 'Cable' and 'Probe' show OFF for both channels, T1 and T2, when no probes are 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 onto the monitor screen. Perform the same check also for the channel T2.



16. 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 chapter [3.4.2 Temperature calibration](#).



17. 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.



18. 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.



Invasive blood pressure measurement

19. Check the front panel membrane keys that are related to the InvBP measurement. Press each of the keys at least for one second. Check that the pressed key is identified, i.e. one of the texts for 'Buttons' changes from OFF to ON in the service menu.



20. 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 onto the screen.

Perform the same check also for the InvBP channel P2.



21. Calibrate the InvBP channels P1 and P2 according to the instructions in the chapter [Invasive pressure calibration](#)



22. Check the InvBP channels with a patient simulator.

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

SENSITIVITY -switch - 5 µV/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 module connectors P1 and P2. Zero the InvBP channels by pressing the keys ZERO P1 and ZERO P2 on the module front panel.

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

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

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



SpO₂ measurement

23. Check that the message 'No probe' is shown when no SpO₂ sensor is connected to the module. Connect a SpO₂ finger probe to the module. Check that the message 'Probe off' is shown when the probe is not connected to a finger.



24. Connect the SpO₂ probe onto your finger. Check that the reading of 95-99 and SpO₂ waveform appears. Check that HR- value is calculated from SpO₂ when ECG and InvBP (P1) are not measured.



Non Invasive Blood Pressure measurement

25. Enter the NIBP module service menu:

Parameters - NIBP

Check that the 'Timeouts', 'Bad checksums' and 'Bad c-s by mod' values are not increasing faster than by 5 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.



26. Check the front panel membrane keys.

Select **Buttons/Leds**.

Press each of the two NIBP related membrane keys at least for one second. Check that the pressed key is identified, i.e. the corresponding text changes from OFF to ON in the menu when the key is released back up again.



27. 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 Exh2**. Press the ComWheel and check that the pressure inside the tubing system starts to drop then press the ComWheel again. 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 150 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**.



28. 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.



29. Calibration check.

Recalibrate the NIBP measurement. Remember to set the calibration protection back on after the 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 ± 20 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.



30. 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 270 - 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 135 to 165 mmHg.

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



31. Connect an adult NIBP cuff to the cuff connector and disconnect one of its hoses. Start NIBP measurement by pressing the key **Start/Cancel** on the module and check that the message 'Cuff loose' appears on the screen within 70 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 70 seconds.



32. Check that automatic inflation limits are in use:

NIBP - NIBP Setup - Inflation Limits - Auto - Previous Menu

Connect the cuff onto your arm, highlight **Start Ven.Stasis** in the NIBP menu and press the ComWheel. Check the module identifies the cuff, i.e. the text 'Adult' appears into the NIBP digit field for a short moment.

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



33. Keep the cuff on your arm and perform one NIBP measurement. Check that the module gives a reasonable measuring result.



34. 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 into the NIBP digit field. Cancel the measurement after the cuff identification.



All modules

35. Perform electrical safety check and leakage current test.



36. Check that the module functions normally after the performed electrical safety check.



37. Clean the module with suitable detergent.



- Fill in all necessary documents.