

3 Service procedures

3.1 General service information

The field service of the hemodynamic modules is limited to replacing faulty printed circuit boards or mechanical parts. The 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 fault description.


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.

3.2 Service check

These instructions include complete procedures for a service check. The service check should be performed after any service repair. Additionally, 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 ("[APPENDIX A:](#)") which should be filled in when performing the procedures.

The symbol  in the instructions means that the check form should be signed after performing the procedure.

3.2.1 Recommended tools

NOTE: Use only properly maintained, calibrated and traceable measurement equipment for the specified calibrations and adjustments to ensure accuracy.

Table 12 Recommended tools

Tool	Order No.	For product(s)
Hemodynamic patient simulator	M1010831	Hemodynamic modules
Adapter cables for simulators		
- Dual temperature adapter cable	402015-004	Hemodynamic patient simulator and Medsim
- Dual Inv.BP adapter cable	2005772-001	Hemodynamic patient simulator
- Temperature adapter cable	M1010832	Medsim
- Inv.BP adapter cable	M1010858	Medsim
- Temperature adapter cable	M1010846	Lionheart & MPS450
- Inv.BP adapter cable	M1010862	Lionheart & MPS450
Pressure manometer		Hemodynamic modules w/ (P)

Tool	Order No.	For product(s)
Accessories:		
Temperature test set	884515	Hemodynamic modules w/ (T)
Multi-Link ECG accessories, IEC:		
- Multi-link 3-leadwire set	412682-003	Hemodynamic modules w/ (E)
- Multi-link 5-leadwire set	412681-003	Hemodynamic modules w/ (E)
- Multi-link 5-leadwire set, C2-C6	416467-004	Hemodynamic modules w/ (E)
- Multi-link 12-lead ECG trunk cable	416035-002	Hemodynamic modules w/ (E12)
Multi-Link ECG accessories, AHA:		
- Multi-link 3-leadwire set	412682-001	Hemodynamic modules w/ (E)
- Multi-link 5-leadwire set	416681-001	Hemodynamic modules w/ (E)
- Multi-link 5-leadwire set, V2-V6	416467-003	Hemodynamic modules w/ (E)
- Multi-link 12-lead ECG trunk cable	416035-001	Hemodynamic modules w/ (E12)
SpO ₂ finger probe	OXY-F-UN	Hemodynamic modules w/ (S)
SpO ₂ Interconnect Cable	OXY-ES3	Hemodynamic modules w/ (S)
InvBP transducer	70077-001	Hemodynamic modules w/ (P)
Adult NIBP cuff hose with cuff ID	2021285-001	Hemodynamic modules w/ (NIBP)
Adult NIBP cuff	2753E	Hemodynamic modules w/ (NIBP)
Infant cuff hose without cuff ID	414874-001	Hemodynamic modules w/ (NIBP)
Screwdriver		

3.2.2 Recommended parts

Table 13 Recommended parts

Part	Order No.	Notes
NIBP pump filter	57142	

3.2.3 Visual inspection

Detach the module box by removing the two screws from the back of the module.

Check:

1. Internal parts
 - screws are tightened properly
 - connectors are connected properly
 - NIBP tubing is attached properly

- there are no loose objects inside the module



2. External parts

- the front cover and the front panel sticker are intact
- all connectors are intact and attached properly
- the module box and latch are intact



3.2.4 Functional inspection

3. NIBP pump filter

Replace the NIBP pump filter, if necessary.



Reattach the module cover 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 - Screen 1 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. Module installation

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



5. Module recognition

Check that the module is recognized, i.e. all the 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&Temp Setup - Resp Setup

Resp Rate Source - Auto

Measurement - On

Detection Limit - Auto

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

P2 'Cvp' Setup - Label - Cvp

PulseOximetry - Pleth Scale - Auto

ECG measurement

6. Module software (serial numbers)

Enter the service menu:

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

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



7. Communication and memories

Enter the **Parameters - ESTP:ECG** service menu.

Check that the Time-outs, 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. Power frequency

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. Cable recognition

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. Lead detection

Connect both 5-leadwire sets to the trunk cable. Connect all the leads together, for example to a suitable screwdriver. Check that all the electrodes show ON and the message 'Asystole' appears. Check that the Cable type shows 10 lead.

Connect the 10-leadwire set to the simulator. Disconnect one of the leads and check that the corresponding electrode in the service menu shows OFF within 10 seconds of the disconnection, and then reconnect the lead. Check the rest of the leads using the same method. Disconnect the trunk cable.

Connect a 3-leadwire set to a trunk cable and connect it to the module. Connect all the leads together, for example to a suitable screwdriver. Check that the cable type shows 3 lead.

NOTE: When any of the limb leads is disconnected, the measurement will automatically change to 3 electrode ECG measurement.

NOTE: The asystole and different leads off messages are shown using certain priority, Even though one of the leads is disconnected, the related leads off message may not appear on the screen.

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

NOTE: With PRESTN/RESTN/PRETN modules and 5 lead cable, the state of the V electrode is displayed only for the selected V Lead (**ECG Setup - V Lead: V1 - V6**).



11. Test with the patient simulator
 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 a 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 the shown pacemaker spikes.
 Set the pacemaker option off:
 ECG - PACE - WAVE - NSR



Respiration measurement

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



13. Test with patient simulator
 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 the 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. Communication and memories

Enter the ESTP: STP service menu:

Parameters - ESTP : STP

Check that the Time-outs, 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. Temperature probe detection

Check that the 'Cable' and 'Probe' show OFF for both channels, T1 and T2, when no probes are connected.

Connect the temperature adapter cable to the module temperature connector and a temperature test plug to the adapter cable. Check that the Cable and Probe for T1 show ON and the corresponding temperature value appears on the monitor screen.



16. Calibration check

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 chapter "Temperature calibration" on page 45."



17. Temp test

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. Module configuration

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 - Set Config** menu, if necessary. To activate the change, reset the module communication by removing and inserting the module.



Invasive blood pressure measurement

19. Membrane keys

Check the front panel membrane keys that are related to the InvBP measurement.

Press each of the keys for at least 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. Cable and transducer detection

Check that the Cable and Probe for P1 show OFF. Connect the InvBP adapter cable to the module, connect a cable with an invasive blood pressure transducer to the adapter cable 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.



21. Calibration

Calibrate the InvBP channels P1 and P2 according to the instructions in chapter "Invasive pressure calibration" on page 46."



22. Test with patient simulator

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 module connectors. 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 the HR value is calculated from P1, when ECG is not measured (ECG cable disconnected).



SpO₂ measurement

23. SpO₂ probe detection

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 (with the interconnection cable, if needed). Check that the message 'Probe off' is shown when the probe is not connected to a finger.



24. Test measurement

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



Non Invasive Blood Pressure measurement

25. Communication and memories

Enter the NIBP module service menu:

Parameters - NIBP

Check that the Time-outs, 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. Membrane keys

Check the front panel membrane keys.

Select **Buttons/Leds**.

Press each of the two NIBP related membrane keys for at least 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. Pump and valves

Check the pump and valves.

Select **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.

Select **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.

Select **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. Leak test

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 290 mmHg and then the pump stops. The max pressure in Adult mode is about 290 mmHg, but in Infant mode only 140mmHg.

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 according to the instructions in chapter "NIBP calibrations" on page 3-44. Remember to set the calibration protection back on after the calibration.

Disconnect the pressure manometer. Select **Calibrations - 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. Safety valve functions

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

Disconnect the pressure manometer from the NIBP module cuff connector. Connect the NIBP hose and cuff to the NIBP module cuff connector.

Perform the check with a standard adult cuff that is connected around some round object, for example a calibration gas bottle.

Select **Start Test**. Start the adult safety valve test by pressing the ComWheel. Wait until the pump stops and the pressure is deflated.

Open the cuff connector or disconnect and connect the cuff connector from the module.

Check the pressure values 'Max press' and '2 s after stop' for both transducers. All the values should be within 270 - 330 mmHg.

Select **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.

Open the cuff connector or disconnect and connect the cuff connector from the module.

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. Cuff related messages

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. Test measurement

Check that the automatic inflation limits are in use:

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

Connect the cuff onto your arm, select **Start Ven.Stasis** in the NIBP menu and press the ComWheel. Check that 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 find out that the cuff is not leaking, then press the ComWheel again. Select **Normal Screen**.

Disconnect the cuff hose.



33. NIBP hose detection

Press the **Start/ Cancel** module or side panel key and check that the 'Cuff loose' message appears in the NIBP digit field.

Attach a NIBP cuff hose without cuff identification and check that the module identifies the hose:

- The message 'Select inflation limits' appears in the NIBP digit field.
- When you try to start the measurement, the monitor automatically opens the selections **NIBP Setup - Inflation Limits**.



All modules

34. Electrical safety check

Perform an electrical safety check and a leakage current test.



35. Functioning after electrical safety check

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



36. Final cleaning

Clean the module with suitable detergent.



Fill in all necessary documents.