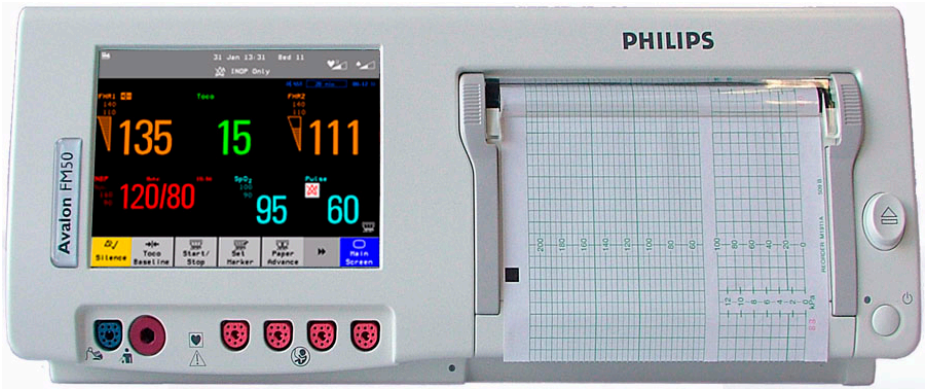
Obstetrical Care



SERVICE GUIDE

Avalon Fetal Monitor
FM40 / FM50

FETAL MONITORING

PHILIPS

Printed in Germany

Part Number M2705-9000A
451261025951

Table of Contents

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Introduction

This Service Guide contains technical details for the Avalon FM40 and FM50 Fetal/Maternal Monitors. It provides a technical foundation to support effective troubleshooting and repair. It is not a comprehensive, in-depth explanation of the product architecture or technical implementation. It offers enough information on the functions and operations of the monitoring systems so that engineers who repair them are better able to understand how they work. It covers the physiological measurements and the monitor hardware that acquires and displays them.

The *Avalon FM40/FM50 Fetal Monitor Service Guide* supplements the maintenance and troubleshooting procedures, carried out by the operator, that are described in the *Instructions for Use*. Refer to the *Instructions for Use* for maintenance and troubleshooting procedures that may be performed during normal operation.

Only qualified service personnel should attempt to install the system, disassemble the monitor, remove or replace any internal assemblies, or replace the transducer cable or belt buttons.

Who Should Read This Guide

This guide is for biomedical engineers or technicians responsible for troubleshooting, repairing, and maintaining Philips' Avalon fetal monitors.

You must:

- understand English
- be familiar with standard medical equipment installation procedures
- be familiar with current conventional technical terms as used throughout this guide

What to Do Next

Familiarize yourself with the contents of this guide and the *Instructions for Use* before attempting to service or repair the system.

Repair Strategy

The Service Support Tool software helps you to determine whether a fault is a hardware or software problem. The main replaceable parts are:

- unit exchange for the transducers
- replacement of
  - the top cover
  - the power supply assembly
  - the loudspeaker assembly
  - the noninvasive blood pressure assembly
  - the SpO_2 assembly
  - the interface boards (RS232/LAN, dual PS/2 and MIB/RS232)
  - the main CPU board
  - the front bezel assembly
  - the telemetry socket connector block
  - the sensor socket connector block
  - the API board
  - the recorder assembly
  - the thermal line printhead (TLPH)
  - the transducer cable
  - the transducer belt button

See Chapter 9, “Parts” for part numbers, and Chapter 10, “Disassembly and Reassembly” for repair details.

Repair or replacement of individual components on the boards is not supported, and should never be attempted.

For tests that you are required to perform after repairs, refer to “When to Perform Test Blocks” on page 30.

Manufacturer’s Information

Philips Medizin Systeme Böblingen GmbH

Hewlett-Packard-Str. 2

71034 Böblingen, Germany

Passwords

In order to access different modes within the monitor a password may be required. The passwords are listed below.

Monitoring Mode: No password required

Configuration Mode: 71034

Demo Mode: 14432

Service Mode: 1345

Refer to Chapter 12, “Understanding Configuration” before making any changes to the monitor configuration.

Warnings and Cautions

In this guide:

- A **warning** alerts you to a potential serious outcome, adverse event or safety hazard. Failure to observe a warning may result in death or serious injury to the user or patient.
- A **caution** alerts you where special care is necessary for the safe and effective use of the product. Failure to observe a caution may result in minor or moderate personal injury or damage to the product or other property, and possibly in a remote risk of more serious injury.

2

Site Preparation

Introduction

This section describes the procedures you should follow to plan and prepare a site for an Avalon FM40/FM50 fetal monitor installation.

- Site planning.
- Roles and responsibilities for local and Philips personnel.

Site Planning

The careful planning of the site for the FM40/FM50 monitor is essential for its safe and efficient operation. A consulting schedule should be established between the Customer and Philips Sales and Support Representatives, to ensure that all preparations are completed when the system is delivered.

The site planning phases prior to equipment installation are:

Location: Planning the location of the various system components.

Environment: Confirming and correcting, as necessary, the environment of the proposed installation site(s).

System Capabilities: Explaining the possibilities for system expansion.

Mounting: Referencing the mounting hardware information website for the listing of suitable mounting hardware recommended for use with the various system components, and all details on the available mounts and accessories.

Cabling: Identifying the requirements for the cabling, conduiting and faceplates for connecting the various system components.

Roles and Responsibilities

This section describes the procedures necessary to prepare a site for a system installation. The procedures are grouped into two parts: procedures that local staff or contractors are responsible for, and procedures that Philips personnel are responsible for.

Site Preparation Responsibilities

Local Staff

- Ensure that all safety, environmental and power requirements are met.
- Provide power outlets.
- Prepare mounts, and consult Philips for detailed mounting requirements.

- Pull cables, install conduit, install wallboxes.

Philips Personnel

- Provide the customer with the safety, environmental and power requirements.
- Assemble mounts, as necessary.
- Provide requirements for cabling.

Procedures for Local Staff

The following tasks must be completed **before** the procedures for Philips personnel may be started.

- Providing Power Outlets

  Provide a power outlet in the vicinity (1 m or 3 ft) or any peripheral equipment.

WARNING Only the power cables provided with the system may be used. For reasons of safety, power (mains) extension cables or adapters shall not be used.

- Preparing Mounts

  Where ceiling, wall, or shelf mounts are required for mounting the equipment, the customer is responsible for the following:

  – Providing and installing all hardware which is required to install the mounting hardware supplied by Philips as detailed in the installation notes.

  – Making sure that all ceilings, walls, and mounting rails that supports mounting hardware are suitable for their proposed load.

WARNING It is the customer's responsibility to have the attachment of the mounting hardware to the ceiling, wall, or mounting rail and the construction of the ceiling, wall, or mounting rail evaluated for structural integrity and compliance with all local, state and any other required codes by a registered, professional, structural and/or mechanical engineer.

Although considerable effort has been made to ensure the safety of the ceiling mount installation and or mounting guidelines, it is to be understood that the installation itself is beyond the control of Philips Medical Systems. Accordingly, Philips Medical Systems will not be responsible for the failure of any such installation.

- Providing Conduit

  – Providing conduit and/or trunking of a sufficient cross-sectional area for the planned cables and possible future expansion (for additional components or systems).

  – Providing and/or installing suitable wall boxes to accommodate the faceplates.

- Pulling Cables

WARNING NEVER run power cables through the same conduit or trunking used for system cables.

- Installing Wall Boxes

It is the customer's responsibility to provide and install wallboxes to house faceplates. The customer must notify the Philips installation coordinator of which size is to be used.

Procedures for Philips Personnel

Before you begin the procedures in the installation sections, ensure that the customer has completed all necessary preparations outlined in the previous section, “Procedures for Local Staff.”

Site Requirements

The site requirements are listed in this section.

Space Requirements

The situating of the monitor should be planned such that the nursing staff are able to monitor the patient with relative ease, with all patient connectors and controls readily available and the displays clearly visible. The location should also allow access to service personnel without excessive disruption and should have sufficient clearance all round to allow air circulation.

Dimensions and weight:

Monitor:

Size (W x H x D): 420 x 172 x 370 mm (16.5 x 6.8 x 14.6 in)

Weight; < 9.0 kg (19.8 lb)

Transducer:

Size (diameter): 83 mm (3.27 in)

Weight (without cable): 190g (6.7 oz.)

Environmental Requirements

The environment where the FM40/FM50 monitor will be used should be reasonably free from vibration, dust and corrosive or explosive gases. The ambient operating and storage conditions for the FM40/FM50 monitor must be observed. If these conditions are not met, the accuracy of the system will be affected and damage can occur.

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Monitor (M2704A/M2705A) Interface Cable for Avalon CTS (M2731-60001/M2732-60001)		
Temperature Range	Operating	0°C to 45°C (32°F to 113°F)
	Storage	-20°C to 60°C (-4°F to 140°F)
Humidity Range	Operating	<95% relative humidity @ 40°C/104°F
	Storage	<90% relative humidity @ 60°C/140°F
Altitude Range	Operating	-500 to 3000 m/-1640 to 9840 ft.
	Storage	-500 to 13100 m/-1640 to 43000 ft.

Transducers (M2734A/M2735A/M2736A/M2738A)		
Temperature Range	Operating	0°C to 40°C (32°F to 104°F)
	Storage	-20°C to 60°C (-4°F to 140°F)

Transducers (M2734A/M2735A/M2736A/M2738A)		
Humidity Range	Operating	<95% relative humidity @ 40°C/104°F
	Storage	<90% relative humidity @ 60°C/140°F
Altitude Range	Operating	-500 to 3000 m/-1640 to 9840 ft.
	Storage	-500 to 13100 m/-1640 to 43000 ft.

SpO_2 Sensors	
Operating Temperature Range	0°C to 37°C (32°F to 98.6°F)

Safety Requirements (Customer or Philips)

The monitor is an electrical Class I device in which protection against electric shock does not rely on basic insulation only, but which includes an additional safety precaution, in that means are provided for the connection of the equipment to a protective earth conductor in the fixed wiring installation in such a way that accessible metal parts cannot become live in the event of a failure of the basic insulation.

WARNING

- Always use the supplied power cord with the earthed mains plug to connect the monitor to an earthed AC mains socket. Never adapt the mains plug from the power supply to fit an unearthed AC mains socket.
- Do not use additional AC mains extension cords or multiple portable socket-outlets. If a multiple portable socket-outlet without an approved separating transformer is used, the interruption of its protective earthing may result in equipment leakage currents equal to the sum of the individual earth leakage currents, so exceeding allowable limits.

Electrical Requirements (Customer or Philips)

Line Voltage Connection

The FM40/FM50 monitor uses < 60 W.

Line Voltage: the FM20/FM30 monitor may be operated on ac line voltage ranges of 100 to 240V (50/60 Hz).

Connecting Non-Medical Devices

The standard IEC/EN 60601-1-1 applies to any combination of devices, where at least one is a medical device. Therefore IEC/EN 60601-1-1 must still be met after all devices are connected.

WARNING

- Do not use a device in the patient vicinity if it does not comply with IEC/EN 60601-1. The whole installation, including devices outside of the patient vicinity, must comply with IEC/EN 60601-1-1. Any non-medical device, **including a PC running an OB TraceVue system**, placed and operated in the patient's vicinity must be powered via a separating transformer (compliant with IEC/EN 60601-1-1) that ensures mechanical fixing of the power cords and covering of any unused power outlets.
- Do not connect any devices that are not supported as part of a system.

Whenever you combine equipment to form a system, for example, connecting the monitor to an OB TraceVue system, perform a system test according to IEC/EN 60601-1-1 (see "System Test" on page 38).

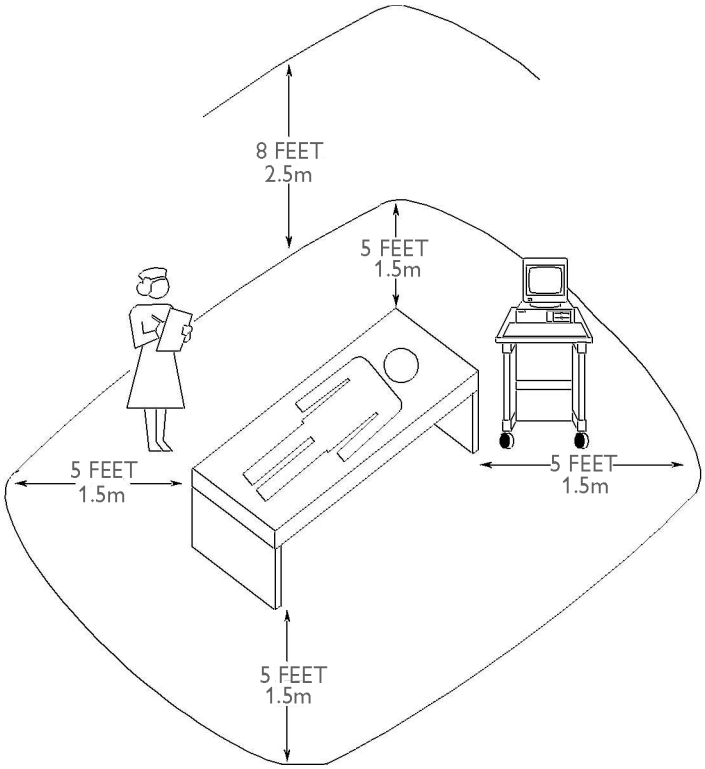


Figure 1 Equipment Location in the Patient Vicinity

Cabling Options and Requirements for Connection to OB TraceVue

For cabling options and requirements for connection to an OB TraceVue system, refer to the **OB** *TraceVue Site Preparation Guide* and the *OB TraceVue Service Guide*.

Mounting Options

See "Mounting Hardware" on page 61 for a list of mounting options. Refer to "Mounting Instructions" on page 12, or contact your local Philips representative for advice on mounting the monitor.

PS/2 Input Devices

The following table describes the input devices which can be connected to the monitor via the optional PS/2 interface.

Product Option Number	Part Number	12NC Part Number	Description
M8024A #A01	862454	989803124741	Slimline Keyboard with integrated Trackball
M8024A #B01	M4046-60104	451261000661	Optical Mouse USB / PS/2
M8024A #C01	M4046-60103	451261000651	Wired Track Ball USB / PS2
M8024A #C02	M4046-60105	451261000671	Wireless Track Ball
M8024A #C03	M4046-60106	451261000681	Wired off table Track Mouse

Displays and Touch Devices

The following two tables describe the remote displays that can be connected to the monitor's video output connector.

For touch operation, the MIB/RS232 interface is required. See "Connecting a Remote Display via the MIB/RS232 Interface" on page 16.

M8031B: 15" TFT Medical Grade Touch Display

Product Number	Part Number	12NC Part Number	Description
M8031B	M8031-60001	45121001911	15" Medical Grade Display with Touch
-	M8031-68001	451261001941	Exchange 15" Medical Grade Display with Touch
-	M8031-60005	451261001921	Power Supply 12V for M8031B Display
-	M8031-64001	451261001931	Power Supply Mounting for M8031B Display
-	M8031-04701	451261001901	Monitor Desk Stand for M8031B/M8033C
-	2090-0860	453563463201	Backlights for M8031B

M8033C: 17" TFT Medical Grade Touch Display

Product Number	Part Number	12NC Part Number	Description
M8033C	M8033-60071	451261009151	17" Medical Grade Display with Touch
-	M8033-68071	451261009161	Exchange 17" Medical Grade Display with Touch
-	M8031-04701	451261001901	Monitor Desk Stand for M8031B/M8033C
-	M8033-64603	451920880311	Backlights for M8033C

Video Cables for Remote Displays

Product Option Number	Part Number	12NC Part Number	Description
M8022 #VA2	M3080-61606	453563484451	1.5 m Analogue Video Cable Kit
M8022 #VA3	M3080-61602	453563334661	3 m Analogue Video Cable Kit
M8022 #VA6	M3080-61603	453563334671	10 m Analogue Video Cable Kit*
Both ends are terminated with HDSUB15 (“VGA”) straight connectors. *Built on demand			

3

Installation Instructions

The information contained in this chapter, **in addition to that given in the *Instructions for Use*,** should enable the monitor to be installed ready for use (the preparation and planning should be adhered to as specified in the "Site Preparation" chapter). Safety checks and inspection procedures for mounts are explained in the "Testing and Maintenance" chapter, and configuration of the system is explained in the "Configuration" chapter.

Please keep the packing materials until you have completed the initial inspection, in case there is a defect on arrival.

Initial Inspection

Inspect the delivery on arrival.

Visual Inspection

Open the shipping container(s) and examine each part of the instrument for visible damage, such as broken connectors or controls, or scratches on the equipment surfaces. If the shipping carton/container is undamaged, check the cushioning material and note any signs of severe stress as an indication of rough handling in transit. This may be necessary to support claims for hidden damage that may only become apparent during subsequent testing.

Electrical Inspection

The instrument has undergone extensive testing prior to shipment. Safety testing at installation is not required (except in situations where devices are interconnected forming a system, see "Connecting Non-Medical Devices" on page 8). An extensive self check may be performed. This recommendation does not supersede local requirements.

All tests are described in the "Testing and Maintenance" chapter of this manual.

Claims for Damage

When the equipment is received, if physical damage is evident or if the monitor does not meet the specified operational requirements of the patient safety checks or the extended self check, notify the carrier and the nearest Philips Sales/Support Office at once. Philips will arrange for immediate repair or replacement of the instrument without waiting for the claim settlement by the carrier.

Repackaging for Shipment or Storage

If the instrument is to be shipped to a Philips Sales/Support Office, securely attach a label showing the name and address of the owner, the instrument model and serial numbers, and the repair required (or symptoms of the fault). If available and reusable, the original Philips packaging should be used to provide adequate protection during transit. If the original Philips packaging is not available or reusable please contact the Philips Sales/Support Office who will provide information about adequate packaging materials and methods.

Mounting Instructions

Every type of compatible mounting solution is delivered with a complete set of mounting hardware and instructions. Refer to the Site prep chapter for a list of mounting options. Refer to the documentation delivered with the mounting hardware for instructions on assembling mounts.

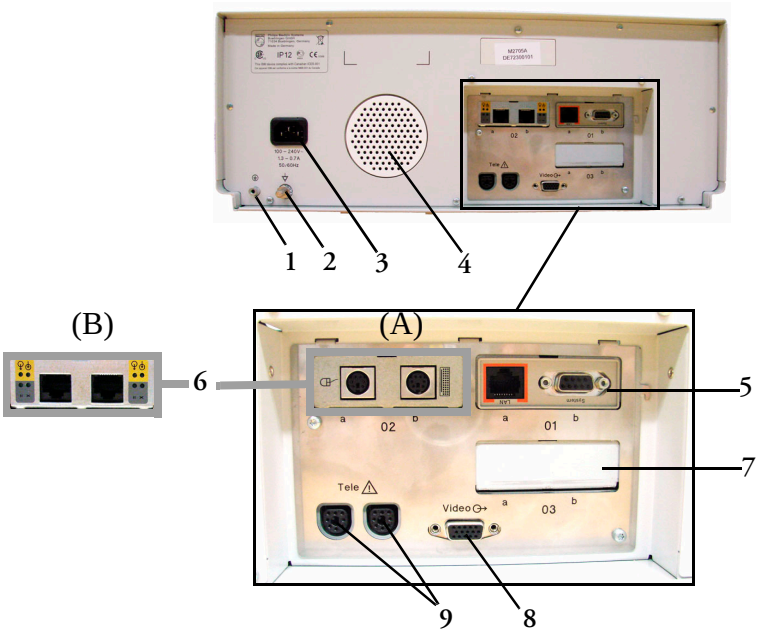
WARNING It is the customer's responsibility to have the attachment of the mounting hardware to the ceiling, wall, or mounting rail and the construction of the ceiling, wall, or mounting rail evaluated for structural integrity and compliance with all local, state and any other required codes by a registered, professional, structural and/or mechanical engineer.

Ensure that this commitment has been met before assembling mounts.

Line Voltage Selection

You do not need to set the line voltage, as this is done automatically by the power supply. The monitor has a wide-range power supply that allows you to operate the monitor from an AC (alternating current) power source of 100 V to 240 V (± 10%) and 50/60 Hz (± 5%).

Rear View



1 Reserved for future use: protective earth intended for use in system installations.

2 Equipotential grounding point

3 Power cord connector

4 Loudspeaker

5 Slot 01 for optional LAN / RS232 system interface (for connection to an obstetrical information and surveillance system)

6 Slot 02 for optional interfaces:

- *Either* dual PS/2 system interface (A) for mouse and keyboard connection)
- *Or* MIB interface (B) for external touch screen connection

7 Slot 03 reserved for future use

8 Video output (VGA)

9 Telemetry interface. If not using one of the fetal sensor sockets, one Avalon CTS can be connected at a time to either socket using the M2732-60001 interface cable (with black connector).

Connecting the Monitor to AC Mains

The monitor is an electrical Class I device in which protection against electric shock does not rely on basic insulation only, but which includes an additional safety precaution, in that means are provided for the connection of the equipment to a protective earth conductor in the fixed wiring installation in such a way that accessible metal parts cannot become live in the event of a failure of the basic insulation.

WARNING

- Always use the supplied power cord with the earthed mains plug to connect the monitor to an earthed AC mains socket. Never adapt the mains plug from the power supply to fit an unearthed AC mains socket.
- Do not use AC mains extension cords or multiple portable socket-outlets.

Connecting the Monitor to Non-Medical Devices

Connect the monitor to an obstetrical surveillance system, such as OB TraceVue, via the optional system interface. For cabling requirements, refer to “Cabling Options and Requirements for Connection to OB TraceVue” on page 9. For safety-related information, refer to “Connecting Non-Medical Devices” on page 8, and “System Test” on page 38.

Connecting a Remote Display via the MIB/RS232 Interface

The configuration of a specific MIB/RS232 port can be viewed in Configuration Mode and altered in Service Mode. This is required when a remote display with touchscreen is installed. To configure an MIB/RS232 port to support a slave display with touchscreen:

1 Select **Main Setup**.

2 Select **Hardware**.

3 Select **Interfaces**.

4 Select **MIB/RS232**.

5 Select **Touch 1**.

NOTE Be aware that if you configure a port, this assignment is retained after a boot up. If the MIB/RS232 board is removed and replaced with a different type of board the settings are deleted. If the MIB/RS232 board is then refitted, you must reconfigure the MIB/RS232 port. The configuration of MIB/RS232 is not cloned between monitors.

After loading the Factory Defaults, you will need to reconfigure the MIB/RS232 port to re-enable the touch operation of the connected remote display.

Installing a Remote Display

The monitor is tested and approved for use with the following remote displays:

- Philips M8031B 15” Remote Display
- Philips M8033C 17” Remote Display

The monitor has an analog-only video output signal, with VGA resolution. Use a standard VGA video cable to connect the remote display to the video output on the rear of the monitor.

Mounting Remote Displays

Mounting solutions for the M8031B and M8033C remote displays must be purchased separately. Please refer to the installation instructions which ship with the mounting solution purchased.

Before Using the Monitor

WARNING Before starting monitoring, check that the configuration meets your requirements.

Check that the following configuration settings are suitable:

- Line Frequency
- Paper Scale
- Paper Speed
- Equipment Label
- Configured SmartKeys

- Input device configuration (if using an external keyboard or mouse)
- Remote display settings (if using a remote display, see “Connecting a Remote Display via the MIB/RS232 Interface” on page 16).

If you need to enter configuration mode to change settings:

1 In the **Main Setup** menu, select **Operating Modes**.

2 Select **Config** and enter the passcode.
The passcode for configuration mode is given in the monitor’s service documentation.

The monitor displays **Config** at the right hand side of the status line and in the center of the Screen while you are in configuration mode.

Before you leave configuration mode, always be sure to store any changes you made. You must store changes made to each Settings Block and to each Profile, individually. As it may be difficult to remember whether the settings you changed belong to a Monitor Settings block or a Measurement Settings block, we recommend that you store each block before you leave configuration mode.

To leave configuration mode:

1 Enter the **Main Setup** menu.

2 Select **Operating Modes**.

3 Select **Monitoring**.

Checking and Setting Line Frequency

Before using the monitor, check that the line frequency setting is correct for your location, and change the setting if necessary in Service Mode.

WARNING An incorrect line frequency setting can affect the ECG filter, and disturb the ECG measurement. Ensure the line frequency setting is correct.

To set the line frequency:

1 Enter the **Main Setup** menu.

2 Select **Global Settings**.

3 Select **Line Frequency** and select **50Hz** or **60Hz** from the pop-up list.

Checking/Setting Paper Scale

Check the paper Scale Type (**US** for paper with a scale of 30-240, or **Internat’l** for paper with a scale of 50-210) in the Fetal Recorder menu. In Monitoring Mode, you can see this setting (grayed out), but you cannot change it. It can be changed in Configuration Mode.

1 Enter the **Main Setup** menu by selecting the SmartKey  .

2 Select **Fetal Recorder**.

3 Check the current setting for Scale Type. If it is not appropriate, change it in the Fetal Recorder menu in Configuration Mode:
Select **Scale Type** to toggle between **US** and **Internat’l**.

Checking/Setting Paper Speed

Check the paper speed before using the monitor. You can choose a paper speed of 1, 2, or 3 centimeters per minute (cm/min). The default setting is 3 cm/min. In Monitoring Mode, you can see this setting (grayed out), but you cannot change it. It can be changed in Configuration Mode.

As a change in paper speed results in a change in the appearance of a FHR trace, you are advised to ensure **ALL** monitors in your institution are set to the same speed.

To set the paper speed:

1 Enter the **Main Setup** menu using the SmartKey  .

2 Select **Fetal Recorder**.

3 In the Recorder menu, you can see the current speed setting. Select **Recorder Speed**.

4 Select the desired speed from the given choices: **1**, **2** or **3** cm/min.

Configuring the Equipment Label

OB TraceVue requires a unique equipment label. In OB TraceVue, is possible to prevent connection to monitors with specific equipment labels by means of a filtering mechanism. For more details, see the OB TraceVue Instructions for Use.

1 Select the **Bed Label** screen element to call up the **Bed Info** menu.

2 Select **Equipment Label** to call up the onscreen keyboard.

3 Enter the system identifier.

Configuring SmartKeys

Check that the configured SmartKeys are suitable. Configure the SmartKeys preferred by the institution from a global list Global Smart Keys. The global list of SmartKeys is stored as a unique monitor setting in the monitor configuration. See the section “Configuring Global SmartKeys” on page 138 for details on how to configure the global SmartKey list.

PS/2 Keyboard/Mouse

Switch off the monitor before connecting any PS/2 compatible device.

Connect the PS/2 connector to the PS/2 Interface board in the monitor at the slot indicated by the appropriate symbol.

The default keyboard language setting for all initial configurations is “US”.

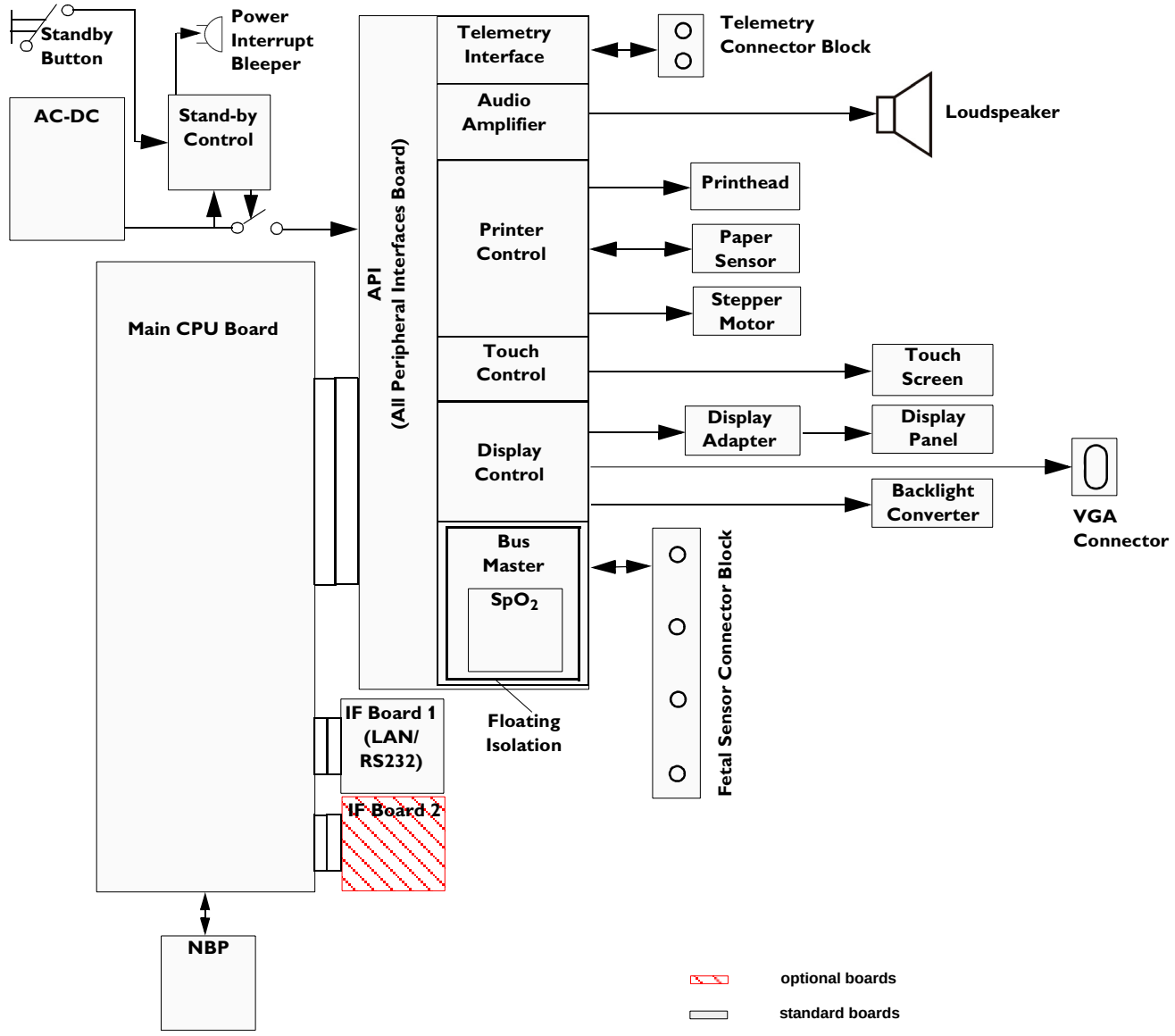
To configure the keyboard language manually, go to Service Mode, select **Main Setup** -> **Hardware** -> **Keyboard** and then select the proper language. Please note that this setting does not clone.

4

Theory of Operation

This chapter describes the functional operation of the monitor and the transducers. It incorporates features of the mechanical design, indicating the physical relationship of the assemblies and components.

Monitor Hardware Overview



The monitor consists of the following main functional components:

- Power supply
- API (All Peripheral Interfaces) Board
- Main CPU Board
- Fetal Recorder (Thermal Printer Unit)
- Fetal Sensor Connector Block
- Noninvasive Blood Pressure Board
- SpO_2 Board
- Input /Output Interface Boards:
  - LAN / RS232
  - Dual PS/2 (optional)
  - MIB / RS232 (optional)

Power Supply

The power supply is a wide-range input switching unit, with an output of 24V. It is located in the chassis assembly.

Fetal Sensor Connector Block

Any compatible fetal transducer can be connected in any order to the monitor via the sockets on the Connector Block. The Connector Block is located on the Bus Master section of the All Peripheral Interfaces (API) Board, and is exchangeable.

API (All Peripheral Interfaces) Board

The All Peripheral Interfaces (API) Board is connected to the Main CPU Board by a 154-pin 0.5 mm pitch press fit connector.

The recorder is controlled by the Printer Control section of the API Board, which is connected to the Stepper Motor and the Thermal Printer Unit.

The signals from the transducers or sensors are conveyed from the sensor sockets to the Bus Master section of the API Board. The Telemetry Interface is also integrated into the API Board.

The Bus Master section is responsible for transducer detection, communicates with the connected transducers via a CAN bus, and communicates parameter data to the Main CPU Board via a serial link for further processing and display. It has floating power isolation.

The API Board also controls the display panel and the backlight converter, and also controls the touchscreen. The display panel is connected to the API Board. The VGA connector is also connected to the API Board.

The API Board incorporates an audio amplifier which controls the loudspeaker.

Main CPU Board

The Main CPU Board controls the monitor's human interface, and is responsible for the final processing of data from the Bus Master Board. It sends this data to the TFT display, and to the thermal printer unit for recording traces and other patient data. It also controls the LAN/RS232 interface board, and the optional PS/2 and MIB interface boards.

Fetal Recorder (Thermal Printer Unit)

The fetal recorder is located in the front of the chassis assembly. The recorder consists of the following major parts:

- Thermal Line Printhead (TLPH)
- Paper Sensor
- Stepper Motor

Thermal Line Printhead (TLPH)

The TLPH is located on its own holder in the recorder chassis.

Paper Sensor

The paper sensor hardware consists of a reflective light sensor that detects the black marks on the trace paper, and paper-out. It is attached to the RFI Bracket, and connected to the Recorder Adapter Board via a removable cable connector.

Stepper Motor

The stepper motor is a bipolar motor controlled by a micro-stepping motor driver on the Recorder Adapter Board. The motor is located on the recorder chassis and is connected to the Recorder Adapter Board via a removable cable connector.

LCD Display and Touchscreen

The LCD Display Assembly consists of a five-wire resistive touchscreen, a 6.5" TFT panel, and a backlight inverter, all connected to the API Board and fitted into the front bezel assembly.

Noninvasive Blood Pressure Assembly

The optional Noninvasive Blood Pressure Assembly is located in the rear lefthand corner of the chassis assembly. It is connected via a serial link to the Main CPU Board.

SpO_2 Assembly

The optional SpO_2 Assembly is physically located on the Bus Master section, but sends data directly to the Main CPU Board via a serial link.

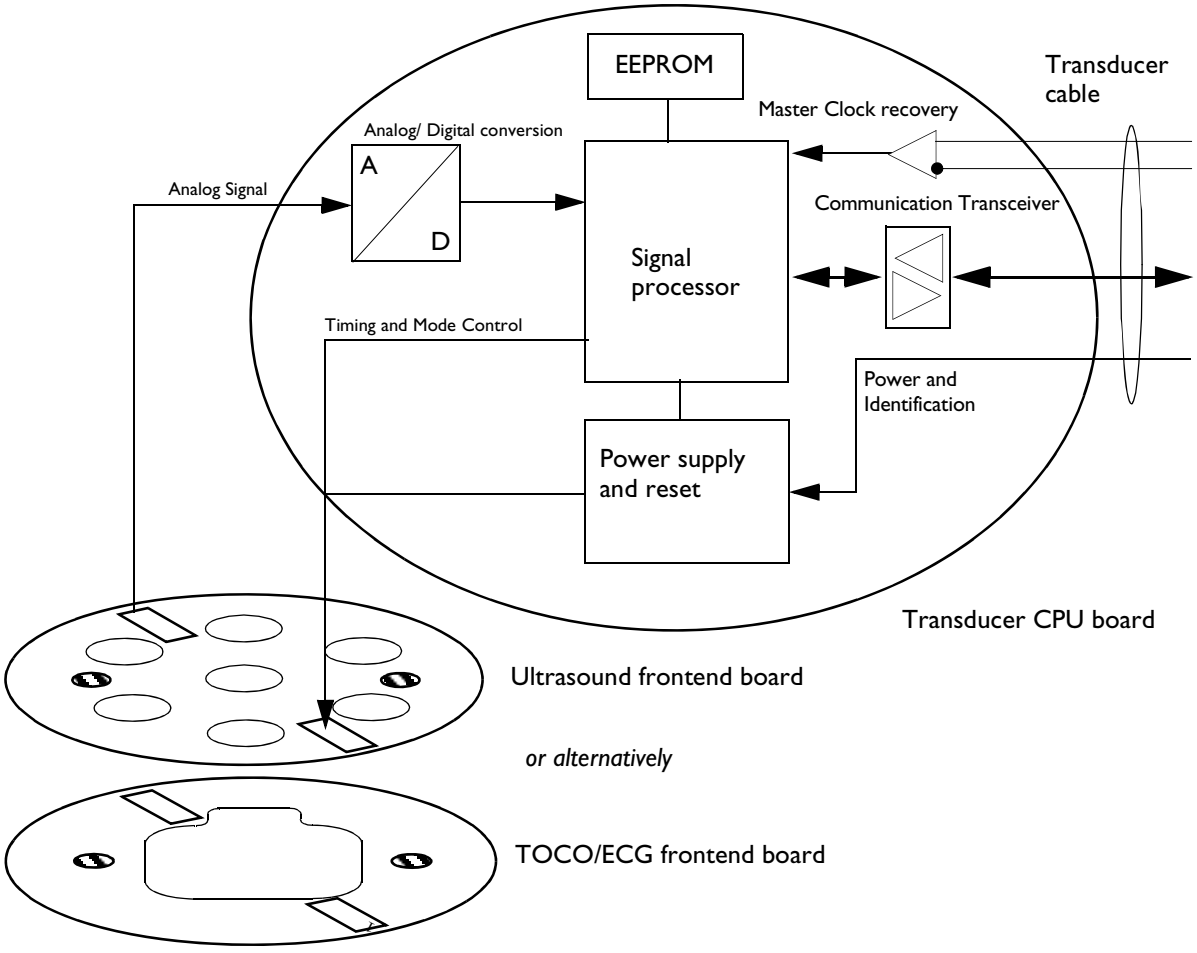
Input/Output Interface Boards

There are three interface boards available:

- LAN/RS232 Interface Board, used for connecting to a PC running the Support Tool and to a surveillance and documentation system such OB TraceVue.
- PS/2 Interface Board (optional), used for connecting an external keyboard or mouse.
- MIB Interface Board (optional), used for connecting external touchscreen displays.

The interface boards plug into the two interface slots on the rear panel of the device, and are controlled by the Main CPU Board.

Transducer Hardware Overview



Transducer Types

All transducers that can connect to the fetal sensor sockets can be used.

Functional Description of the Transducer CPU

The CPU section of the transducers is made up of the following main functional blocks:

- CPU (micro controller)
- Analog-to-Digital Converter
- Communication Transceiver (CAN bus driver)
- EEPROM

CPU (Micro Controller)

A single-chip processor is used to control the transducer, generate the frontend control signals, control the analog-to-digital signal conversion, and to perform the signal processing.

Analog-to-Digital Converter

Analog-to-digital (A/D) signal conversion is carried out by the 16-bit AD converter. Digital signals are directly communicated from the A/D converter to the CPU.

Communication Transceiver (CAN Bus Driver)

The communications transceiver (CAN bus driver) communicates directly with the transducer CPU, and allows the transducer to communicate with the Bus Master Board via the CAN bus.

EEPROM

The serial EEPROM stores all non-volatile data required to operate the transducer (for example, calibration and correction factors for frontend gains and offsets, country-specific information, serial numbers and error logs).

Toco Transducer Frontend

Uterine activity is measured by evaluating the hardness of the mother's abdomen with a pressure sensitive resistor bridge (strain gauge sensor element). The strain gauge sensor element requires an excitation voltage and its differential output signal is proportional to the pressure applied to it. A DC excitation voltage is used, and the resulting output signal is fed directly to an A/D signal converter before being sent to the processor.

Ultrasound Transducer Frontend

The ultrasound frontend is a pulsed Doppler system with a 1.0 MHz ultrasound frequency, and a pulse repetition rate of 3 kHz. Seven ultrasound crystals are used as transmitter and receiver.

Toco+ Transducer Frontends

Several parameter frontends are combined on one board. In addition to the Toco frontend, additional supported parameters are DECG, MECG and IUP.

A seven-pin 'D-type' socket carries all parameter related inputs and outputs. An external mode resistor, connected to one of the pins, automatically detects which mode to set when an adapter cable is plugged in (whether it is DECG, MECG, or IUP).

Toco Frontend

See "Toco Transducer Frontend" on page 23.

IUP Frontend

Intrauterine pressure (IUP) is measured via a piezo resistive bridge with AC excitation connected to the RA / LA input pins of the ECG amplifier. A/D conversion of the IUP signal is done by the 16-bit A/D converter.

ECG Frontend

The ECG frontend measures both DECG and MECG, using a 3-lead system (RA, LA and reference electrode). The ECG mode is automatically detected when an adapter cable is attached. Input lines are ESD protected.

Patient Module Frontends

The patient module shares the same parameter frontends as the Toco+ transducer, with the exception of the Toco frontend.

Avalon CTS Interface Cable (TMIF)

The Avalon CTS Interface Cable contains the Telemetry Module Interface (TMIF). The TMIF shares the signal processing circuitry with the rest of the Avalon transducers, with the exception that it has no frontend board. The TMIF is responsible for converting the analog signals from the parameter frontends of the Avalon CTS transducers into digital signals for transmission to the fetal monitor.

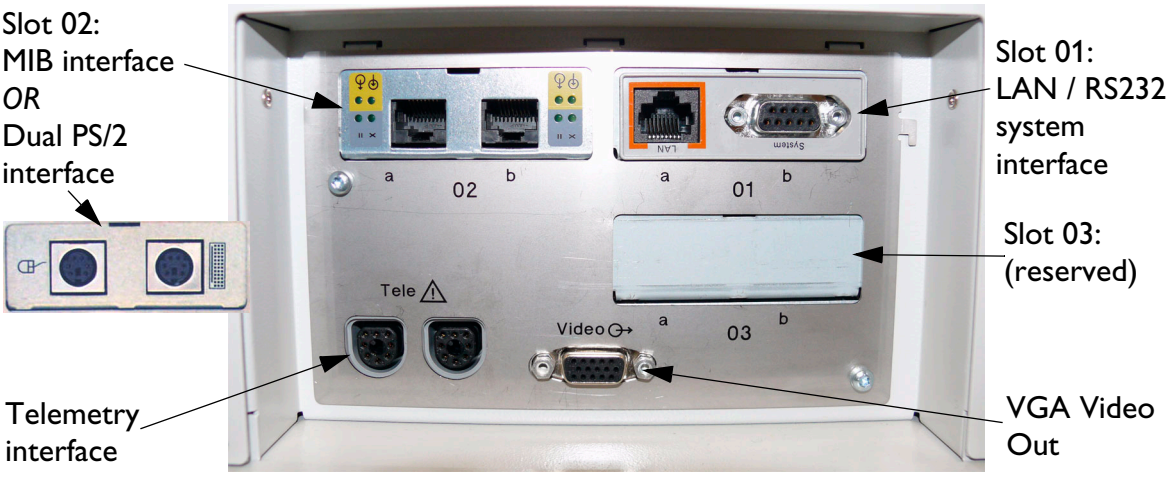
5

Rear Interfaces

All the interfaces can be found on the recessed rear panel of the monitor.

There are three interface boards available for the Avalon FM40 and FM50 fetal monitors:

- LAN / RS232 system interface
- Dual PS/2 interface (optional)
- MIB interface (optional)



The interfaces are "plug-and-play" boards, and fit into dedicated slots on the rear panel of the monitor. See "Removing the Interface Boards" on page 105 for details of how to remove and fit the boards.

LAN / RS232 Interface

The LAN / RS232 system interface has two fully isolated ports:

- The LAN connection can be used for connecting the monitor to a PC for configuration or upgrade using the Support Tool, for connecting the monitor to an OB TraceVue obstetrical information system on a network, and for future system expansion.
- The RS232 connection can be used for connecting the monitor to an obstetrical information and surveillance system, such as OB TraceVue.

Dual PS/2 Interface

This interface provides two PS/2 ports to enable the monitor to be connected to off-the-shelf, “plug-and-play” input devices:

- **Mouse:** any specified PS/2 mouse or trackball may be used for navigation and data entry.
- **Computer keyboard:** a PS/2 computer keyboard can be used for data entry instead of the on-screen pop-up keyboard.

MIB / RS232 Interface

The MIB interface (IEEE P1073) provides two independently configurable ports for connection to an external touch device.

Telemetry Interface

The telemetry interface is for connecting an Avalon CTS Cordless Fetal Transducer System. If you are not already using the M2731-60001 interface cable (with red connector) to connect to one of the fetal sensor sockets, one Avalon CTS can be connected at a time to either rear socket using the M2732-60001 interface cable (with black connector).

VGA Video Out

This connector is for connecting an external analog display. The video output has VGA resolution.

6

Connection to a Network

You can connect the fetal monitor to an OB TraceVue obstetrical information and surveillance system on a network using the LAN connection on the optional LAN / RS232 interface (see “LAN / RS232 Interface” on page 21).

Network Infrastructure Requirements

The Avalon FM40/50 sends Connection Indication messages that OB TraceVue processes to establish an ethernet connection to the fetal monitor. The general requirements for connecting the Avalon FM40/50 to an OB TraceVue obstetrical surveillance system over a network are as follows:

- The fetal monitor and the data acquisition PC must be in the same network segment.
- The Avalon FM40/50 can be allocated a valid IP address either manually, or from a BOOTP service. If no IP address is entered manually, the Avalon FM40/50 requires a BOOTP service to obtain a valid IP address automatically, therefore BOOTP service must be available in each network segment. If the OB TraceVue internal server is part of that network segment, then it can be configured to serve BOOTP requests.
- The ethernet port of the Avalon FM40/50 supports only 10 M-bit half-duplex data transfer.

Connection Indication Messages

Connection Indication (CI) messages can be sent by the Avalon FM40/50 in two ways: by Broadcast or by Unicast.

Broadcast

When CI messages are sent by broadcast, they have the potential to reach any data acquisition PC in the same network segment, and the connection to the fetal monitor is made dynamically by the next available host PC (the data acquisition PC with the least active connections).

Broadcast is the default, and recommended, method for sending CI messages. This is because if there are multiple host PCs available in the same network segment, the broadcast method provides greater availability by allowing load balancing and failure-tolerant functionality. If a particular host PC happens to be unavailable, the next available PC takes over the connection. In the **`Bed Information`** menu, the **`IP OB Server`** entry is **`0.0.0.0`**.

Unicast

When CI messages are sent by unicast, the fetal monitor sends a request to a specific target OB TraceVue data acquisition hosting PC in the same network segment. The CI message contains the IP address of the target PC, and only this PC will host the connection.

An example where CI messages are typically sent by unicast is where the fetal monitor and OB TraceVue PC are installed in the same cart, and you therefore always want the fetal monitor to be hosted by the same PC.

To avoid conflicts where there are multiple OB TraceVue systems operating in the same network segment, we recommend that you configure the fetal monitors to send the CI messages by unicast.

To enter the IP address of the target PC:

1 Enter Configuration Mode.

2 Select **Main Setup**.

3 Select **Bed Information**.

4 In the Bed Information menu, select **IP OB Server**.

5 Using the pop-up keypad, enter the IP address of the target server, and press Enter when you are done.

Equipment Label and OB TraceVue Fetal Monitor Domain Name

For connection to an OB TraceVue system over a network, OB TraceVue requires each fetal monitor to have an unique equipment label.

When a fetal monitor is configured with an equipment label, this equipment label is sent as part of the CI message. In OB TraceVue, it is possible to specify a Fetal Monitor Domain Name in the fetal monitor configuration user interface (see OB TraceVue Instructions for Use for details). The OB TraceVue system compares this name with the fetal monitor equipment label. Only if the domain name matches the beginning of the equipment label string is the CI message processed and accepted. Otherwise the CI message is ignored.

Using this filtering process, you can avoid conflicts where there are multiple OB TraceVue systems operating in the same network segment by controlling which monitors connect to a specific OB TraceVue system, and which monitors are excluded.

To enter or change the equipment label:

1 Enter Service Mode.

2 Select **Main Setup**.

3 Select **Bed Information**.

4 In the Bed Information menu, select **Equipment Label**.

5 Enter the desired equipment label for your monitor (up to 12 alphanumeric characters are displayed), then press **Enter**.

7

Testing and Maintenance

This chapter contains the testing and maintenance procedures to ensure the proper functioning of the monitor and accessories, covering preventive maintenance, performance assurance and safety.

Carry out the procedures as specified in the following sections.

For detailed instructions on how to clean the monitor, transducers and accessories, see the monitor's *Instructions for Use*.

Recommended Frequency

Perform the procedures as indicated in the suggested testing timetable. These timetable recommendations do not supersede local requirements.

Table 1: Suggested Testing Timetable

Tests			Frequency
Preventive Maintenance		Noninvasive Blood Pressure Calibration	Once every two years, or as specified by local laws (whichever comes first).
Other Regular Tests		Visual Inspection	Before each use.
		Recorder Maintenance	Once a year, or if the printout is degraded.
		Testing Transducers and Patient Modules	Once a year, or if you suspect the measurement is incorrect.
Performance Assurance Tests		Noninvasive Blood Pressure Performance Tests	Once every two years, or if you suspect the measurement is incorrect.
		SpO_2 Performance	
Safety Tests	**Visual**	Visual Inspection	Once every two years and after repairs where the power supply is removed or replaced, or if the NBP assembly, SpO_2 board, or fetal sensor connector block is removed or replaced, or the monitor has been damaged by impact.
	Electrical	Protective Earth Equipment Leakage Current Patient Leakage Current	

When to Perform Test Blocks

This table tells you when to perform specific test blocks. See page 31 for test details.

Table 2: When to perform test blocks

Service Event	Test Block(s) Required - Complete these tests
Installation	
Installation of standalone monitor	Perform Visual Inspection and Power On Test Blocks (see Table 3).
Installation of monitor with a display connected to the video output	Perform Visual Inspection, Power On and System test blocks (see Table 3).
Installation of networked monitor (LAN)	Perform Visual Inspection, Power On and System test blocks (see Table 3).
Preventive Maintenance	
Noninvasive Blood Pressure performance testing	Perform Noninvasive Blood Pressure Performance tests blocks (see Table 3).
Other Regular Tests and Tasks	
Visual Inspection	Perform Visual Inspection test block (see Table 3).
Transducer and Patient Module Testing	See “Performance Assurance Tests” on page 38.
Recorder Maintenance	Regular cleaning and maintenance (see “Fetal Recorder Maintenance” on page 31 Perform the recorder selftest (see “Fetal Recorder Selftest Report” on page 50).
Repairs	
Repairs when the monitor has been damaged by impact.	Perform Visual Inspection, Power On, Performance and all Safety test blocks (see Table 3).
Repairs where the power supply has been removed or replaced.	
All repair events involving any of the following: Noninvasive Blood Pressure connector, SpO_2 connector/ board or the red fetal sensor sockets.	Perform Visual Inspection, Power On, Performance test blocks and all Safety test blocks (see Table 3).
All other repair events.	Perform Visual Inspection, Power On and Performance test blocks (see Table 3).
Upgrades	
Software upgrades.	Perform Visual Inspection and Power On test blocks (see Table 3.)
Combining or Exchanging System Components	Perform the System Test (see Table 3 and “System Test” on page 37).
All other service events	Perform Visual Inspection, Power On and Performance test blocks (see Table 3).

Preventive Maintenance Procedures

Noninvasive Blood Pressure Measurement Calibration

Carry out the noninvasive blood pressure measurement performance tests at least every two years, or as specified by local laws (whichever comes first).

Fetal Recorder Maintenance

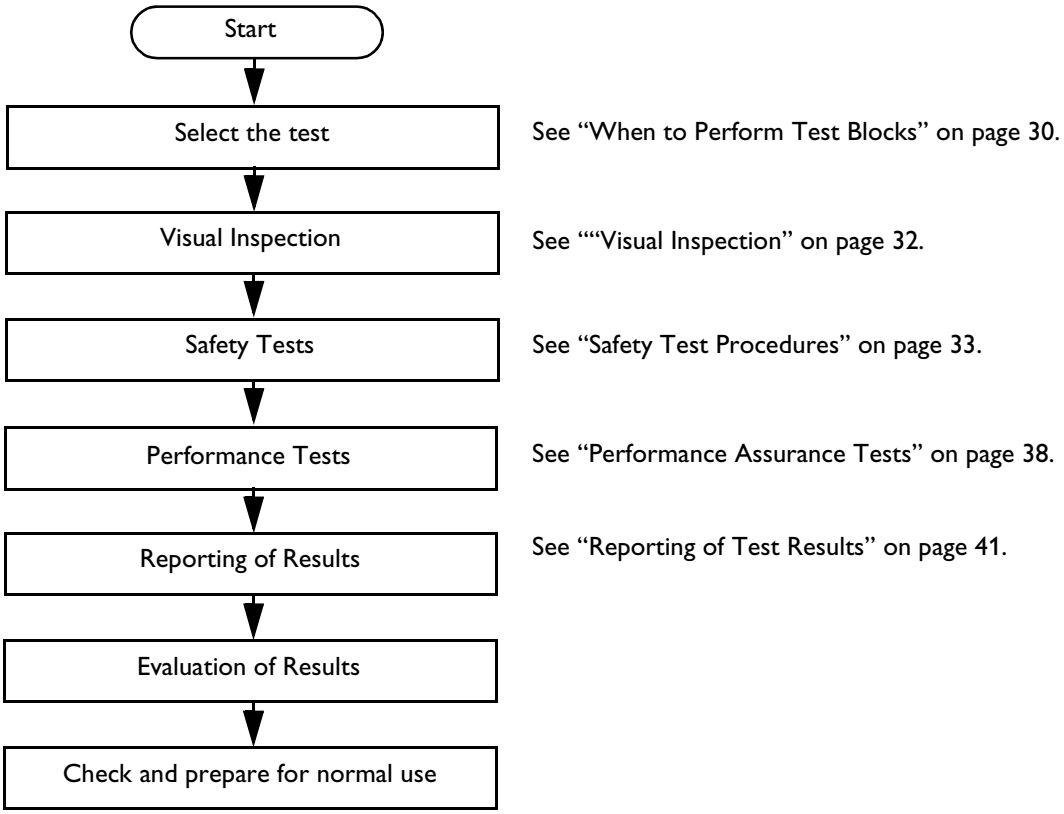
The recorder platen, thermal printhead and paper sensor should be cleaned at least once a year, or when needed (when traces become faint).

Clean the assemblies as follows:

- Clean the recorder roller with a lint-free cloth using a soap/water solution.
- Wipe the printhead using a cotton swab moistened with 70% Isopropyl alcohol based solution.
- Check the paper sensing mechanism is dust free.

Testing Sequence

Here is a summary of the recommended sequence of testing:



NOTE If any single test fails, testing must be discontinued immediately and the device under test must be repaired or labeled as defective.

Visual Inspection

Before Each Use

Check all exterior housings for cracks and damage. Check the condition of all external cables, especially for splits or cracks and signs of twisting. If serious damage is evident, the cable should be replaced immediately. On the Toco+ transducer and the patient module, ensure that the adapter cable socket is not damaged. Check that all mountings are correctly installed and secure. Refer to the instructions that accompany the relevant mounting solution.

After Each Service, Maintenance or Repair Event

Ensure all fuses accessible from the outside comply with the manufacturer's specification.

Check:

- the integrity of mechanical parts, internally and externally.
- any damage or contamination, internally and externally.
- that no loose parts or foreign bodies remain in the device after servicing or repair.
- the integrity of all relevant accessories.

Safety Tests

Safety test requirements are set according to international standards, their national deviations and specific local requirements. The safety tests detailed in this Service Guide are derived from international standards but may not be sufficient to meet local requirements. We recommend that you file the results of safety tests. This may help to identify a problem early particularly if the test results deteriorate over a period of time.

Warnings, Cautions, and Safety Precautions

- These tests are well established procedures of detecting abnormalities that, if undetected, could result in danger to either the patient or the operator.
- Disconnect the device under test from the patient before performing safety tests.
- You need test equipment (for example, a ***Safety Analyzer***) to perform the tests. Ensure the test equipment is specified to be suitable for the respective test(s). Refer to the documentation that accompanies the test equipment. Only skilled technicians should perform safety testing.
- The consistent use of a ***Safety Analyzer*** as a routine step in closing a repair or upgrade is emphasized as a mandatory step to maintain approval agency status. You can also use the ***Safety Analyzer*** as a troubleshooting tool to detect abnormalities of line voltage and grounding plus total current loads.
- During safety testing, high voltage and electrical currents are applied to the device under test. This could result in danger to the safety analyzer operator.
- For Europe and Asia/Pacific, the monitor complies with:
  IEC60601-1:1988 + A1:1991 + A2:1995 = EN60601-1:1990 +A1:1993 + A2:1995
  For USA, the monitor complies with:
  UL60601-1
  For Canada, CAN/CSA C22.2#601.1-M90

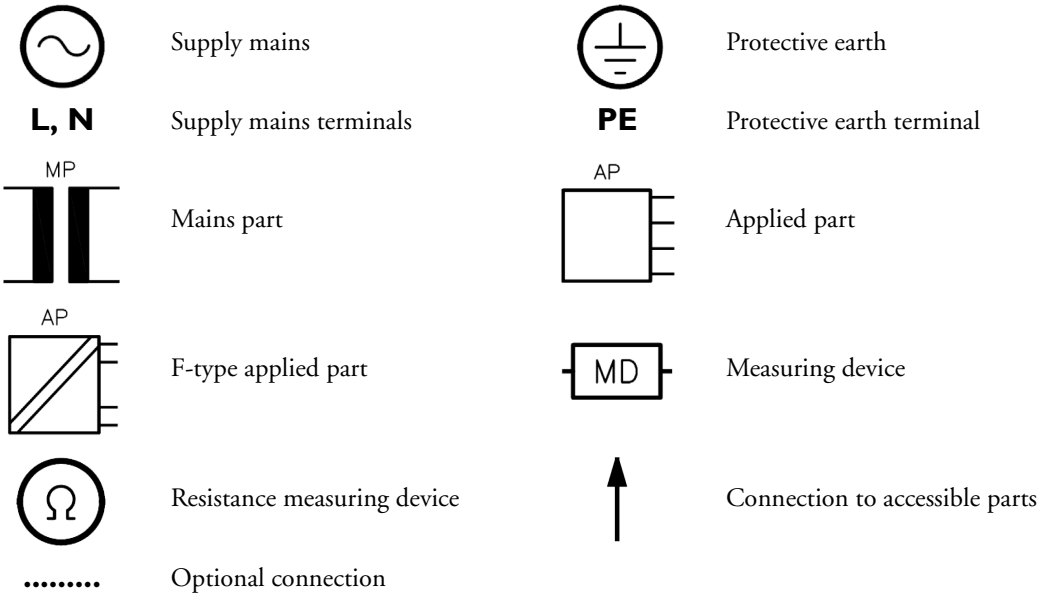
- Additional tests may be required according to local regulations.
- Any device that is connected to the medical device must comply with IEC/EN 60601-1, and UL60601-1:2003 for the USA, if within the patient vicinity and be separately tested at the same intervals as the monitor.
- Perform safety tests as described on the following pages.

Safety Test Procedures

Use the test procedures outlined here **only** for verifying safe installation or service of the product. The setups used for these tests and the acceptable ranges of values are derived from local and international standards but may not be equivalent. These tests are not a substitute for local safety testing where it is required for an installation or a service event. If using an approved safety tester, perform the tests in accordance with the information provided by the manufacturer of the tester and in accordance with your local regulations, for example IEC/EN 60601-1, UL60601-1 (US), IEC/EN 62353, and IEC/EN 60601-1-1. The safety tester should print results as detailed in this chapter, together with other data.

Please refer to Annex C of IEC/EN 62353 for requirements for the measurement equipment and for measurement circuits for protective earth resistance and leakage currents.

The following symbols are used in the diagrams illustrating the safety tests:



CAUTION **After each service, maintenance or repair event:**

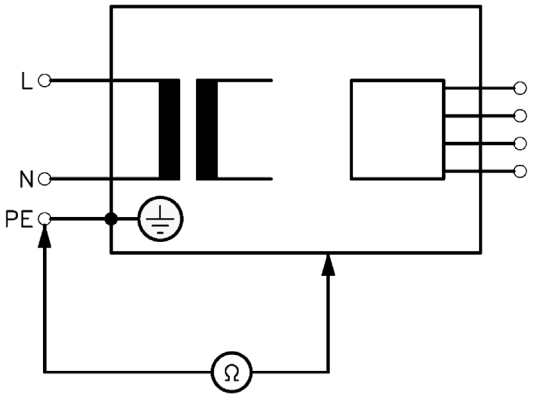
Ensure all fuses accessible from the outside comply with the manufacturer's specification.

Check:

- the integrity of mechanical parts, internally and externally.
- any damage or contamination, internally and externally.
- that no loose parts or foreign bodies remain in the device after servicing or repair.
- the integrity of all relevant accessories.

S(1): Protective Earth Resistance Test

Test to perform:



Measuring circuit for the measurement of Protective Earth Resistance in medical electrical equipment that is disconnected from the supply mains.

This measures the impedance of the Protective Earth (PE) terminal to all exposed metal parts of the Instrument under Test (IUT), which are for safety reasons connected to the Protective Earth (PE).

Measurements shall be performed using a measuring device capable to deliver a current of at least 200 mA.

This safety test is based on IEC/EN 60601-1, IEC/EN 62353, and UL2601-1 Ed. 2/UL60601-1:2003.

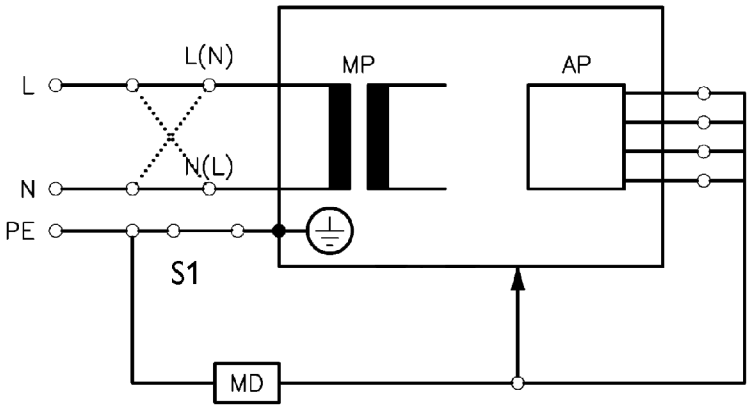
For measurement limits, refer to test block Safety (1), “Test and Inspection Matrix” on page 42.

Report the highest value (X1).

NOTE If the protective earth resistance test fails, testing must be discontinued immediately and the device under test must be repaired or labeled as defective.

S(2): Equipment Leakage Current Test - Normal Condition

Test to perform:



Measuring circuit for the measurement of Equipment Leakage Current - *Direct method* according to IEC/EN 62353.

This test measures leakage current of exposed metal parts of the FM40/FM50 monitor and the functional earth leakage current. It tests normal and reversed polarity. Perform the test with S1 closed (Normal Condition).

There are no parts of the equipment that are not protectively earthed.

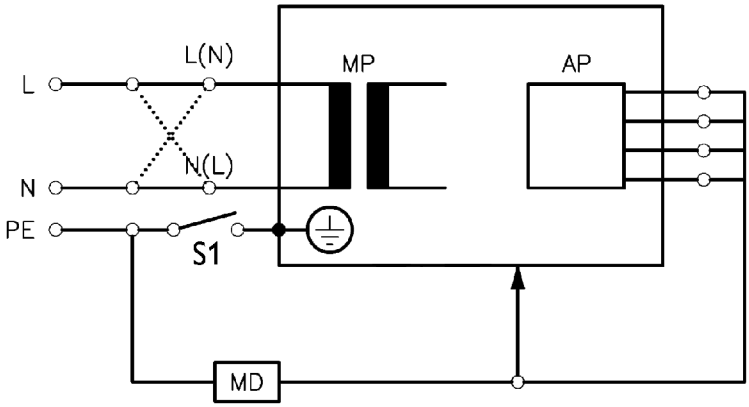
This safety test is based on IEC/EN 60601-1, IEC/EN 62353, and UL2601-1 Ed. 2/UL60601-1:2003.

For measurement limits, refer to test block Safety (2), "Test and Inspection Matrix" on page 42.

Report the highest value (X1).

S(3): Equipment Leakage Current Test - Single Fault Condition

Test to perform:



Measuring circuit for the measurement of Equipment Leakage Current - *Direct method* according to IEC/EN 62353.

This test measures leakage current of exposed metal parts of the FM40/FM50 monitor and the functional earth leakage current. It tests normal and reversed polarity. Perform the test with S1 open (Single Fault Condition).

There are no parts of the equipment that are not protectively earthed.

This safety test is based on IEC/EN 60601-1, IEC/EN 62353, and UL2601-1 Ed. 2/UL60601-1:2003.

For measurement limits, refer to test block Safety (3), "Test and Inspection Matrix" on page 42.

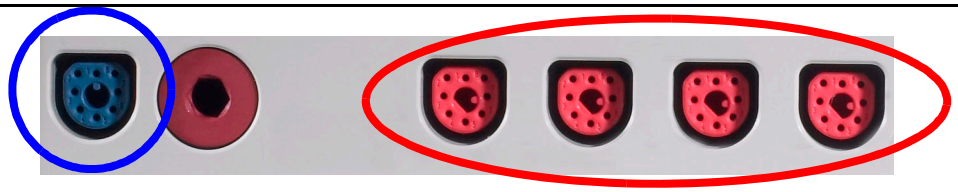
Report the highest value (X2).

S(4): Applied Part Leakage Current - Mains on Applied Part

NOTE During measurement of the Applied Part Leakage Current it is possible that the measured current can exceed the allowed limit (per IEC/EN 60601-1 or IEC/EN 62353).

This can occur when the safety tester is connected to more than one connector simultaneously, that is, either to two fetal sensor connectors at the same time, or to a fetal sensor connector and the SpO_2 connector at the same time during the applied leakage current measurement.

The connectors for the fetal sensors and for SpO_2 are independently functioning connectors.



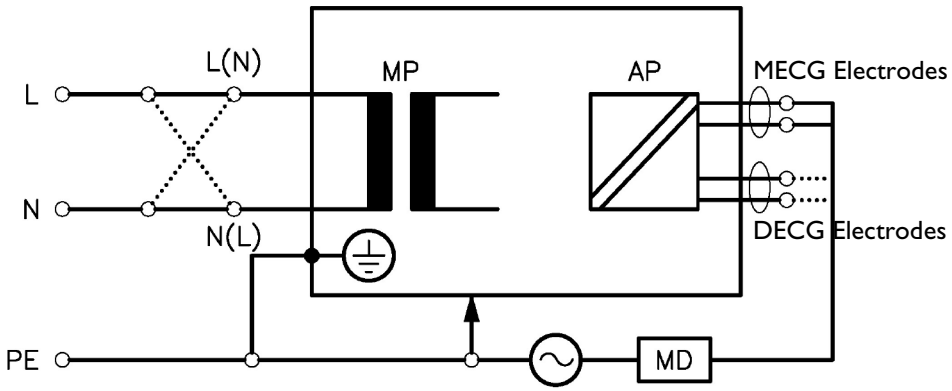
SpO_2 Connector Fetal Sensor Connectors

Test **one** connector at a time! Do not connect the tester to the SpO_2 connector at the same time as one of the fetal sensor sockets.

Although there are individual connectors on the front end, internally those parameters use the same electrical insulation interface and are hardwired to each other. This results in an electrical short of those connectors during measurement if a test current is applied simultaneously. Therefore this should be avoided.

Due to the combined insulation interface, it is sufficient to connect to only one parameter interface (that is, one of the fetal sensor connectors or SpO_2) of the fetal sensor/SpO_2 measurement block. This avoids a short and the potential of exceeding the limit for the current.

Test to perform:



Measuring circuit for the measurement of Applied Part Leakage Current - *Direct method* according to IEC/EN 62353.

This test measures applied part leakage current from applied part to earth caused by external main voltage on the applied part of 264V. Each polarity combination possible shall be tested. This test is applicable for ECG measurement inputs.

There are no parts of the equipment that are not protectively earthed.

This safety test is based on IEC/EN 60601-1, IEC/EN 62353, and UL2601-1 Ed. 2/UL60601-1:2003.

For measurement limits and test voltage, refer to test block Safety (4), “Test and Inspection Matrix” on page 42.

Report the highest value. (X1).

System Test

After mounting and setting up a system, perform system safety tests according to IEC/EN 60601-1-1.

What is a Medical Electrical System?

A medical electrical system is a combination of at least one medical electrical device and other electrical equipment, interconnected by functional connection or use of a multiple portable socket-outlet.

- Devices forming a system must comply with IEC/EN 60601-1-1.
- Any device that is connected to the medical device must comply with IEC/EN 60601-1-1 if outside the patient vicinity and be tested accordingly.

General Requirements for a System

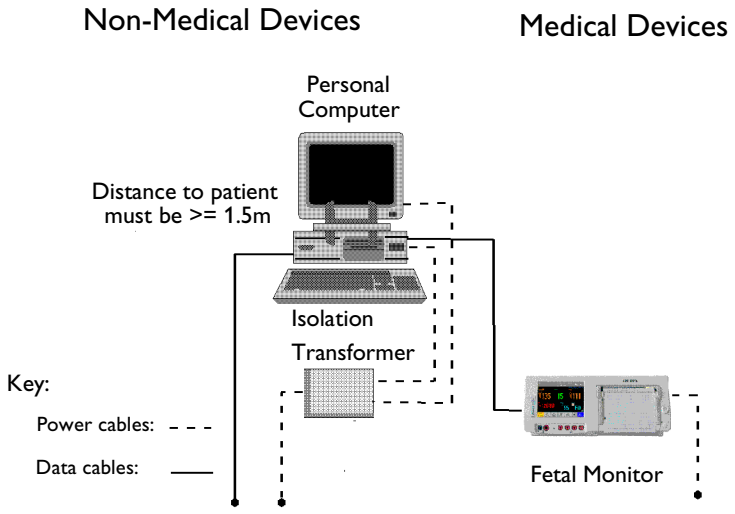
After installation or subsequent modification, a system must comply with the requirements of the system standard IEC/EN 60601-1-1. Compliance is checked by inspection, testing or analysis, as specified in the IEC/EN 60601-1-1 or in this book.

Medical electrical equipment must comply with the requirements of the general standard IEC/EN 60601-1, its relevant particular standards and specific national deviations. Non-medical electrical equipment shall comply with IEC and ISO safety standards that are relevant to that equipment.

Relevant standards for some non-medical electrical equipment may have limits for equipment leakage currents higher than required by the standard IEC/EN 60601-1-1. These higher limits are acceptable only outside the patient environment. It is essential to reduce equipment leakage currents when non-medical electrical equipment is to be used within the patient environment.

System Example

This illustration shows a system where both the medical electrical equipment and the non-medical electrical equipment are situated at the patient's bedside.



WARNING

- Do not use additional AC mains extension cords or multiple portable socket-outlets. If a multiple portable socket-outlet is used, the resulting system must be compliant with IEC/EN 60601-1-1.
- Do not connect any devices that are not supported as part of a system.
- Do not use a device in the patient vicinity if it does not comply with IEC/EN 60601-1. The whole installation, including devices outside of the patient vicinity, must comply with IEC/EN 60601-1-1. Any non-medical device, **including a PC running an OB TraceVue system**, placed and operated in the patient's vicinity must be powered via a separating transformer (compliant with IEC/EN 60601-1-1) that ensures mechanical fixing of the power cords and covering of any unused power outlets.

Performance Assurance Tests

Some of the following test procedures must be performed in service mode. To enter service mode select **`Operating Modes`** in the main menu. Then select **`Service Mode`** and enter the password.

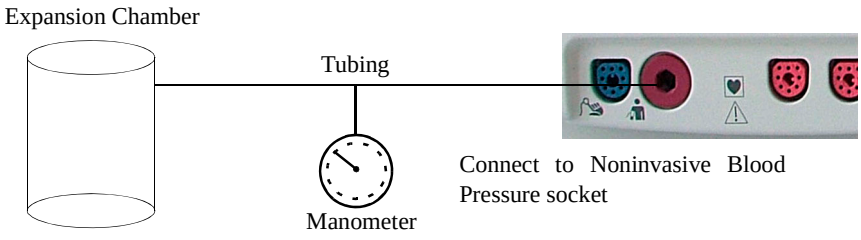
Noninvasive Blood Pressure Performance Tests

This section describes noninvasive blood pressure test procedures. The monitor must be in service mode.

Table 3 gives the expected test results for each of the tests.

Accuracy Test

This test checks the performance of the noninvasive blood pressure measurement. Connect the equipment as shown:



Tools required:

- Reference manometer (includes hand pump and valve), accuracy 0.2% of reading.
- Expansion chamber (volume 250 ml +/- 10%)
- Appropriate tubing.

In service mode, the systolic and diastolic readings indicate the noise of noninvasive blood pressure channels 1 and 2 respectively. When static pressure is applied, the reading in noninvasive blood pressure channel 1 should be below 50. The value in parentheses indicates the actual pressure applied to the system.

1 Connect the manometer and the pump with tubing to the noninvasive blood pressure connector on the monitor and to the expansion chamber.

2 In service mode, select the **Setup NBP** menu.

3 Select **Close Valves: On**

4 Raise the pressure to 280 mmHg with the manometer pump.

5 Wait 10 seconds for the measurement to stabilize.

6 Compare the manometer values with the displayed values.

7 Document the value displayed by the monitor (X1).

8 If the difference between the manometer and displayed values is greater than 3 mmHg, calibrate the noninvasive blood pressure measurement. If not, proceed to the leakage test.

9 To calibrate the noninvasive blood pressure measurement, select **Close Valves off** then **Calibrate NBP** and wait for the instrument to pump up the expansion chamber.Wait a few seconds after pumping stops until **EnterPrVal** is highlighted and then move the cursor to the value shown on the manometer. If one of the following prompt messages appears during this step, check whether there is leakage in the setup:

– NBP unable to calibrate–cannot adjust pressure

– NBP unable to calibrate–unstable signal

10 Press **Confirm**.

If the INOP NBP Equipment Malfunction message occurs in monitoring mode, go back to service mode and repeat the calibration procedure.

Leakage Test

The noninvasive blood pressure leakage test checks the integrity of the system and of the valve. It is required once every two years and when you repair the monitor or replace parts.

1 If you have calibrated, repeat steps 2 to 6 from the accuracy test procedure so that you have 280 mmHg pressure on the expansion chamber.

2 Watch the pressure value for 60 seconds.

3 Calculate and document the leakage test value (X2).
X2 = P1 - P2
where P1 is the pressure at the beginning of the leakage test and P2 is the pressure displayed after 60 seconds.
The leakage test value should be less than 6 mmHg.

Linearity Test

1 Reduce the manometer pressure to 150 mmHg.

2 Wait 10 seconds for the measurement to stabilize.

3 After these 10 seconds, compare the manometer value with the displayed value.

4 Document the value displayed by the monitor (X3)

5 If the difference is greater than 3 mmHg, calibrate the noninvasive blood pressure measurement (see steps 9 to 10 in the accuracy test procedure).

Valve Test

1 Raise the pressure again to 280 mmHg.

2 Select **`Close valves: Off`**.

3 Wait five seconds and then document the value displayed. The value should be less than 10 mmHg.

4 Document the value displayed by the monitor (X4).

Expected Test Results

Test	Expected test results
Accuracy test	x1 = value displayed by monitor Difference ≤ 3mmHg
Leakage test	x2 = leakage test value x2 < 6 mmHg
Linearity test	x3 = value displayed by monitor Difference ≤ 3mmHg
Valve Test	x4 = value < 10 mmHg

SpO_2 Performance Test

This test checks the performance of the SpO_2 measurement.

Tools required: none

1 Connect an adult SpO_2 transducer to the SpO_2 connector.

2 Measure the SpO_2 value on your finger (this assumes that you are healthy).

3 The value should be between 95% and 100%.

Expected Test Results

Test	Expected test results
SpO_2 Performance Test	95% and 100%

Measurement Validation

The SpO_2 accuracy has been validated in human studies against arterial blood sample reference measured with a CO-oximeter. In a controlled desaturation study, healthy adult volunteers with saturation levels between 70% and 100% SaO_2 were studied.

The population characteristics for those studies were:

- Gender: about half female and half male subjects
- Age range: 18 to 45 years
- Skin tone range: from light to very dark

NOTE A functional tester cannot be used to assess the accuracy of a pulse oximeter monitor. However, it can be used to demonstrate that a particular pulse oximeter monitor reproduces a calibration curve that has been independently demonstrated to fulfill a particular accuracy specification.

Reporting of Test Results

Philips recommends all test results are documented in accordance with local laws. Authorized Philips personnel report test result back to Philips to add to the product development database. While hospital personnel (biomedical engineers or technicians) do not need to report results to Philips, Philips recommends that they record and store the test results in accordance with local laws.

Table 3 lists what to record after completing the tests in this chapter. Record the results in the empty column in Table 3.

The following is a guide as to what your documentation should include:

- Identification of the testing body (for example, which company or department carried out the tests).
- Name of the person(s) who performed the tests and the concluding evaluation.
- Identification of the device(s) being tested (serial number, etc.).
- Date of testing and of the concluding evaluation.
- A record of the actual values of the test results, and whether these values passed or failed the tests.

Carrying Out and Reporting Tests

Table 3: Test and Inspection Matrix

Test Block	Test or Inspection to be Performed	Expected Test Results	Record the Results (mandatory for Philips Personnel only)	
			What to Record	Actual Results
Visual Inspection	Perform Visual Inspection (see "Visual Inspection" on page 32).	Pass or Fail	V:P or V:F	
Power On	Power on the unit. Does the self-test complete successfully?	If Yes, Power On test is passed.	PO:P or PO:F	
Noninvasive Blood Pressure Performance Tests	Perform the Accuracy Test (see page 38).	X1 = value displayed by monitor Difference <= 3mmHg	PN:P/X1 or PN:F/X1	
	Performance Leakage Test (see page 39).	X2 = leakage test value X2 < 6 mmHg	PN:P/X2 or PN:F/X2	
	Performance Linearity Test (see page 39).	X3 = value displayed by monitor Difference <= 3mmHg	PN:P/X3 or PN:F/X3	
	Performance Valve Test (see page 40).	X4 = value < 10 mmHg	PN:P/X4 or PN:F/X4	
SpO_2 Performance Test	Perform the SpO_2 Performance Test (see page 40).	Value should be between 95% and 100%	No reporting necessary	
Safety (1)	Perform Safety Test (1): Protective Earth Resistance.	With mains cable: Maximum impedance (X1): <= 300 mOhms	S(1):P/X1 or S(1):F/X1	
Safety (2)	Perform Safety Test (2): Equipment Leakage Current - Normal Condition.	With mains cable: Maximum leakage current (X1): <= 100µA	S(2):P/X1 or S(2):F/X1	
Safety (3)	Perform Safety Test (3): Equipment Leakage Current - Single Fault Condition (Open Earth).	With mains cable: Maximum leakage current (X2): <= 300µA	S(3):P//X2 or S(3):F/X2	
Safety (4)	Perform Safety Test (4): Patient Leakage Current - Single Fault Condition, mains on applied part.	Maximum leakage current (X1): <= 50µA @ 264V	S(4):P/X1 or S(4):F/X1	
System	Perform the system test according to sub clause 19.201 of IEC/ EN 60601-1-1, if applicable, after forming a system.	Equipment Leakage Current: <= 100µA (Normal Condition) <= 300µA (Single Fault Condition)	System test:P or System test:F	
		Protective Earth Leakage Current of Multiple Portable Socket-Outlets: <= 500µA		
		Patient Leakage Current: <= 10µA (Normal Condition)		
Key: P = Pass, F = Fail, X = test result value to be recorded				

Other Regular Tests

The care and cleaning requirements that apply to the monitor and its accessories are described in the *Instructions for Use*. This section details the periodic maintenance recommended for the monitor, transducers and accessories.

Transducers and Patient Modules: Functional Tests

If any of the following tests fail, repeat the test using another transducer. If the second transducer passes the tests, confirming that the first transducer is defective, contact your service personnel.

If the second transducer also fails the tests, contact your Philips Service Engineer or Response Center.

Ultrasound Transducer Electrical Check

CAUTION Use of ultrasound gel that is not approved by Philips may reduce signal quality and may damage the transducer. This type of damage is not covered by warranty.

To test an ultrasound transducer:

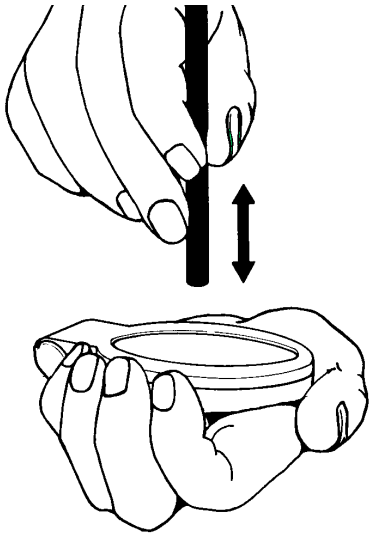
1 Switch on the monitor and the recorder.

2 Connect the transducer to the fetal monitor.

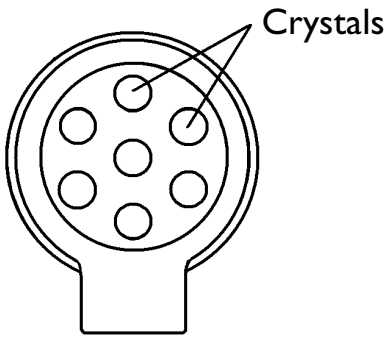
3 Select the fetal heart sound for this channel.

4 Increase the loudspeaker volume to an audible level.

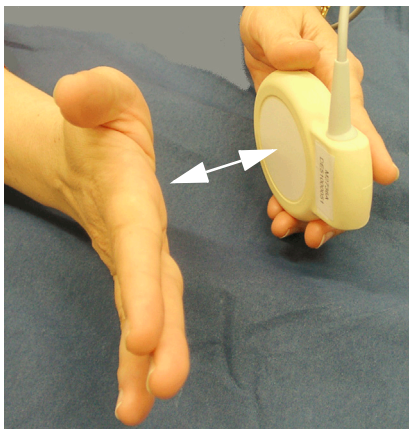
5 The ultrasound transducer contains seven piezoelectric crystals. Basic functioning of each can be verified by holding a flat bottomed pencil or similar above each crystal and moving it up and down as shown.



6 A sound should be heard for each crystal tested. The pencil should be held two to three centimeters from the transducer surface when the test is carried out.



7 A sound should also be heard when the transducer is moved back and forth over a solid surface, or the hand as shown.



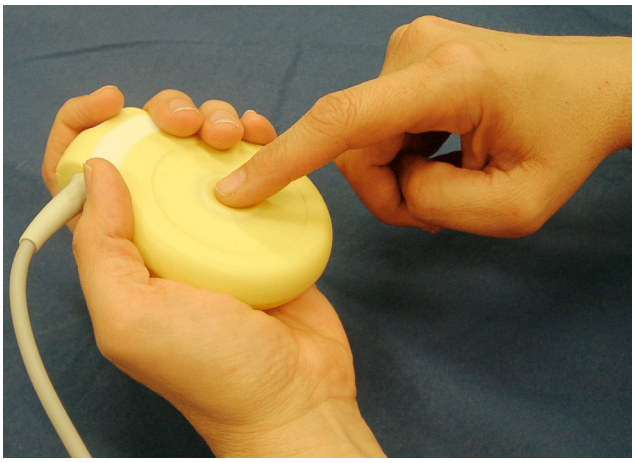
Toco Transducer Electrical Check

To test a Toco transducer:

1 Switch on the monitor and the recorder.

2 Connect the transducer to the fetal monitor.

3 Gently apply pressure to the Toco sensor.



4 Check that the value on the display and paper shows this change in pressure.

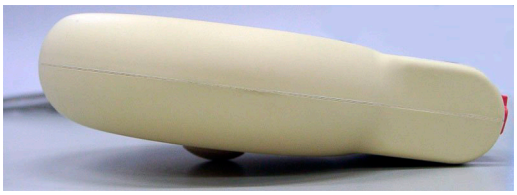
5 Lay the transducer face up on a hard, flat surface for a few seconds.

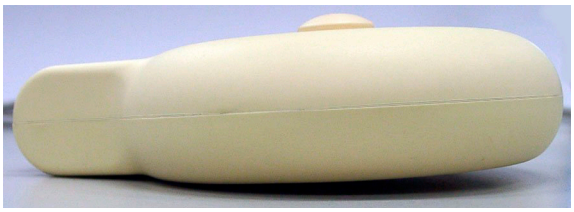
6 Press the Toco Baseline Key to re-adjust the Toco display to 20.

7 Turn the transducer over so that the Toco sensor is resting on the flat surface. You should see a marked increase in the value of the Toco reading in the Toco display.

Toco display = 20

Toco display = 35 - 45





Testing the Patient Module (M2738A)/Toco+ Transducer (M2735A): DECG Mode

1 Switch on the monitor and the recorder.

2 Connect the patient module or Toco+ transducer to the fetal monitor.

3 Attach the DECG adapter cable M1362B to the socket on the patient module or Toco+ transducer.

4 Ensure that the DFHR channel display on the fetal monitor shows the **DECG LEADS OFF** INOP with the DECG adapter cable attached.

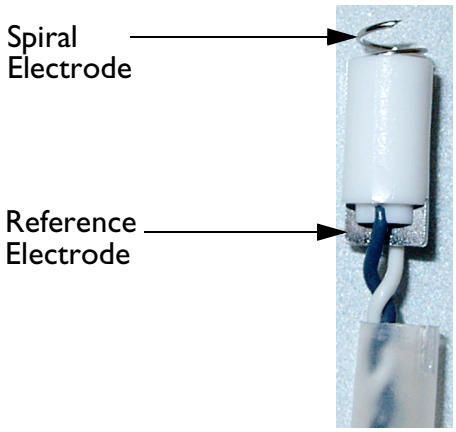
5 Take a Fetal Scalp Electrode, and connect it to the DECG adapter cable.

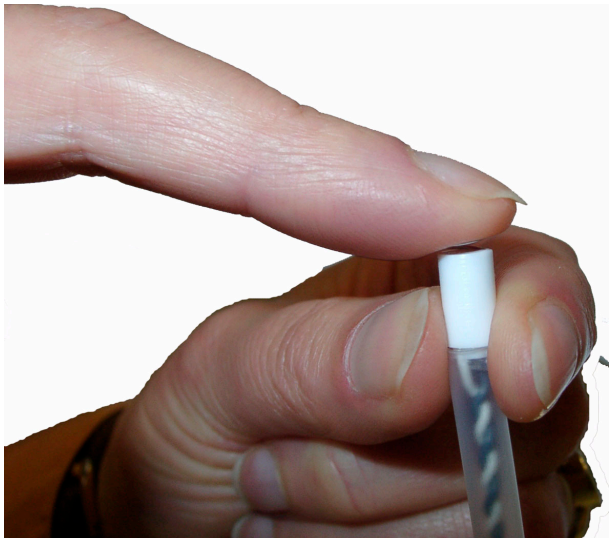
6 *EITHER*

Hold the reference electrode between the thumb and index finger of one hand, and touch the spiral electrode with the index finger of the other hand, as illustrated below. This makes a short between

the spiral electrode and the reference electrode (it is best to wet your fingers first). Use a **sterile** Fetal Scalp Electrode.

CAUTION The tip of the spiral electrode is sharp. Take care not to injure your fingers.





OR

Cut off the plastic tip of the fetal scalp electrode (containing the spiral and reference electrodes) from the end of the wires. Strip the insulation from the end of the wires, and connect them to a patient simulator.

Note—We do not recommend the use of a specific patient simulator. The use of a patient simulator does not allow checking the specification of the ECG-functionality; it allows only a check of general function.

Result: the **DECG LEADS OFF** INOP should disappear.

Viewing the ECG wave: when configured, you can view the DECG wave on the screen, and any noise will be visible as additional verification of the effectiveness of the test.

If the test results are not as outlined above, repeat the test with another ECG transducer. If this does not solve the problem, try the following:

- Check all connections.
- If the **DECG LEADS OFF** INOP is still displayed, the DECG adapter cable may be defective. Replace the adapter cable.

If the problem persists, replace the transducer.

Testing the Patient Module (M2738A)/Toco+ Transducer (M2735A): MECG Mode

1 Switch on the monitor and the recorder.

2 Connect the patient module or Toco+ transducer to the fetal monitor.

3 Attach the MECG adapter cable M1363A to the red color-coded socket on the patient module or Toco+ transducer

4 *EITHER*

Attach electrodes to the M1363A adapter cable, and apply the electrodes to the skin (for example on the wrists).

OR

Attach the M1363A adapter cable to a patient simulator.

Note—We do not recommend the use of a specific patient simulator. The use of a patient simulator does not allow checking the specification of the ECG-Functionality; it allows only a check of general function.

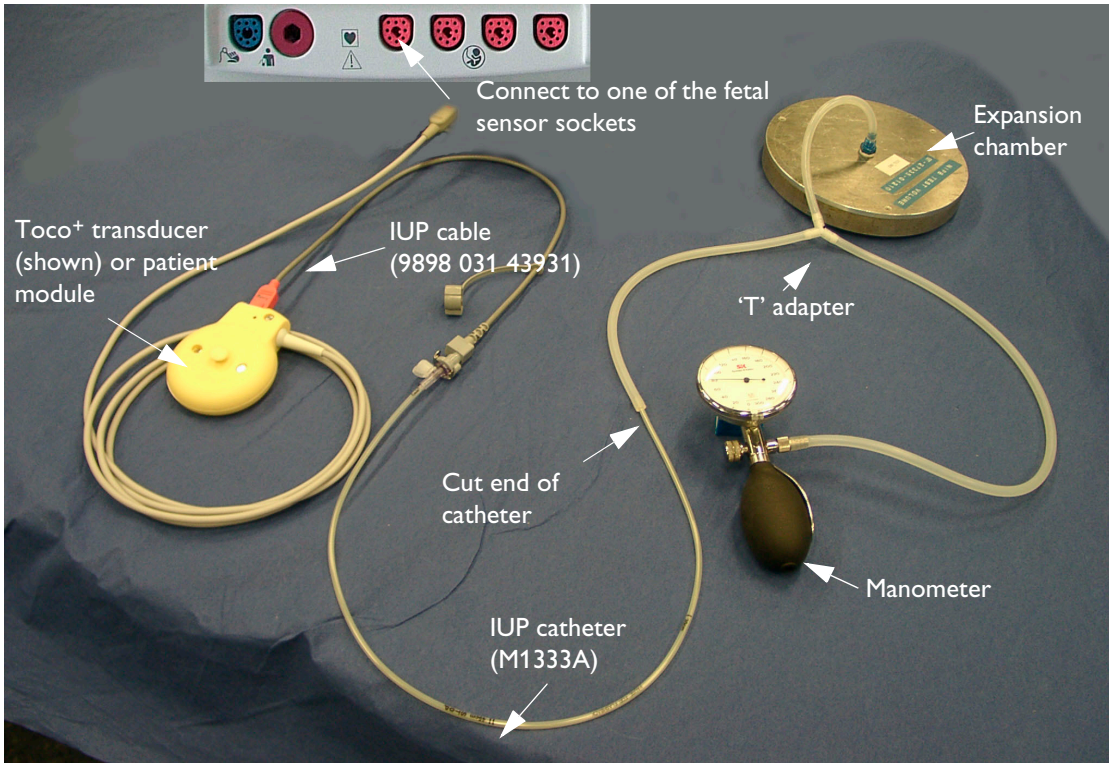
Result: You should see MECG values displayed on the maternal display or annotated on the recorder trace.

If the test results are not as outlined above, repeat the test with another ECG transducer. If this does not solve the problem:

- The MECG adapter cable may be defective. Replace the adapter cable, and repeat the test.
- Check all connections.

Testing the Patient Module (M2738A)/Toco+ Transducer (M2735A): IUP Mode

To test the IUP functionality of the patient module or the Toco+ transducer, you need the following:



- Manometer.
- Expansion chamber.
- Three lengths of silicone tubing with a 'T' adapter.

1 Switch on the monitor and the recorder.

2 Connect the patient module or Toco+ transducer to the fetal monitor.

3 Attach the IUP adapter cable (989803143931) to the socket on the patient module or Toco+ transducer.

4 Cut the sensor tip off an IUP catheter (M1333A).

5 Connect the catheter to the IUP adapter cable.

6 Connect the silicone tubing to the test volume chamber and the manometer as shown in the picture.

7 Connect the cut end of the catheter to the silicone tubing.

8 Apply a pressure of 80 mmHg ± 5 mmHg with the manometer. Check that the value on the display and on trace corresponds to this pressure. Slowly release the pressure, and check that the value on the display and on trace shows this change in pressure.

Touchscreen Calibration

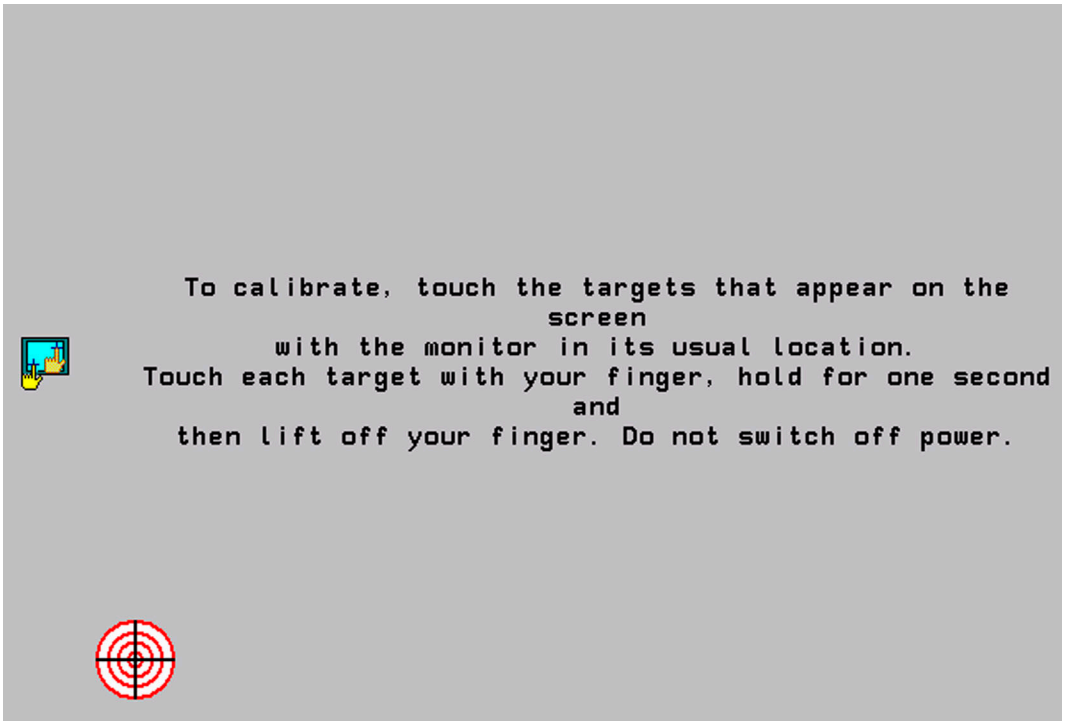
To access the touchscreen calibration screen:

1 Enter service mode

2 Select **Main Setup**

3 Select **Hardware**

4 Select **Calibrate Touch**



Make sure you complete the calibration procedure without powering off the monitor mid-way. If the monitor is powered off after the first point is touched, the touch panel will be deactivated until the touch calibration is performed again.

If the touchscreen is accidentally mis-calibrated by selecting the wrong spot, you must use another input device to re-enter calibration mode, for instance, a mouse connected to the PS/2 interface. If you have the support tool, you can select **Start Touch Calibration** and it will create a rough calibration which will allow you to access the calibration menu again via the touchscreen.

Disabling/Enabling Touch Operation

To disable touchscreen operation of the monitor, press and hold the **Main Screen** key for about three seconds. A red padlock will blink on the key. Press and hold the **Main Screen** key again for about three seconds to re-enable touchscreen operation.

Checking the Fetal Recorder Offset

To check the recorder offset:

1 Connect a Toco transducer to the monitor.

2 Place the Toco transducer on a flat surface so that it is resting on the belt button, and is therefore not under any load.

3 Start the recorder, and press the Paper Advance key three times to make sure that at least three pages of paper have advanced.

4 If the Toco trace is recording exactly on the 20 unit gridline, then the offset is correctly set.

5 If the Toco trace is not recording exactly on the 20 unit gridline, then set the offset as described in "Setting the Fetal Recorder Offset".

Setting the Fetal Recorder Offset

To set the fetal recorder offset, you first need to run the fetal recorder calibration:

1 Enter Service Mode.

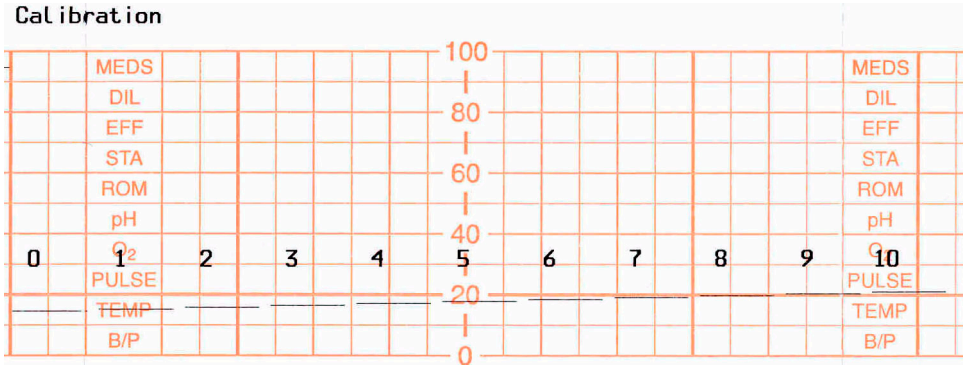
2 In **Main Setup**, select **Fetal Recorder** to enter the Fetal Recorder menu.

The current setting for the recorder offset is shown (but it is still grayed out, and you cannot select it yet).

3 Select **Calibration** to start the recorder calibration printout.

4 The recorder stops, and the **Cal. Offset** becomes selectable.

5 Look at the section of the printout entitled "Calibration".



You will see the numbers 0 to 10, and each number has a line printed below it. See for which number the line best fits the 20 unit gridline (8 in this example).

6 Select **Cal. Offset**, and select the offset value from 0 to 10 from the list, as determined in step 4.

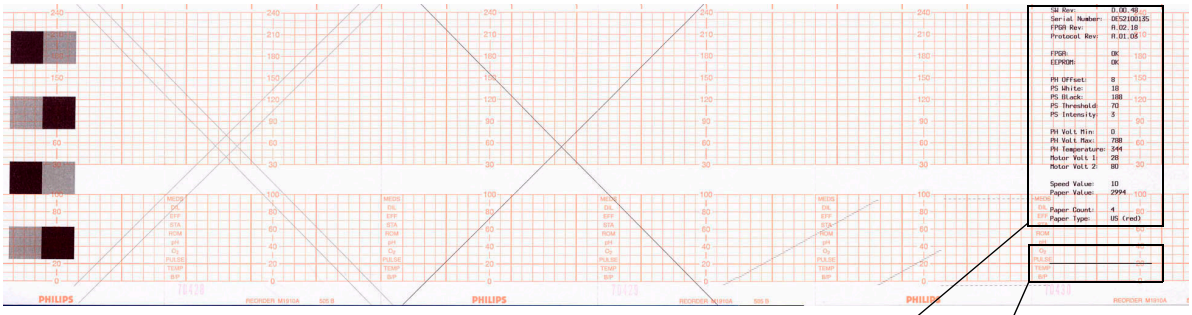
7 The recorder then finishes the calibration printout. Confirm that the line prints on the 20 unit gridline.

Fetal Recorder Selftest Report

To verify your printer configuration, or if you doubt the performance of the recorder, you may want to print a test report.

To print a selftest report, in Service Mode, select **Main Setup -> Fetal Recorder-> Selftest.**

Here is an excerpt from a sample test report to give you an idea what it looks like (the exact appearance may vary slightly):



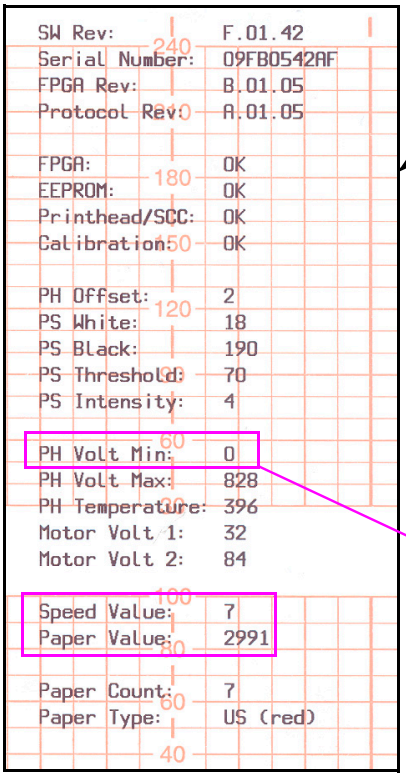
Same data from the trace header (see "Trace Header" on page 54

Selftest status

Print quality data

Recorder electrical data

Paper-related data (Paper Count is the number of pages detected in this test)



Example of selftest report

This line should print exactly on the 20 unit gridline (Toco baseline) if the recorder is correctly calibrated.

Expected value for PH Volt Min is 0. If value is greater that 0, there may be a TLPH voltage problem.

Speed Value is the tolerance for paper detection. Value should be less than 20. If it is more, there could be a recorder assembly problem.
A Paper Value of 2994 is optimal: you may see small variations from this figure.

Check the test pattern to ensure all the heating elements on the printer head are operational. Ensure that:

- No more than 20 dots are missing over the entire printhead.
- No more than 2 adjacent dots are inoperative.
- No dots in the mode annotation (for example, FHR1) are inoperative.

If any of the above conditions are not met, replace the recorder assembly (see “Removing the Recorder Assembly” on page 107).

Ensure that all printed lines are straight. If the lines are not straight, there may be a problem with the paper recorder speed.

8

Troubleshooting

A list of system error messages and troubleshooting information for common problems you may encounter while using the monitor and its accessories is given in the *Instructions for Use*. This chapter provides a guide for qualified service personnel for troubleshooting problems that cannot be resolved by the user.

CAUTION If the troubleshooting procedure requires you to disassemble the monitor or transducers, be certain to follow the disassembly and reassembly procedures given in Chapter 10, “Disassembly and Reassembly”.

Who Should Perform Repairs

Only qualified service personnel should open the monitor housing, remove and replace components, or make adjustments. If your medical facility does not have qualified service personnel, contact Philips’ Response Center or your local Philips representative.

WARNING **High Voltage** - Voltages dangerous to life are present in the instrument when it is connected to the mains power supply. Do not perform any disassembly procedures with power applied to the instrument. Failure to adhere to this warning could cause serious injury or death.

Replacement Level Supported

The replacement level supported for this product is to the printed circuit board (PCB) and major subassembly level. Once you isolate a suspected PCB, follow the procedures in Chapter 10, “Disassembly and Reassembly” to exchange the PCB with a known good replacement. Check to see if the symptom disappears and that the monitor passes all performance tests. If the symptom persists, swap back the replacement PCB with the suspected malfunctioning PCB (the original PCB that was installed when you started troubleshooting) and continue troubleshooting as directed in this chapter.

Checking Revision Information

There are various ways to check revision information:

- Most of the revision information can be checked from reading the contents of the trace header (see “Trace Header” on page 54).
- You can also identify the hardware revision via the Main Setup menu (see “Hardware Revision Check” on page 54).

- You can also identify the software revision via the Main Setup menu (see “Software Revision Check” on page 55).

Trace Header

The trace header printed when the recorder starts contains useful information about the monitor and its parameters.

- The first line (marked 1) contains:
  - the time.
  - date.
  - set paper speed.
- The second line (marked 2) contains:
  - result of the selftest.
  - firmware revision of the FPGA microcontroller, responsible for controlling the recorder, the display and the ultrasound tone. This revision is always fixed with a particular software revision.
  - revision of the internal recorder communication protocol. This revision is always fixed with a particular software revision.
  - paper type (US or INT).
  - information on whether the recording is a real-time trace (RT appears), or a stored data/trace recovery printout (RT is not printed).
  - information on the printhead intensity (I).
- The rest of the information (marked 3) contains:
  - product serial number and firmware revision.
  - Bus Master firmware revision (OB).
  - serial number and firmware revision of connected devices.

If a transducer is plugged into the monitor after the recorder started, the serial number and revision information is annotated along the bottom of the trace.

Hardware Revision Check

Some troubleshooting tasks may require that you identify the hardware revision of your monitor’s main board. To check your hardware revision:

1 Enter the Main Setup menu and select **Revision**.

2 Select **Product**.

You see the hardware revision in the pop-up window, along with the serial number, part number, and the software revision.

Software Revision Check

Some troubleshooting tasks may require that you identify the software revision of your monitor. You can find the software revision along with other information, such as the system serial number, in the monitor revision screen.To access the monitor revision screen:

1 Enter the Main Setup menu and select **`Revision`**.

2 Select **`Product`**.

You see the software revision in the pop-up window, along with the serial number, part number, and the hardware revision.

NOTE The part numbers listed in the monitor revision screen do not necessarily reflect the part numbers required for ordering parts. Please refer to Chapter 9, “Parts” for the ordering numbers. Photos of the parts are included for swift identification.

NOTE The system serial number can also be found on the rear of the monitor.

Obtaining Replacement Parts

See Chapter 9, “Parts”, for details on replacement parts.

Troubleshooting Guide

Problems with the monitor are separated into the categories indicated in the following sections and tables. Check for obvious problems first. If further troubleshooting instructions are required refer to the Troubleshooting Tables.

Taking the recommended actions discussed in this section will correct the majority of problems you may encounter. However, problems not covered here can be resolved by calling Philips Response Center or your local representative.

Checks for Obvious Problems

When first troubleshooting the instrument, check for obvious problems by answering basic questions such as the following:

1 Is the AC power cord connected to the instrument and plugged into an AC outlet?

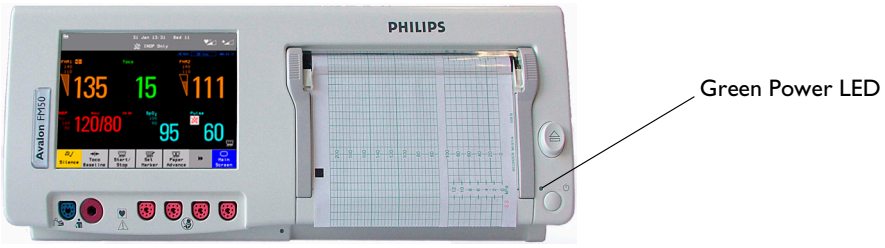
2 Is the power switch turned on?

Checks Before Opening the Instrument

You can isolate many problems by observing indicators on the instrument before it is necessary to open the instrument.

Checks with the Instrument Switched On, AC connected

When the monitor is connected to AC mains, the green power LED is constantly lit. After switching on, the green power LED blinks during the boot phase, and then remains lit during normal operation. The location of the green LED is shown in the following photograph:



Individual Parameter INOPs

If you see any of the following parameter INOPs:

DECG EQUIP MALF	IUP EQUIP MALF
ECG EQUIP MALF	NBP EQUIP MALF
FetRec EQUIP MALF	OB EQUIP MALF
FHR1 EQUIP MALF	SpO_2 EQUIP MALF
FHR2 EQUIP MALF	SpO_2 SENSOR MALF
FHR3 EQUIP MALF	TOCO EQUIP MALF

try exchanging the relevant component (transducer, sensor, patient module or board) with a known good replacement, following the procedures in Chapter 10, “Disassembly and Reassembly”. Check to see if the INOP disappears, and that you can measure the parameter in question normally. If the INOP persists, swap back the original component and continue troubleshooting as directed in this chapter.

If you see the **OB EQUIP MALF** INOP following a monitor software upgrade, it is likely that the firmware in the bus master section of the API Board is incompatible with the new software. Check the firmware revision, and upgrade this if necessary with the Support Tool. Contact Philips Support for more information regarding software and firmware revisions.

After checking/upgrading the bus master firmware, and you still suspect a defective API Board, first try plugging the transducers into another monitor. If the transducers work properly with the other monitor, then exchange the API Board.

In the case of the INOPs **FHR1 EQUIP MALF**, **FHR2 EQUIP MALF**, and **FHR3 EQUIP MALF**, when there are two or more ultrasound transducers attached to the monitor, identify the transducer for which the INOP was issued, using the blue transducer Finder LED. Touching a numeric on the screen makes the Finder LED light on the transducer providing the measurement. If you cannot identify the suspected transducer directly because the transducer Finder LED does not light due to the defect, identify the other, functioning transducers by activating their Finder LEDs, thus finding the defective one by a process of elimination.

Initial Instrument Boot Phase

The following table describes the regular initial boot phase of the monitor. If the boot phase does not proceed as described below, go to Boot Phase Failures for troubleshooting information.

Boot Phase	Boot Phase Event
1	Switch the monitor on using the On/Off switch. (Green power light is lit as soon as the device is connected to AC mains.)
2	The green AC Power LED blinks for about during the boot phase.
3	You hear a 'pop' from the loudspeaker.
4	Green AC Power LED stops blinking, and remains lit.
5	Boot Screen with the Philips Logo appears on the display. Test Sound is issued.
6	Boot Screen with the Philips Logo disappears.
	Fixed screen elements (for example smart keys, alarm fields) appear on the screen.
7	First measurement information appears on the screen, touchscreen is functional.

Troubleshooting Tables

The following tables list troubleshooting activities sorted according to symptoms.

How to Use the Troubleshooting Tables

The possible causes of failure and the remedies listed in the troubleshooting tables should be checked and performed in the order they appear in the tables. Always move on to the next symptom until the problem is solved.

- Boot Phase Failures
- Screen is Blank
- Touchscreen not Functioning
- General Monitor INOP Messages
- Network Status Icons
- Alarm Tones
- Fetal Recorder
- Keyboard/Mouse Not Functioning
- LAN / RS232
- Remote Touchscreen Display Not Responding

Boot Phase Failures

Symptoms	Possible Causes of Failure	Failure Isolation and Remedy
Green LED does not light up, and no test tone is heard	No AC mains connection	Check that the power cord is not damaged and is properly connected to the monitor. Check that the power cord is correctly connected to a powered AC mains socket.
	Power supply defective	Remove power supply and check if output voltage is within the specifications (24V). Measure on multi-colored wired connection between red and black wires. Exchange power supply if defective.
	Switch board cable disconnected, or not firmly connected to the API Board connector	Check that the switch board cable is firmly connected to API Board connector.
	Switch board defective	Replace the switch board.
	API Board defective	Replace API Board. Add boards in reverse order and try again with each board.
Green LED does not blink after pressing power On/Off switch	Switch board defective	Replace the switch board.
	Defective processor on API Board	Replace the API Board.
Cyclic reboot: a) the monitor tries to boot b) power fails c) LED blinks d) display comes on briefly, then goes dark e) green LED stays lit f) boot cycle starts again and sequence repeats	Hardware failure caused by a short circuit, most likely the result of a NBP board defect	First disconnect the NBP board. Reconnect the NBP board, making sure all cables are connected securely. If the problem persists, replace the NBP assembly.
No Test Sound issued or INOP **`Speaker Malfunct.`** issued	Speaker cable disconnected	Check speaker connections.
	Speaker defective	Check for INOPs and follow instructions Exchange speaker
	API Board defective	Exchange API Board

Screen is Blank

The information listed in this table is only valid if the boot phase has completed without error. See Boot Phase Failures table for a description of the boot phase.

Symptoms	Possible Causes of Failure	Failure Isolation and Remedy
Display is blank or brightness is reduced	Display flex cable not connected properly	Check cable connection is secure at both ends of the display flex cable.
	Backlight tubes defective	Replace complete Front Bezel Assembly.
	Backlight inverter defective	
	LCD flat panel defective	
	API Board defective	Replace API Board.

Touchscreen not Functioning

Symptoms	Possible Causes of Failure	Failure Isolation and Remedy
Touchscreen not functioning	Touchscreen functionality has been temporarily disabled	Check if touchscreen functionality has been temporarily disabled (padlock symbol on Main Screen key). If yes, press and hold the Main Screen key to re-enable touchscreen operation.
	Touch screen cable not connected	Check connection from the Display Assembly to the API Board.
	Touch controller defective	Replace API Board
	Touch Sensor defective	Replace Front Bezel Assembly
Touch Position invalid	Possible touch calibration problem	First check the existing calibration offset: 1 Touch any point on the screen with a suitable plastic pointer (such as a touch stylus from a palm PC). 2 Check offset between the point of contact and the cursor position. 3 If the offset is greater than 5 mm, perform touch calibration. To perform touch calibration: 1 Enter Service Mode 2 Enter the Main Setup Menu 3 Select **`Hardware`** 4 Select **`Calibrate Touch`** See “Touchscreen Calibration” on page 48.

General Monitor INOP Messages

INOP Message	Possible Causes of Failure	Failure Isolation and Remedy
CheckInternVoltage **Check Monitor Func**	Problem with the voltages (5V) in the monitor	Remove all I/O boards and put them back in one at a time to isolate any defective board. If this does not resolve the problem, replace the main board.
Check Monitor Temp	The temperature inside the monitor is too high	Check the environment for possible causes.
	Main Board defective	Replace Main Board.
Check Settings	INOP occurs during normal operation, indicating a possible monitor software problem	Check the monitor and patient settings before you resume monitoring. If the settings are unexpected, there may be a problem with the monitor software. 1 Silence the INOP. 2 Load the User Defaults (see "Loading the User Defaults" on page 122). 3 If this is unsuccessful, try loading the Factory Default (see "Loading the Factory Default" on page 122), and reconfigure the monitor in Configuration Mode, and save the new settings in the User Defaults. If the INOP persists, there is an unresolved software problem. Report the problem to factory support.
	INOP occurs after a software upgrade, indicating a possible incomplete or unsuccessful upgrade	Clone the correct settings via the Support Tool.
Internal.Comm.Malf.	Main CPU Board defective	Replace Main CPU Board.
Settings Malfunc.	Problem during cloning process.	Reclone configuration file.
	Memory space in which the settings are stored has been corrupted	Reclone configuration file. This will reload the memory space.
	Main CPU Board defective	Replace Main CPU Board.

Network Status Icons

Icon	Explanation
No Icon	LAN cable not connected (monitor does not have a LAN connection).
	LAN cable connected, no connection to OB TraceVue. To check whether an IP Address has been assigned, enter **`Main Setup --> Bed Information`** and scroll to **`IP Address`**. (**`0.0.0.0`** means no IP address has been assigned.) OB TraceVue may send a prompt message, giving the reason why connection to OB TraceVue cannot take place.
	LAN cable connected, IP address assigned, monitor connected to OB TraceVue. OB TraceVue may send a prompt message, indicating a possible problem.

Alarm Tones

Symptoms	Possible Causes of Failure	Failure Isolation and Remedy
INOP Message **`Speaker Malfunct.`** is displayed	Speaker cable disconnected	Reconnect speaker cable
	Speaker defective	Replace speaker
	Sound amplifier on API Board defective	API Board
Alarm occurs but no alarm sound is issued	Volume set to 0	Increase volume
	Speaker defective	Replace speaker
	Sound amplifier on API Board defective	API Board

Alarm Behavior

If your monitor did not alarm in the way in which the end user expected, please consult the *Instructions for Use* for possible setup issues or configuration settings which could affect alarm behavior.

Fetal Recorder

Symptom	Possible Cause	Corrective Action
Paper empty warning is issued in the status line at the bottom of the screen, but paper is not out.	Drawer is open.	Close the drawer.
	Paper jam.	Open the drawer, remove paper, tear off scrumpled paper and re-load, or load a new pack of paper. Close the drawer. To minimize the risk of paper transport problems, use the recorder with the paper guide.
	Paper sensor disconnected.	Check the paper sensor flex cable connection to the API Board.
	Paper sensor defective.	Replace Recorder Assembly.

Symptom	Possible Cause	Corrective Action
No paper transport.	Drawer is open, or not properly closed.	Close the drawer.
	Paper jam.	Open the drawer, remove paper, tear off scrumpled section of paper and re-load, or load a new pack of paper. Close the drawer. To minimize the risk of paper transport problems, use the recorder with the paper guide.
	Stepper motor cable is disconnected.	Check that the stepper motor cable is properly connected to the API Board.
	Stepper motor is defective.	To test the functioning of the motor, open the drawer and press the recorder **Paper Advance** key to start the recorder. A good motor should rotate. If the motor does not rotate: 1 Check the stepper motor is connected properly to the API Board. 2 If the problem persists, replace the recorder assembly.
The recorder appears to be running normally, but the paper remains blank	Thermal Printhead is disconnected.	Check the connection. Then run the recorder Selftest to verify correct printing (see "Fetal Recorder Selftest Report" on page 50).
	Thermal Printhead is defective.	Replace the recorder assembly. Then calibrate the recorder (see "Setting the Fetal Recorder Offset" on page 49).
	The wrong side of the paper is facing up.	Load the paper correctly, the right way up.
No recorder key is available on the screen, and the INOP **FetRec EQUIP MALF** is issued.	The recorder has not been calibrated.	Calibrate the recorder (see "Setting the Fetal Recorder Offset" on page 49).
	EEPROM on the API Board is defective	Exchange the API Board and calibrate the recorder (see "Setting the Fetal Recorder Offset" on page 49).
	Recorder Controller on the API Board is defective.	Exchange the API Board and calibrate the recorder (see "Setting the Fetal Recorder Offset" on page 49).
	Recorder cable is disconnected.	Ensure the recorder cable is connected firmly at both ends.

Symptom	Possible Cause	Corrective Action
The INOP **CHECK PAPER** is issued.	The drawer is open and there is paper on the paper sensor.	Ensure the paper is loaded correctly, and close the drawer.
	Paper jam.	Open the drawer, remove paper, tear off scrumpled section of paper and re-load, or load a new pack of paper. Close the drawer.
	Paper sensor dirty.	Clean paper sensor (see "Fetal Recorder Maintenance" on page 31).
	Paper sensor defective.	Exchange the recorder assembly.
	The rubber roller is slipping.	Clean the rubber roller (see "Fetal Recorder Maintenance" on page 31).
	Paper is not approved by Philips.	Use only paper approved by Philips.
	Inadequate contrast of paper marks, or no paper marks.	Use only Philips approved paper. Calibrate the recorder.
The INOP **WRONG PAPER SCALE** is issued.	Paper with the wrong scale has been loaded (for example, International paper has been loaded instead of US paper).	Check, and if necessary, replace the paper pack with one with the correct scale. Check, and if necessary, change the paper scale setting to the correct setting for the paper used.
The INOP **PRINTHEAD OVERHEAT** is issued.	The printhead is too hot.	Wait for the printhead to cool down, then press the recorder **Start/Stop** key or the **Silence** key to clear the INOP.
Bad or distorted printout within the first 1 cm of the trace.	Paper drawer was not fully closed.	Always ensure the paper drawer is fully closed before starting recording.
Poor print quality.	Heat setting needs adjusting.	Adjust the Thermal Printhead heat setting. Then run the recorder Selftest to verify correct printing (see "Fetal Recorder Selftest Report" on page 50).
	Thermal Printhead dirty (there are partially missing dots on the recorder output).	Clean the Thermal Printhead (see "Fetal Recorder Maintenance" on page 31). Then run the recorder Selftest to verify correct printing (see "Fetal Recorder Selftest Report" on page 50).
	Thermal Printhead failure.	Exchange the Recorder Assembly. Then run the recorder Selftest to verify correct printing (see "Fetal Recorder Selftest Report" on page 50).
Paper not feeding properly.	Paper incorrectly loaded.	Load paper correctly.
	The rubber roller is dirty.	Clean the rubber roller (see "Fetal Recorder Maintenance" on page 31).
Trace is not printed correctly with reference to the paper gridlines.	Offset needs adjusting.	Calibrate the recorder and change the offset (see "Setting the Fetal Recorder Offset" on page 49).
	The wrong paper scale is being used.	Ensure the paper you are using matches the paper scale setting.

LAN / RS232

Symptoms	Cause of Failure	Failure Isolation and Remedy
External device (such as a surveillance system like OB TraceVue) not receiving data	The LAN/RS232 port is not configured for data export	Check configuration of the LAN/RS232 ports in configuration mode
	The cable between the external device and the monitor is not connected correctly or defective	Check cable and replace if necessary
	The external device does not support the version of the data export protocol used in the monitor	Check if the device supports the version of the data export protocol. Upgrade device or monitor if necessary (if matching versions exist).
	A terminal concentrator is used in between the device and the monitor and a protocol with dynamic speed negotiation is used	Some terminal concentrators do not support changing the transmission speed (baud rate) dynamically. Check if the connection works without the concentrator
	The LAN/RS232 board is in a wrong slot (slot has been changed after software configuration or an additional board has been plugged in)	Verify correct placement of the I/O boards
	The LAN/RS232 board is defective	Check board and replace if necessary
	For RS232 connections only: the wrong cable is being used.	Check that the correct cable is being used.

Keyboard/Mouse not Functioning

Symptoms	Possible Causes of Failure	Failure Isolation and Remedy
Keyboard/Mouse attached directly to the monitor not functioning	Keyboard/Mouse not connected properly	Check cabling
	Keyboard/Mouse defective	Replace Keyboard/Mouse
	PS/2 I/O board is not properly plugged in	Ensure the PS/2 I/O board is properly plugged in. If necessary, remove the board and plug it in again.
	PS/2 I/O board defective	Replace I/O board

Remote Touch Display not Responding (MIB/RS232)

Symptoms	Possible Causes of Failure	Failure Isolation and Remedy
Touch screen operation of connected remote display not possible.	Cable not properly connected.	Check cabling at both ends.
	MIB/RS232 port not configured.	Configure the MIB/RS232 port (see "Connecting a Remote Display via the MIB/RS232 Interface" on page 16).
	Factory Defaults were loaded.	After loading the Factory Defaults, the MIB/RS232 port assignment settings are no longer valid. Reconfigure the MIB/RS232 port ("Connecting a Remote Display via the MIB/RS232 Interface" on page 16).

No Video on Remote Display

Symptoms	Possible Causes of Failure	Failure Isolation and Remedy
No video on a connected remote display.	Cable not properly connected.	Check video cable is securely connected at both ends.
	Remote display has no power.	Ensure the remote display is properly connected to AC mains.

Transducers

Note that immediately after plugging in a normally functioning transducer, the Finder LED briefly lights twice.

Symptoms	Possible Cause	Failure Isolation and Remedy
The transducer Finder LED does not light up after plugging in the transducer, and the transducer appears not to work. INOP **OB EQUIP MALF** is displayed.	Defective transducer cable.	Visually inspect the transducer cable and the cable connector for damage. If there are obvious signs of damage, replace the cable.
	Defective connector block.	Visually inspect the connector block and the sensor sockets for damage. If there are obvious signs of damage, replace the connector block.
	Transducer or connector block is defective.	Try plugging the transducer into a different sensor socket. • If the Finder LED works, then the original socket is defective. Replace the connector block. • If the Finder LED still does not light in any of the other sockets, try using a known good transducer. If the Finder LED lights, the original transducer is defective: replace it.
	API Board is defective.	Try using a known good transducer. If the Finder LED does not light in any of the sockets using a known good transducer, then the API Board is defective. Replace the API Board.
	No power to API Board.	If both the SpO_2 board and the API Board are not working, replace the API Board. If the green power LED does not light, exchange the power supply.
Transducer appears not to work, and: *EITHER* the transducer Finder LED lights briefly after plugging in the transducer and INOP **OB EQUIP MALF** is displayed. *OR* the transducer Finder LED lights briefly after plugging in the transducer, and there are no parameters on the screen (transducer is not recognized). INOP **OB EQUIP MALF** is displayed.	Transducer is defective.	Replace transducer.
All transducers (US, Toco, IUP and ECG) do not work. INOP **OB EQUIP MALF** is displayed.	API Board is defective.	Replace API Board.

Symptoms	Possible Cause	Failure Isolation and Remedy
Transducer is connected, INOP **OB EQUIP MALF** is displayed.	API Board is defective.	Replace API Board.
	Transducer defective.	Replace transducer.
After a transducer software upgrade, the message "Unknown transducer connected" is displayed at the bottom of the screen.	Transducer is in boot mode, and is not recognized by the monitor.	Try a new software upgrade of the transducer with the Support Tool.
"Unknown transducer connected" is displayed at the bottom of the screen (**not** following a software upgrade)	The transducer is defective.	Replace the transducer.
Transducer belt button is broken or damaged.	Mechanical damage.	Replace the belt button. Handle transducers with care. **Never use a transducer with a broken or damaged knob.**

Status Log

Many events that occur during start-up or regular monitoring are logged in the Status Log. The Status Log can be cleared. Not all entries in the Status Log are errors. You can print the Status Log via the Support Tool.

Monitor Id.	Code	No.	Date Time
H 18202	20100	1	4 Dec 07 16:37
C 1721	21050	1	4 Dec 07 15:37

The Status Log window shows logged events which caused a reboot of the monitor.

To enter the Status Log Window, select **Main Setup** -> **Revision**. The following list opens up:

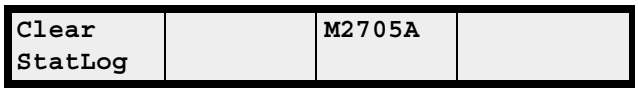
- **Status Log**
- **Product**
- **Appl. SW**
- **Config**
- **Boot**
- **Language**
- **Settings**
- **OB**

- **FetRec**
- **NBP**
- **SpO_2**
- **List of plugged parameters**

Select **Status Log.**

The first column in the log identifies the event class (“C”: caused a cold start, “H”: caused a hot start, “N”: no restart, for information only). Column 3 and 4 identify the event source and event code. Column 4 counts the number of occurrences of the event. The last column shows the time and date of the last occurrence of the event.

The following pop-up keys overlay the SmartKeys:



Clear StatLog

This key clears the currently displayed Status Log

M2705A

This key switches to the Monitor Revision Window

If an event occurs repeatedly, contact your Philips Service Representative.

NOTE It is possible, using the support tool, to download the status log and send it to your Philips Service Representative as a file (for example via e-mail).

Troubleshooting with the Support Tool

Using the support tool you can:

- access the full status log which can be saved as a file
- reload software
- identify defective devices
- start touch screen calibration

For details on how to perform these tasks see the Support Tool Instructions for Use.

Troubleshooting the Individual Measurements or Applications

For problems isolated to an individual parameter or application, please consult the *Instructions for Use* and configuration information.

If the *Instructions for Use* did not resolve an individual parameter problem, then another transducer or patient module should be tried.

If you are getting questionable readings for individual measurements you may want to do the performance assurance tests in Chapter 7, “Testing and Maintenance”.

The performance of the individual applications are affected by the configuration of the monitor. When contacting Philips support you may be asked about the configuration of the monitor to aid in troubleshooting.

9

Parts

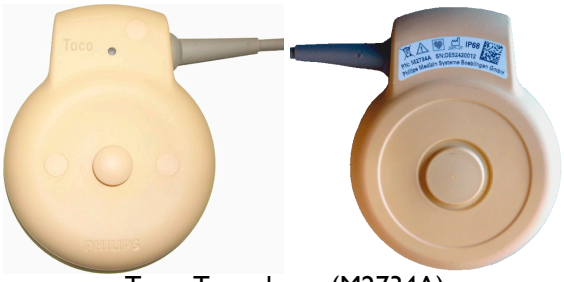
Spare parts, along with part numbers, are listed in the tables that follow.

Monitor

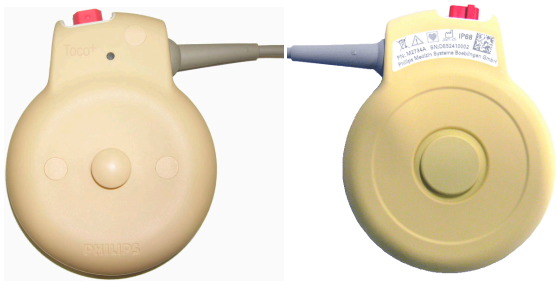
Description	Ordering Number				Qty
	Number for New Parts		Number for Exchange Parts		
	Part No.	Alternative Identifier	Part No.	Alternative Identifier	
Front Bezel Assembly, Text (picture on page 75)	M2705-64101	451261024941	M2705-68011	451261025131	1
Front Bezel Assembly, Symbols (picture on page 75)	M2705-64100	451261024931	M2705-68010	451261025121	1
Main CPU Board (picture on page 76)	M2705-66510	451261024951	M2705-68510	451261024961	1
API Board Kit (kit contents on page 76)	M2705-64300	451261025021	M2705-68001	451261025111	1
Noninvasive Blood Pressure Assembly (picture on page 76)	M2703-64502	451261010271	M2703-68502	451261010551	1
Recorder Assembly (picture on page 77)	M2705-60501	451261025071	M2705-68601	451261025081	1
Thermal Line Printhead (TLPH) (picture on page 77)	M2705-60502	451261026321	-	-	1
Loudspeaker Assembly (picture on page 77)	M2705-60530	451261024971	-	-	1
Top Cover (picture on page 78)	M2705-60550	451261024921	-	-	1
AC/DC Power Supply (picture on page 78)	M8105-60001	451261019041	-	-	1

Description	Ordering Number				Qty
	Number for New Parts		Number for Exchange Parts		
	Part No.	Alternative Identifier	Part No.	Alternative Identifier	
SpO_2 Board (picture on page 78)	M1020-66513	451261010601	-	-	1
LAN / RS232 Interface Assembly (picture on page 79)	M2703-67501	451261010531	-	-	1
Dual PS/2 Interface (picture on page 79)	M8086-67501	453563469651	-	-	1
MIB / RS232 Interface (picture on page 79)	M8081-67001	453563459361	-	-	1
Fetal Sensor Socket Connector Kit (kit contents on page 79)	M2705-64503	451261025001	-	-	1
Rear Connector Kit (kit contents on page 79)	M2705-64504	451261025011	-	-	1
SpO_2 Connector Kit (kit contents on page 80)	M2705-64502	451261024991	-	-	1
Noninvasive Blood Pressure Connector Kit (kit contents on page 80)	M2705-64501	451261024981	-	-	1
Camlock Kit (kit contents on page 80)	M2705-64400	451261025061	-	-	1
FM Small Parts Kit - plastics and labels	M2705-64203	451261025031	-	-	1
FM Small Parts Kit - screws and cables (kit contents on page 83)	M2705-64202	451261025041	-	-	1
Recorder Parts Kit	M2705-64600	451261025051	-	-	1

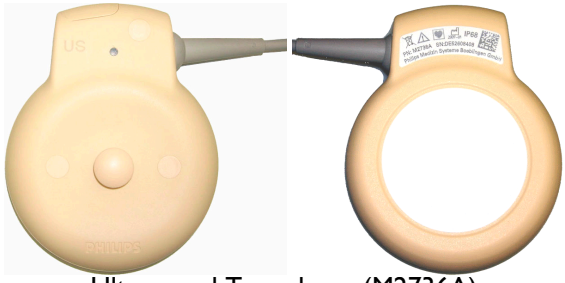
Transducers



Toco Transducer (M2734A)



Toco+ Transducer with ECG/IUP capability (M2735A)



Ultrasound Transducer (M2736A)

Description	Ordering Number				Qty
	Number for New Parts		Number for Exchange Parts		
	Part No.	Alternative Identifier	Part No.	Alternative Identifier	
Toco Transducer	M2734-60501	451261010451	M2734-68501	4512 610 11231	1
Toco+ Transducer	M2735-60501	451261010461	M2735-68501	4512 610 11241	1
US Transducer	M2736-60501	451261010471	M2736-68501	4512 610 11251	1
Cable Assembly (for all transducers; see page 84)	M2735-64201	4512610 0481	-	-	1
Belt Button Kit, with tool, pack of 5, “Belt Button Kit” on page 84	M2703-64204	451261010511	-	-	1

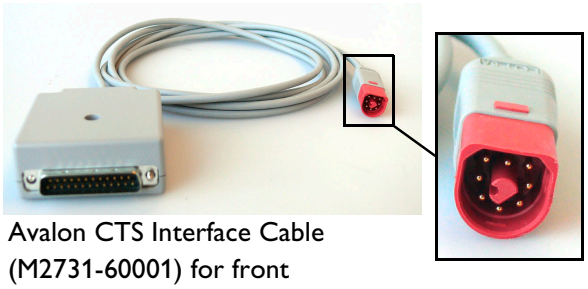
Patient Modules

Patient module for ECG/IUP (M2738A)

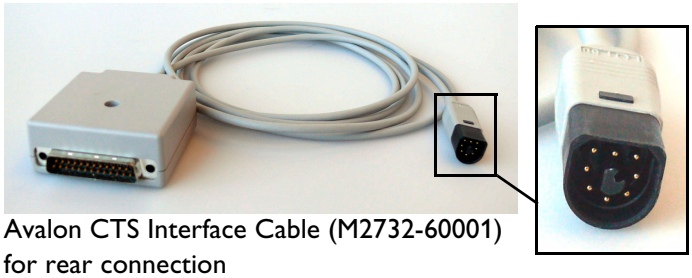
Remote Event Marker (989803143411)

Description	Ordering Number				Qty
	Number for New Parts		Number for Exchange Parts		
	Part No.	Alternative Identifier	Part No.	Alternative Identifier	
ECG/IUP Patient Module	M2738-60501	451261011261	-	-	1
Remote Event Marker	-	989803143411	-	-	1

Interface Cables



Avalon CTS Interface Cable (M2731-60001) for front connection



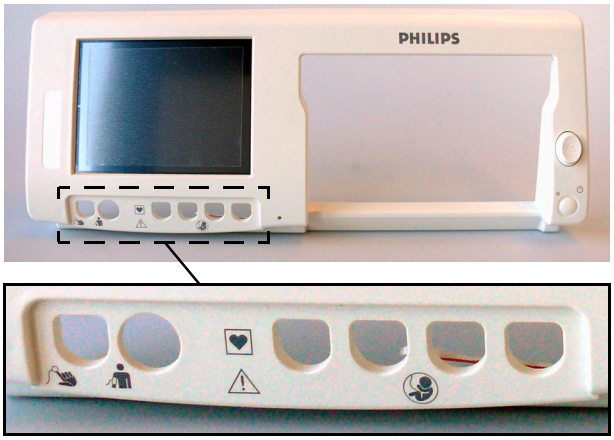
Avalon CTS Interface Cable (M2732-60001) for rear connection

Description	Ordering Number				Qty
	Number for New Parts		Number for Exchange Parts		
	Part No.	Alternative Identifier	Part No.	Alternative Identifier	
Avalon CTS Interface Cable (M2731-60001), red connector, for connection to the red fetal sensor sockets on the front of the monitor.	M2731-60501	451261016251	-	-	1
Avalon CTS Interface Cable (M2732-60001), black connector, for connection to the black telemetry sockets on the rear of the monitor.	M2732-60501	451261025091	-	-	1
Serial (RS232) Interface Cable to OB Tracevue.	M1380-61612	453563278111	-	-	1

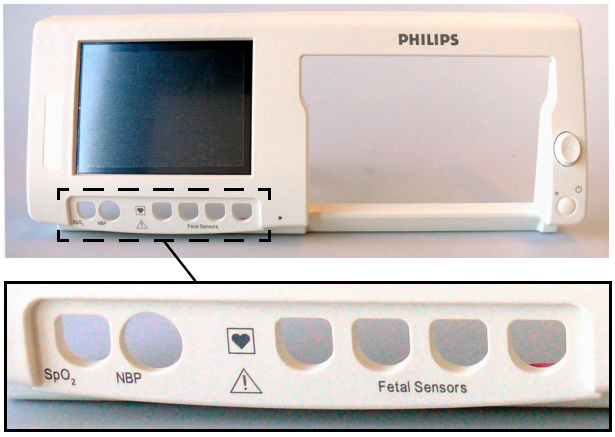
Assemblies and Kits

This section contains additional information for quick identification of assemblies and kit contents.

Front Bezel Assembly

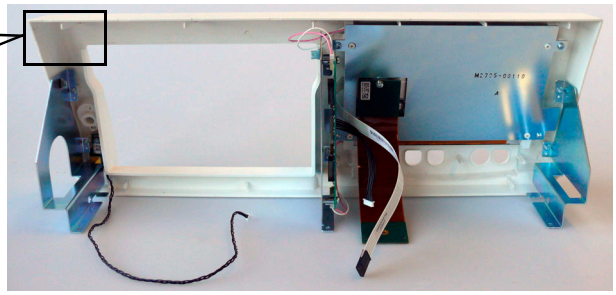


Front Bezel Assembly, SYMBOLS



Front Bezel Assembly, TEXT

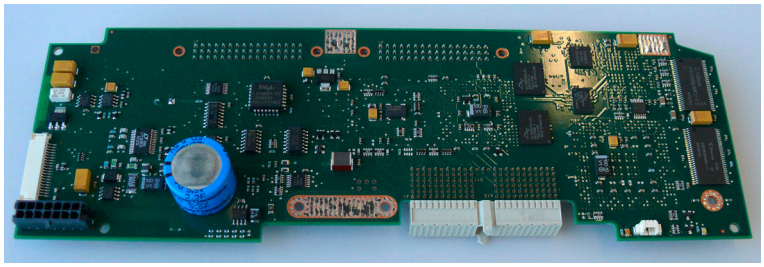
Part number and serial number printed here



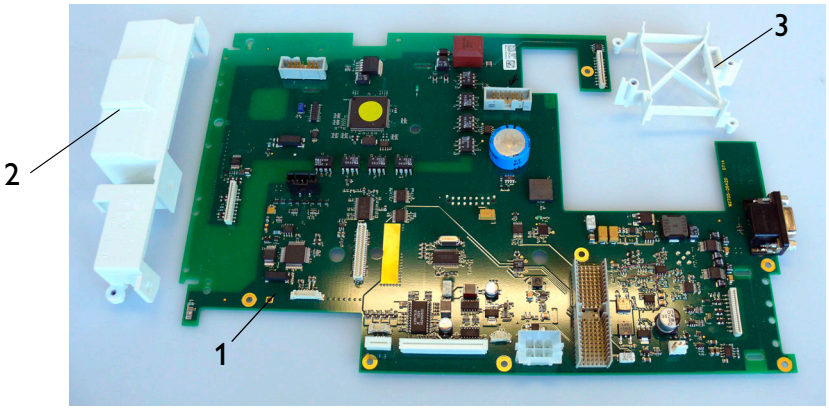
Front Bezel Assembly, Rear View

A set of labels is included with the assembly

Main CPU Board

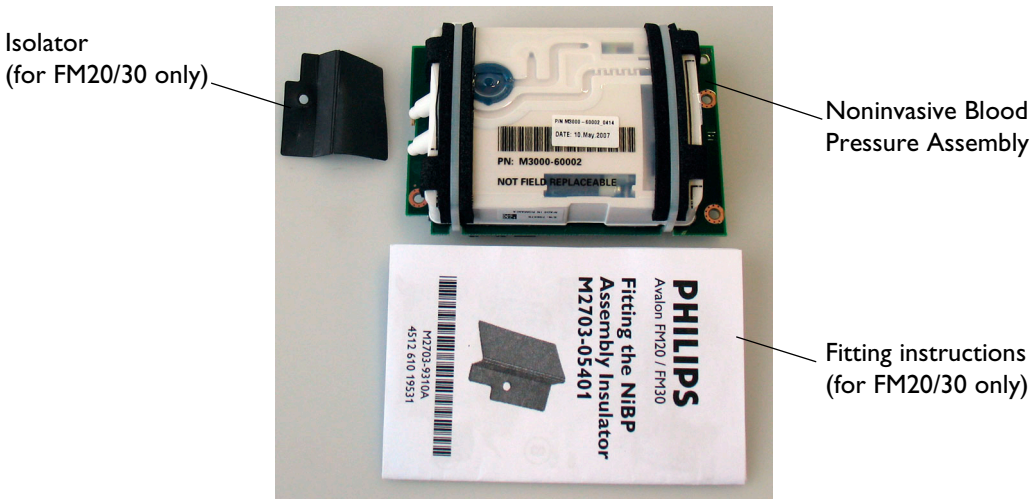


API Board Kit

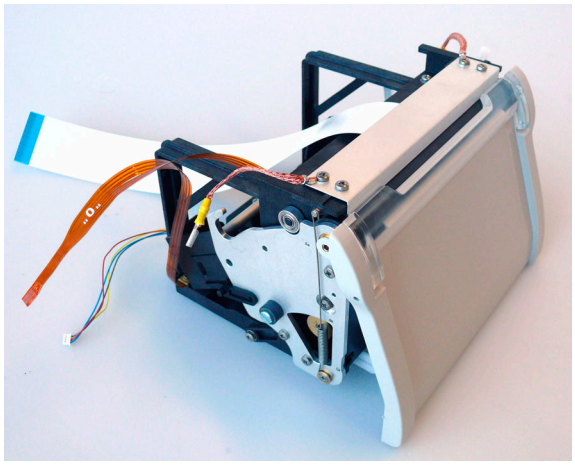


Item	API Board Kit Contents	Qty
1	API Board	1
2	Connector Block Frame	1
3	Mounting Frame for SpO_2 Board	1

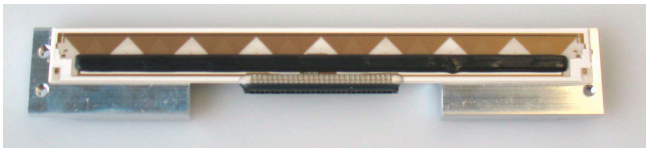
Noninvasive Blood Pressure Assembly



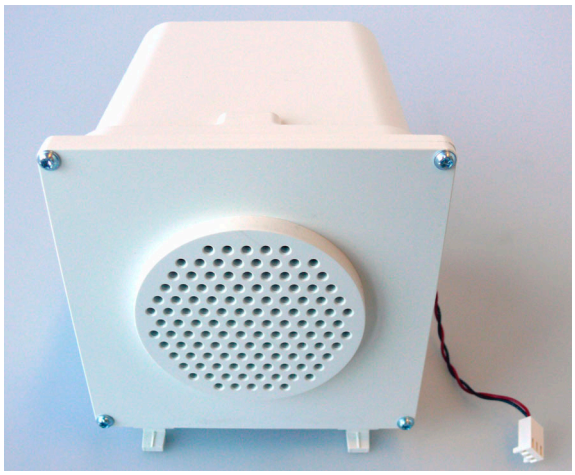
Recorder Assembly



Thermal Line Printhead (TLPH)

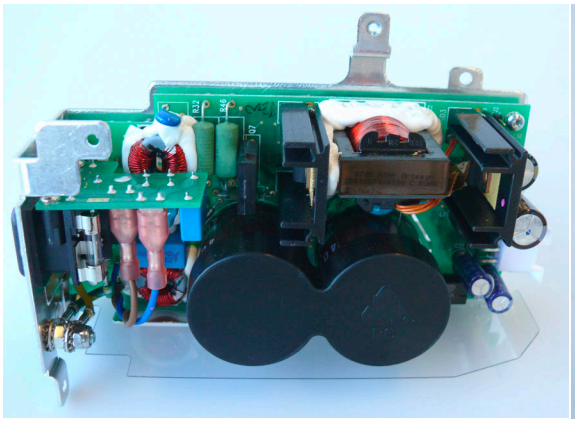


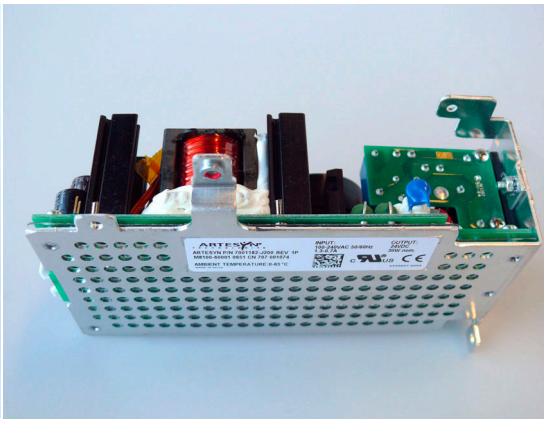
Loudspeaker Assembly



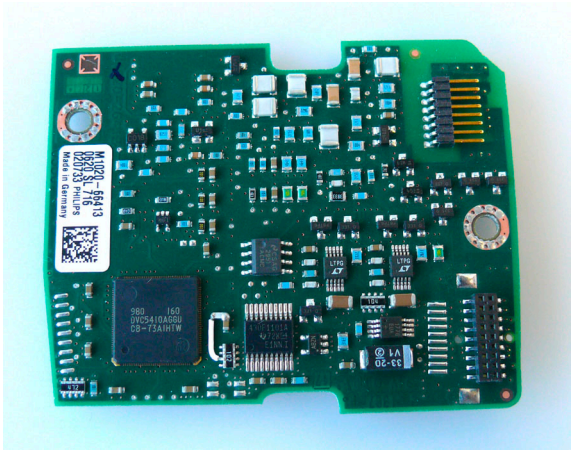
Top Cover

AC/DC Power Supply

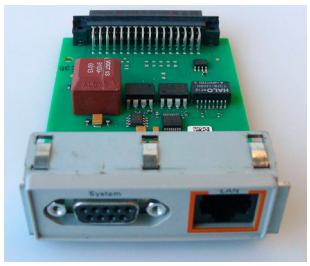




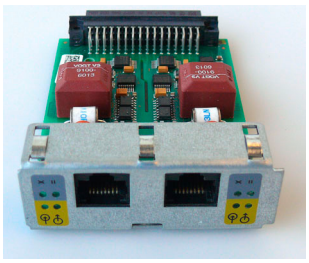
SpO_2 Board



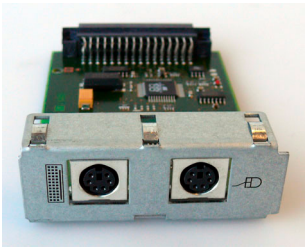
Interface Boards



LAN / RS232 Interface



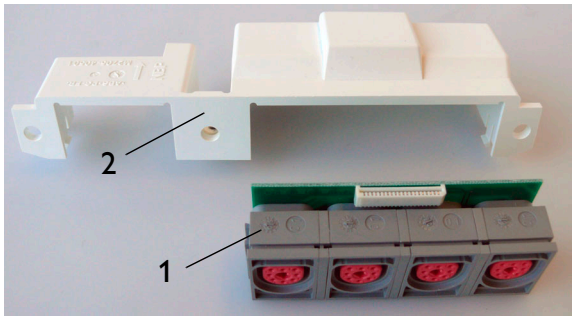
MIB / RS232 Interface



Dual PS/2 Interface

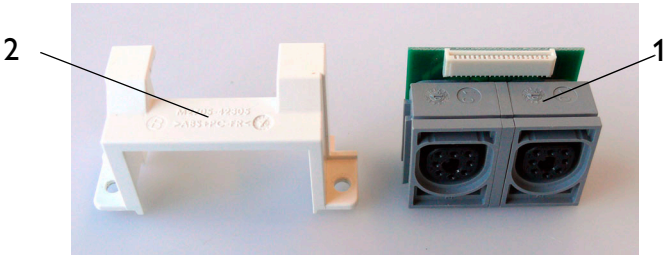
Interface slot steel blank

Fetal Sensor Socket Connector Kit



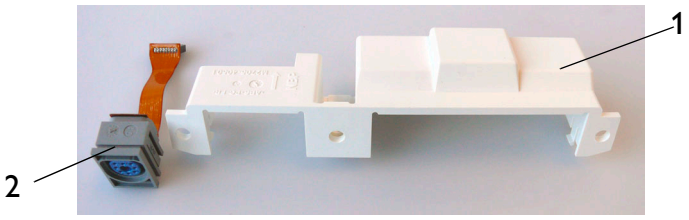
Item	Fetal Sensor Socket Connector Kit Contents	Qty
1	Fetal Sensor Socket Connector Block	1
2	Connector Block Frame	1

Rear (Telemetry) Connector Kit



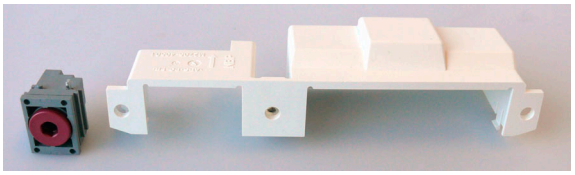
Item	Rear (Telemetry) Connector Kit Contents	Qty
1	Rear Socket Connector Block	1
2	Rear Connector Block Frame	1

SpO_2 Connector Kit



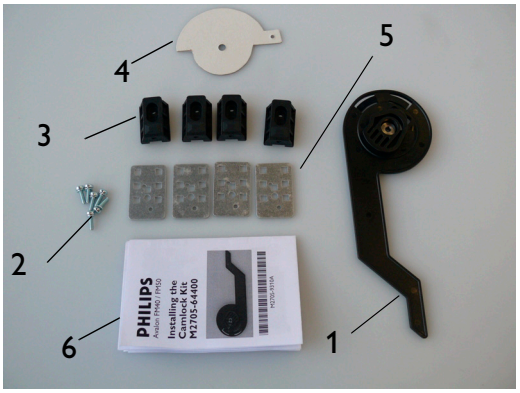
Item	SpO_2 Connector Kit Contents	Qty
1	SpO_2 Socket Connector Block	1
2	Connector Block Frame	1

Noninvasive Blood Pressure (NBP) Connector Kit



Item	Noninvasive Blood Pressure Connector Kit Contents	Qty
1	NBP Socket Connector Block	1
2	Connector Block Frame	1

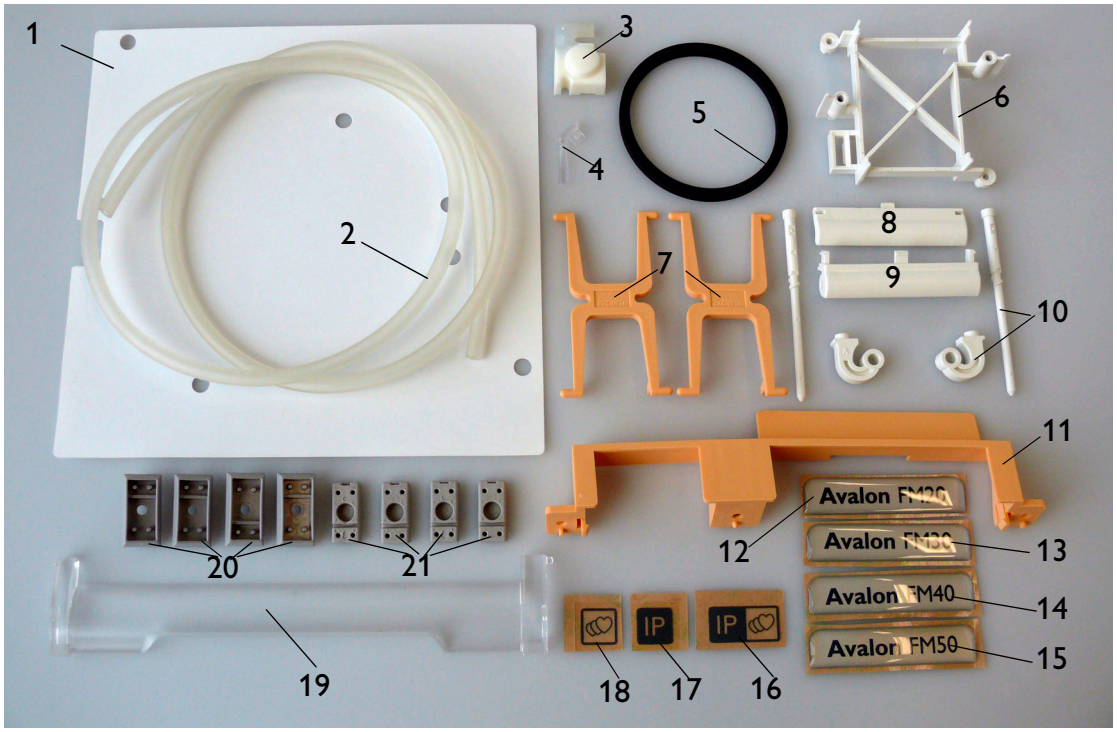
Camlock Kit



Item	Camlock Kit Contents	Qty
1	Cam	1
2	Screws M3 x 10	5
3	Feet	4

Item	Camlock Kit Contents	Qty
4	Mounting Plate (for Cam)	4
5	Mounting Plates (for Feet)	4
6	Installation Instructions	1

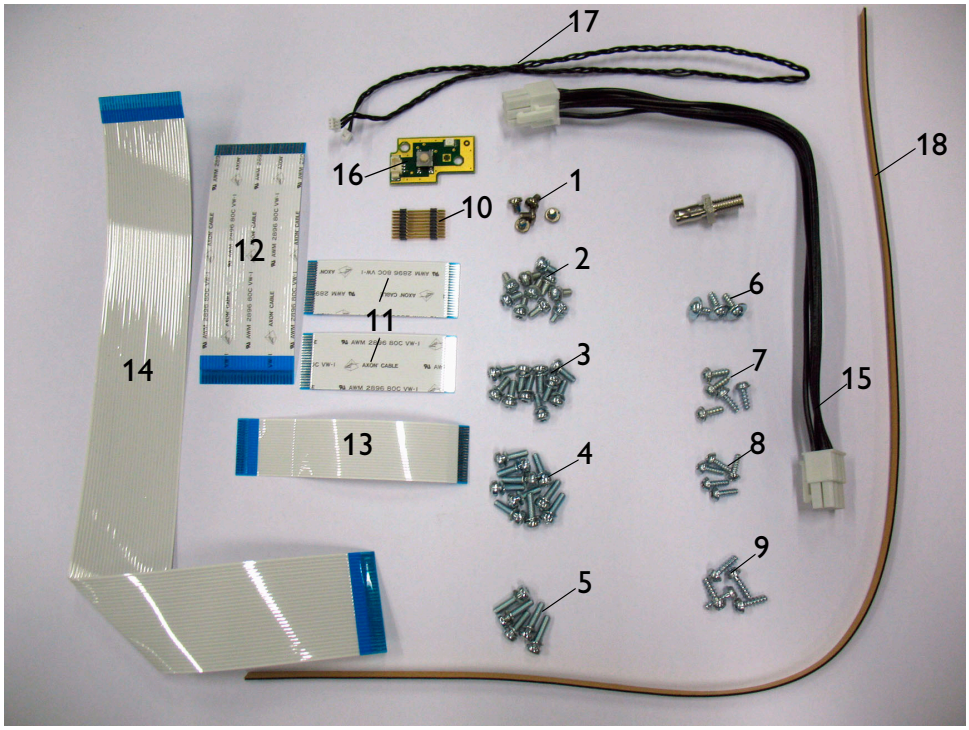
FM Small Parts Kit - Plastic Parts and Labels



Item	FM Small Parts Kit Contents - Plastic Parts and Labels	Qty
1	FM40/50 Insulator, API Board	1
2	NBP Tubing (needs to be cut to size)	1
3	FM40/50 Silicone ON/OFF Key	1
4	FM40/50 Lightpipe	1
5	FM20/30 O-Ring, loudspeaker	1
6	FM40/50 Mounting Frame for SpO_2 Board	1
7	FM20/30 Ratchet Lever/Clip	2
8	FM20/30 Cable Guide, Rear	1
9	FM20/30 Cable Guide, Front	1
10	FM20/30 Hinge	2
11	FM20/30 Connector Frame	1
12	Label, FM20	1
13	Label, FM30	1
14	Label, FM40	1
15	Label, FM50	1

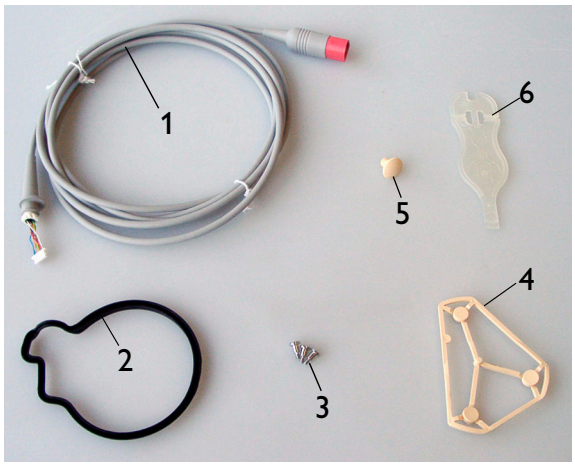
Item	FM Small Parts Kit Contents - Plastic Parts and Labels	Qty
16	Intrapartum/Triplets Label	1
17	Intrapartum Label	1
18	Triplets Label	1
19	FM40/50 Paper Guide (incorporating tear-off edge)	1
20	FM40/50 Holder, Bumper Foot	4
21	FM40/50 Bumper Foot	4

FM Small Parts Kit - Screws and Cables



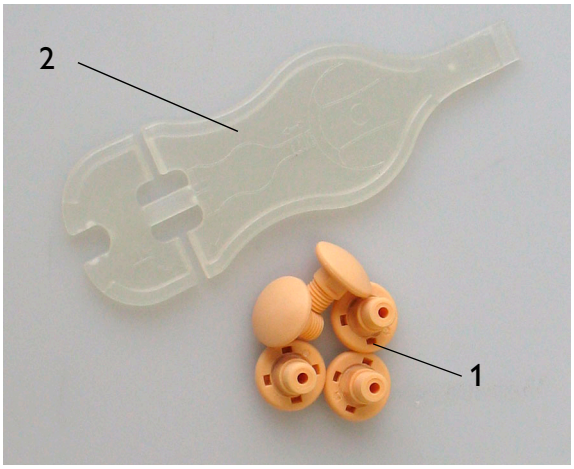
Item	FM Small Parts Kit Contents - Screws and Cables	Qty
1	Torx M3 x 4	5
2	Torx M3 x 6 with washer	10
3	Torx M3 x 8 with washer	10
4	Torx M3 x 10 with washer	10
5	Torx M3 x 12 with washer	5
6	Screw Ejot K30 x 8	3
7	Screw Ejot 3 x 8	8
8	Screw Ejot 2.5 x 8	5
9	Screw Ejot 3 x 10	5
10	Connector for SpO_2 Board (all monitors)	1
11	Ribbon cable, Bus Master (all monitors)	2
12	FM20/30 Ribbon cable, Recorder	1
13	Ribbon cable, NBP to Main CPU Board (all monitors)	1
14	FM40/50 Ribbon cable, API Board to Recorder	1
15	FM40/50 Cable assembly, Power Supply	1
16	FM40/50 PCA, Switch Board	1
17	FM40/50 Switch Board cable to API Board	1
18	FM40/50 Sealing Gasket, Top Cover	1
19	FM40/50 Equipotential grounding bolt	1

Transducer Cable Assembly



Item	Cable Assembly Contents	Qty
1	Transducer Cable (for all fetal transducers)	1
2	Sealing Gasket	1
3	Screw M2.5	3
4	Screw Cover (set of 3)	1
5	Transducer Belt Button	1
6	Avalon Tool	1

Belt Button Kit



Item	Belt Button Kit Contents	Qty
1	Belt Buttons	5
2	Avalon Tool (for removing/replacing transducer belt buttons)	1

10

Disassembly and Reassembly

WARNING

- Before attempting to open or disassemble the monitor, disconnect it from the AC mains supply.
- Energized circuits are accessible with the covers open. Do not work on the monitor with the covers open and AC power connected. Only qualified service personnel should open or disassemble the monitor.
- Performance verification: do not place the system into operation after repair or maintenance has been performed, until all performance tests and safety tests listed in Chapter 7, “Testing and Maintenance” have been performed. Failure to perform all tests could result in erroneous parameter readings, and/or patient/operator injury.

CAUTION Observe ESD (electrostatic discharge) precautions when working within the unit.

Introduction

Remember to store all screws and parts in a safe place for later refitting.

How to Use this Chapter

The disassembly sections detail the step-by-step procedures you use to access replaceable parts of the monitor and the transducers.

All major assemblies are fitted to the chassis assembly.

The chassis assembly consists of the chassis, the power supply assembly, the main CPU board, the All Peripheral Interfaces (API) Board (which includes the Bus Master section), the sensor sockets, the recorder assembly, the front bezel assembly including touchscreen display, the loudspeaker, the noninvasive blood pressure assembly, the SpO_2 assembly, the RS232/LAN, dual PS/2 and MIB/RS232 interfaces, the telemetry interface and the VGA video out connector.

All part numbers of spare parts are listed in Chapter 9, “Parts”.

Tools Required

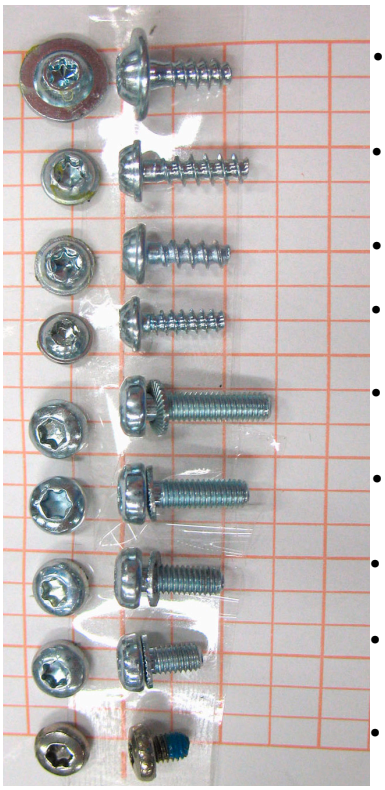
CAUTION Do not over-torque the screws. Excessive torque may damage the plastic screw mountings.

You need the following tools:

- Long-nosed pliers.
- Torx-head screwdriver, size T-10, minimum shaft length 80mm.
- Torx-head screwdriver, size T-8.
- Small flat-head screwdriver, 2.0-3.0 mm, for disengaging cable lock, and so on, and for removing the transducer screw covers.
- Flat-head screwdriver, head thickness 0.5 mm to fit transducer screw.

Screws Used

The following picture shows the range of screws used in the Avalon FM20/30/40/50 fetal monitors:



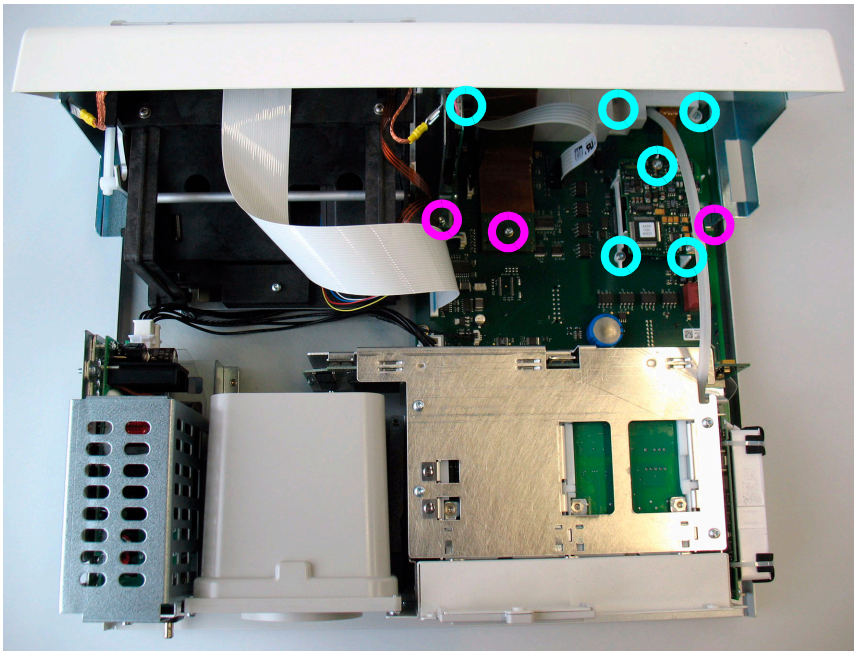
- Screw Ejot K30x8, T-10
- Screw Ejot 3x10, T-10
- Screw Ejot 3x8, T-10
- Screw Ejot 2.5x8, T-8
- Screw M3x12 with washer, T-10
- Screw M3x10 with washer, T-10
- Screw M3x8 with washer, T-10
- Screw M3x6 with washer, T-10
- Screw M3x4, T-10

Screw Map

All internal screws are M3x8 except the following:

Screws, front bezel, M3x6

Screws for plastic holders, Ejot 3x8



Serial Numbers

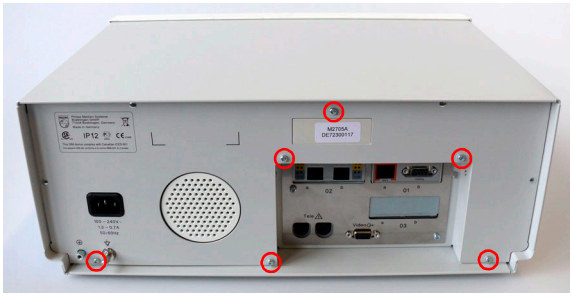
The serial number of the monitor appears on the rear panel. It is also stored electronically in the power supply.

If you exchange the power supply of the monitor, you may have to re-enter the monitor serial number afterwards. Check the serial number of the monitor in the Support Tool device view to see whether this is necessary: if the sixth digit of a monitor serial number is an “X”, you must re-enter the serial number, which you will find on the nameplate. Refer to the *Support Tool Instructions for Use* for details of how to change or re-enter a serial number.

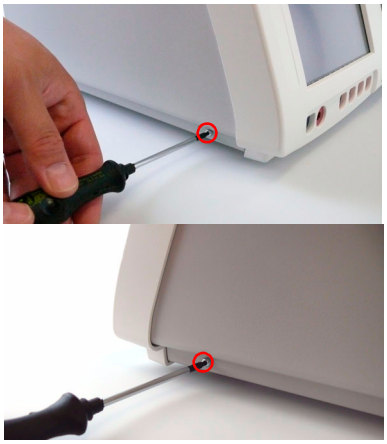
Removing the Top Cover

The top cover is held by eight screws, six at the rear and one on each side.

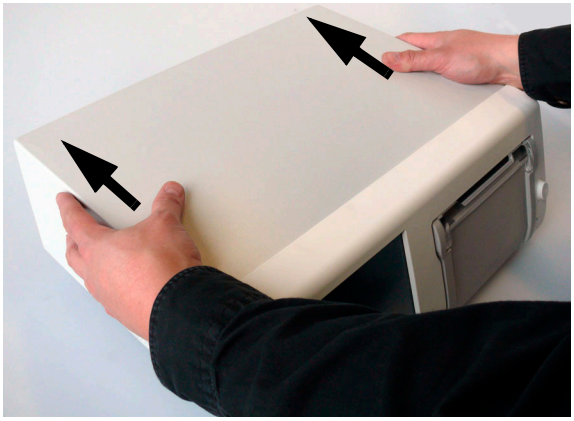
1 Remove the six screws from the rear, and one screw from each side of the top cover (all M3 x 6), using a T-10 Torx driver. The location of the screws to remove are shown here:.

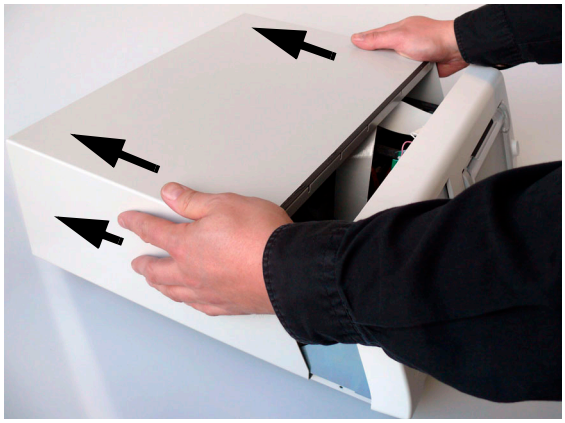


○ Screws, M3x8

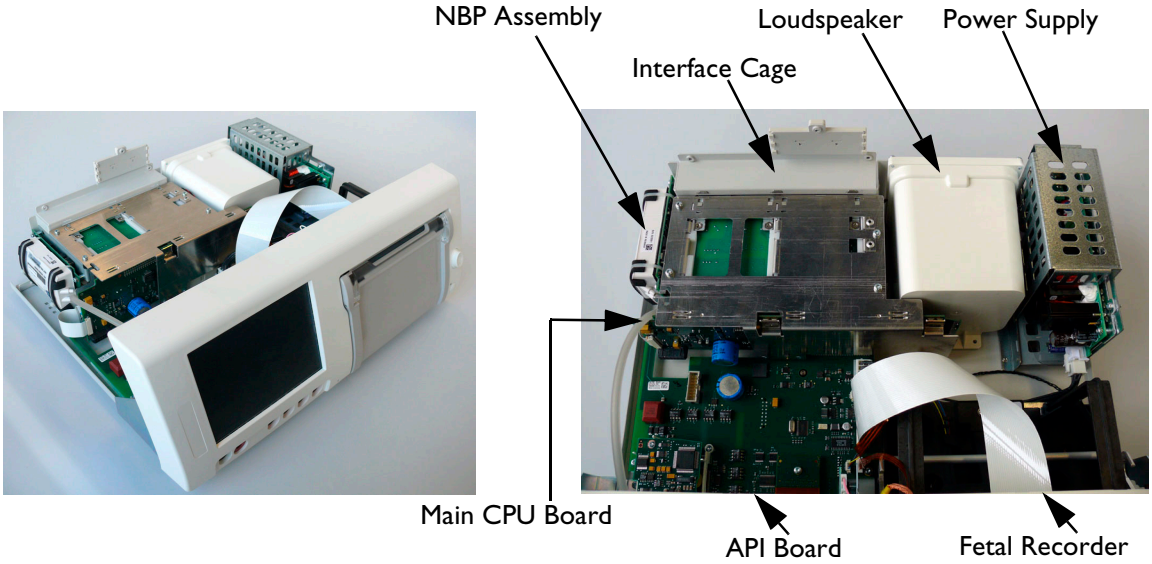


2 With the front of the monitor facing you, hold the sides of the top cover and push sharply away from you to release the top cover from the chassis.





3 Remove the top cover, taking care not to catch the serial number holder with the front edge of the top cover.



Refitting the Top Cover

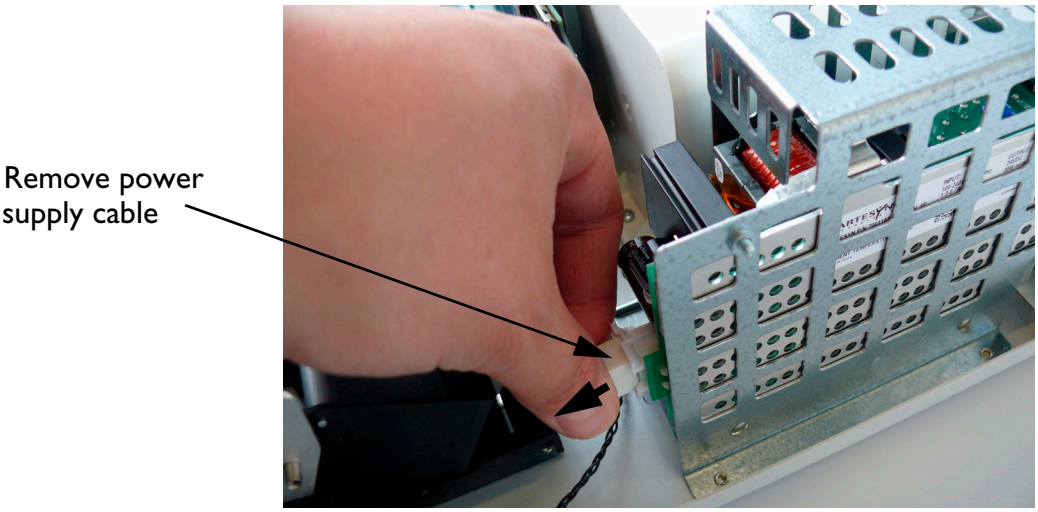
Check, and if necessary renew, the top cover sealing gasket before refitting the top cover. The sealing gasket is contained in the FM Small Parts Kit, “Screws and Cables”. For ordering information, see page 83.

Refitting the top cover is a reversal of the removal procedure. Take care not to trap the printer ribbon cable.

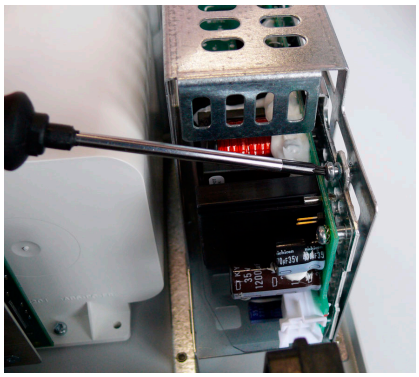
Removing the Power Supply Assembly

1 Remove the top cover (see page 87).

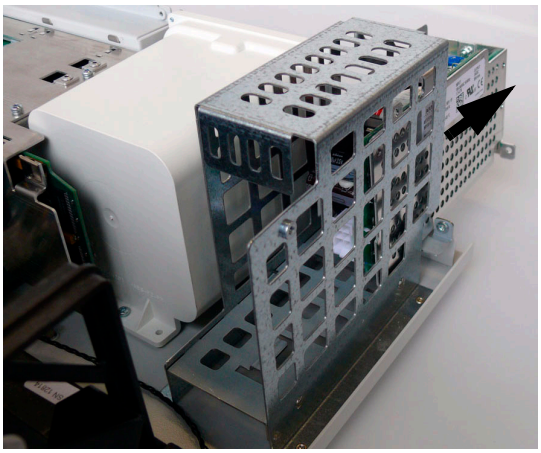
2 Disconnect the power supply cable connector.

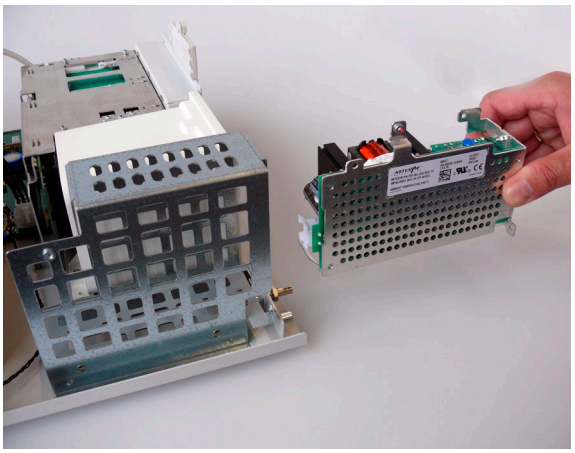


3 Remove the three screws securing the power supply



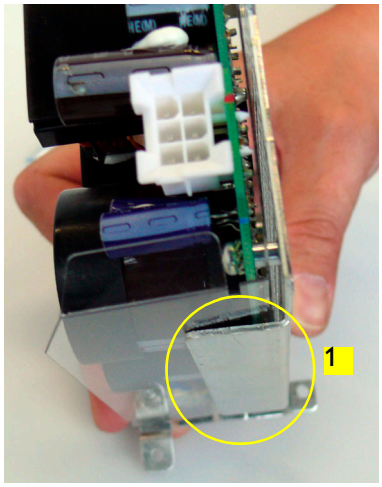
4 Lift the cable end of the power supply assembly with one hand, while guiding the power socket/on/off switch free of the aperture in the bottom housing, then lift out the power supply.





Refitting the Power Supply Assembly

1 When refitting the power supply assembly, make sure the metal runner (1) on the underside of the power supply assembly slides under the two locating guides (2).



2 Secure the power supply assembly to the power supply bracket

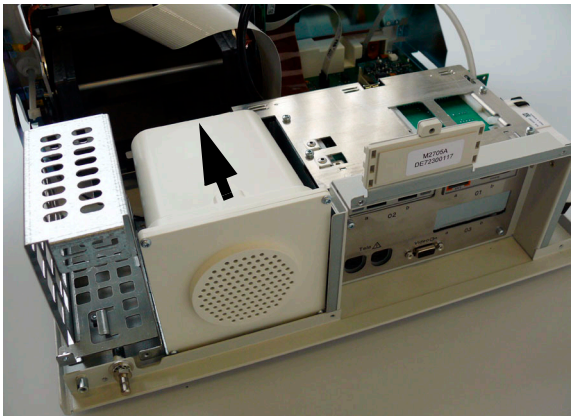
3 Reconnect the power supply cable connector.

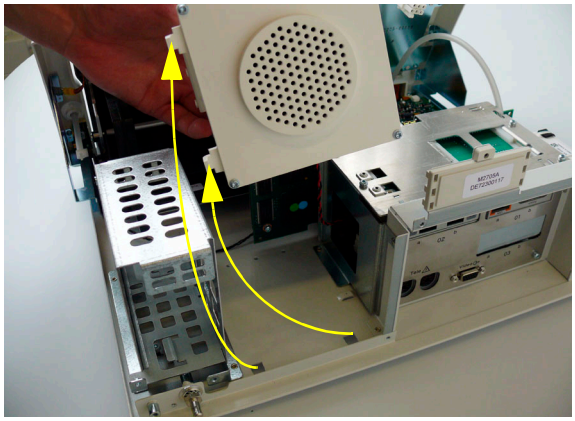
Removing the Loudspeaker Assembly

1 Remove the top cover (see page 87).

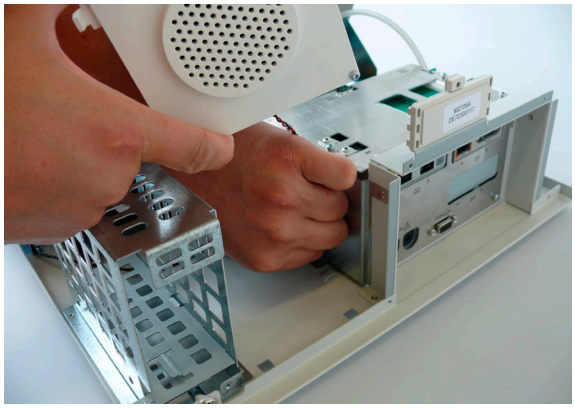
2 Remove the screw (T-10) securing the loudspeaker assembly to the chassis. The picture shows the power supply removed, but this is not a necessary step to remove the loudspeaker assembly.

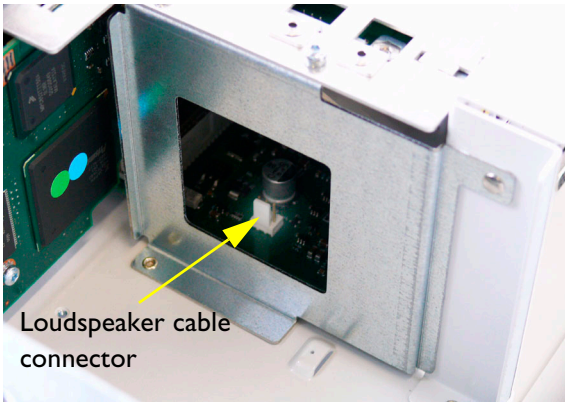
3 The loudspeaker assembly has two plastic feet which clip into two cut-outs in the metal chassis. Slide the loudspeaker assembly back to release the plastic feet, then lift the loudspeaker out. Remember that the cable is still connected.





4 Reach inside the interface board cage and disconnect the loudspeaker cable.





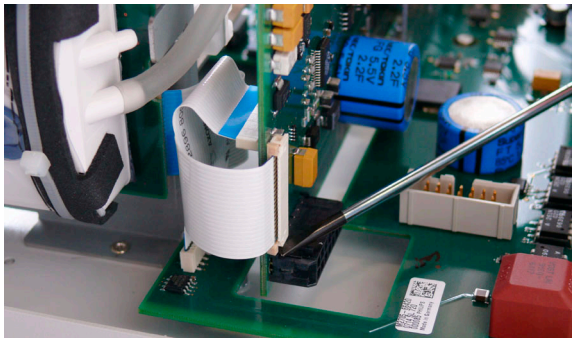
Refitting the Loudspeaker Assembly

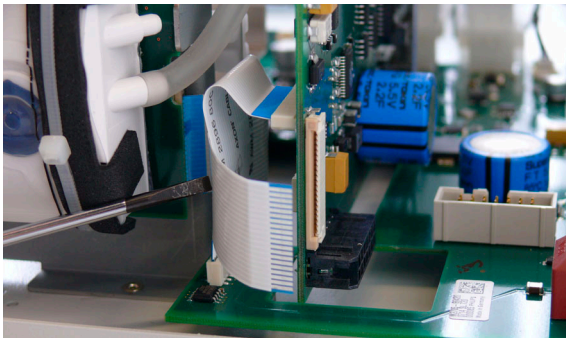
The procedure to refit the loudspeaker assembly is a reversal of the removal procedure.

Removing the Noninvasive Blood Pressure Assembly

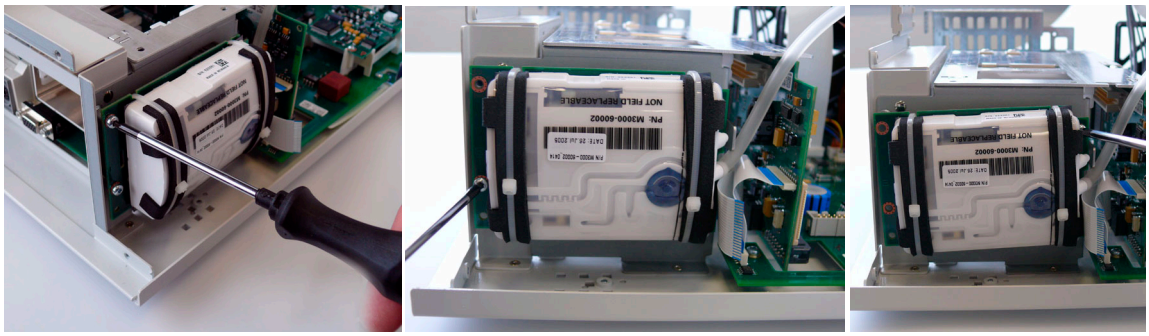
1 Remove the top cover (see page 87).

2 Disconnect the ribbon cable from the main CPU board after first disengaging the cable lock.

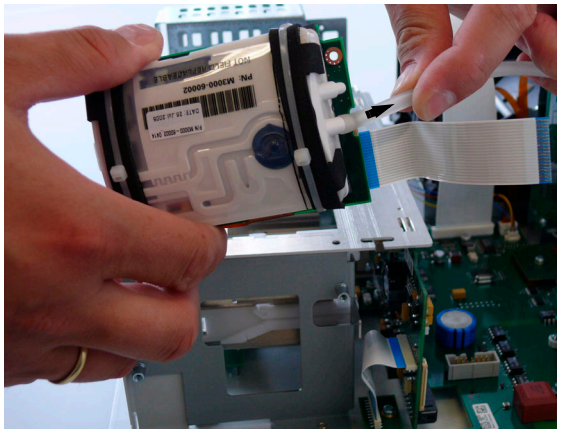


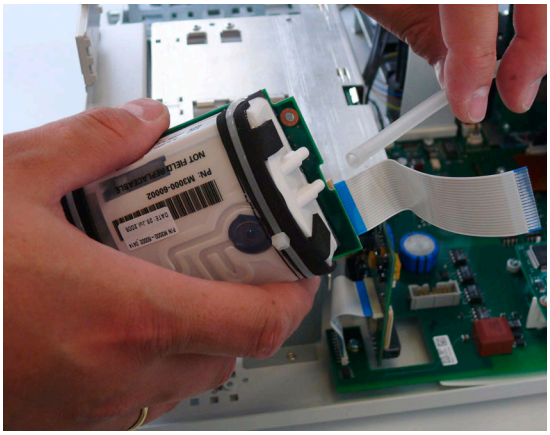


3 Remove the three screws holding the noninvasive blood pressure assembly to the chassis.



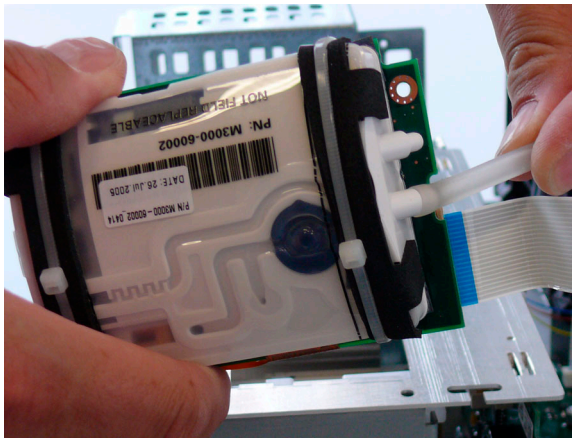
4 Disconnect the tubing from the noninvasive blood pressure connector and remove the noninvasive blood pressure assembly.

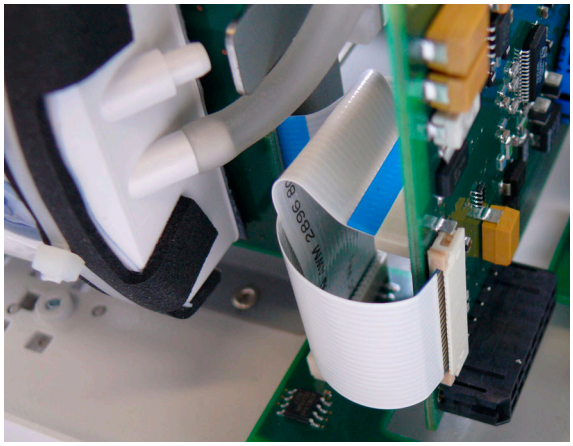




Refitting the Noninvasive Blood Pressure Assembly

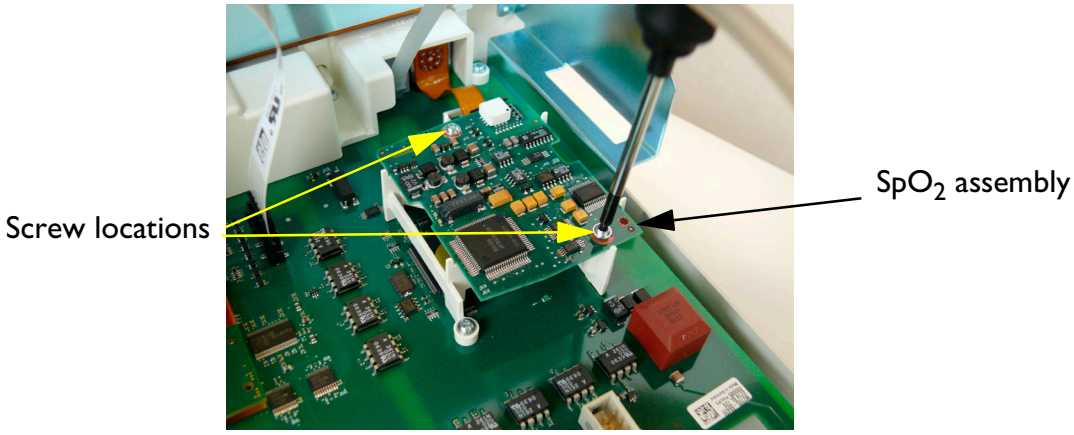
The procedure to refit the noninvasive blood pressure assembly is a reversal of the removal procedure. When refitting the tubing, make sure you connect it to the lower connector as shown. Also ensure that the ribbon cable is firmly reattached to the connector on the main CPU board, and that the cable lock is engaged.





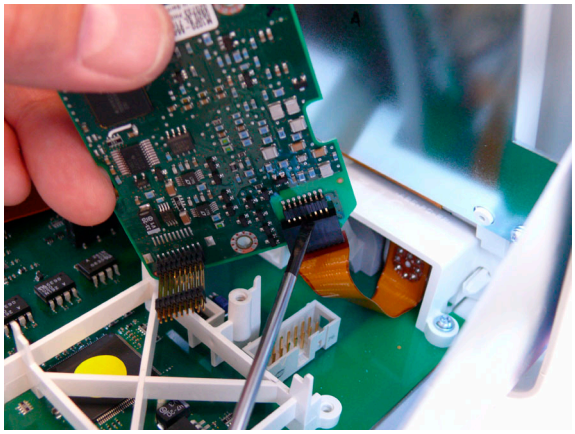
Removing the SpO_2 Assembly

1 Remove the top cover (see page 87).
The SpO_2 assembly is identified in the next picture. Remove the two screws holding the SpO_2 assembly.



2 Lift the side of the SpO_2 assembly nearest the SpO_2 socket, carefully disconnecting the multi-pin connector.

3 Disconnect the flat cable from the SpO_2 assembly, then remove the assembly.



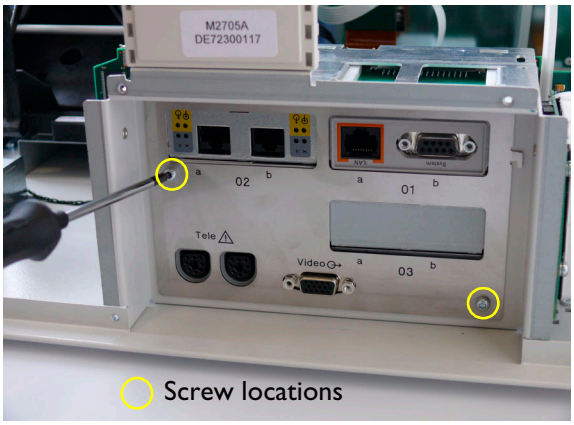
Refitting the SpO_2 Assembly

The procedure to refit the SpO_2 assembly is a reversal of the removal procedure.

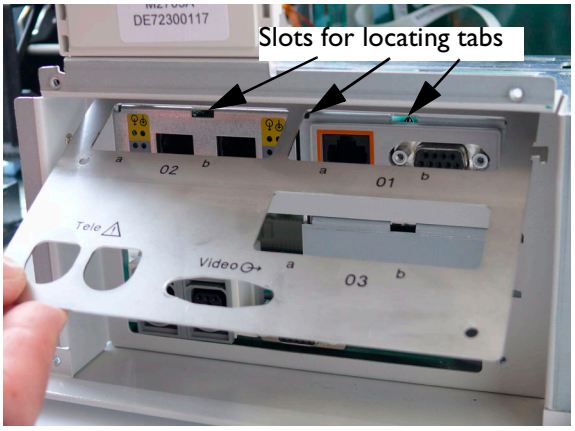
Removing the Interface Boards

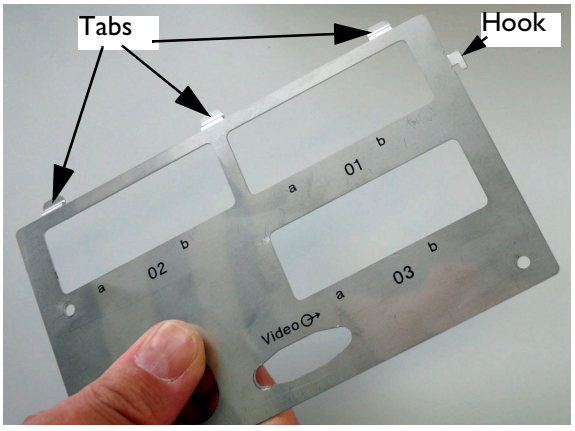
The interface boards are located in the interface board cage at the rear of the chassis. The boards can be removed without removing the top cover. However, the photos here show the top cover removed.

1 Remove the two screws securing the interface connector panel (located in the recess at the rear of the monitor).

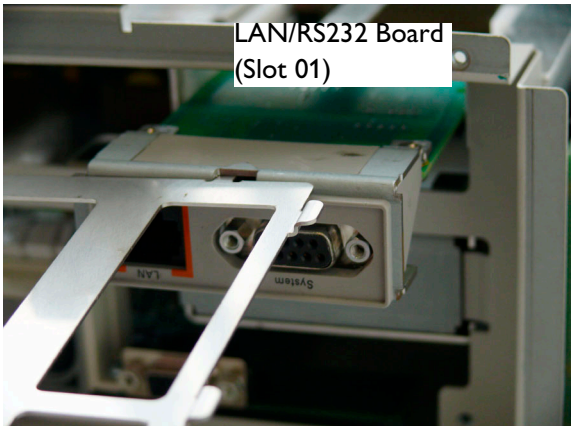


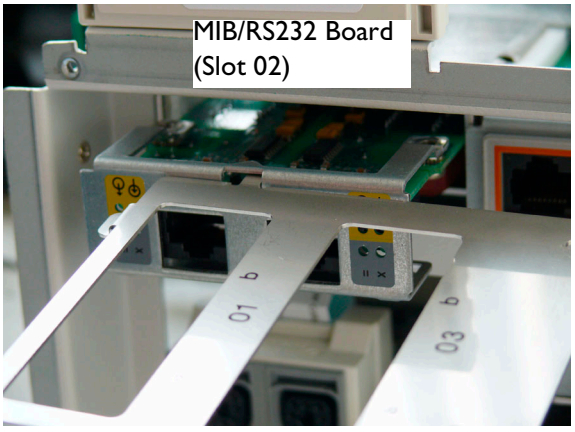
2 Raise the lower edge of the panel and then release the panel by freeing the three tabs at the top of the panel from the slots in the interface board cage.

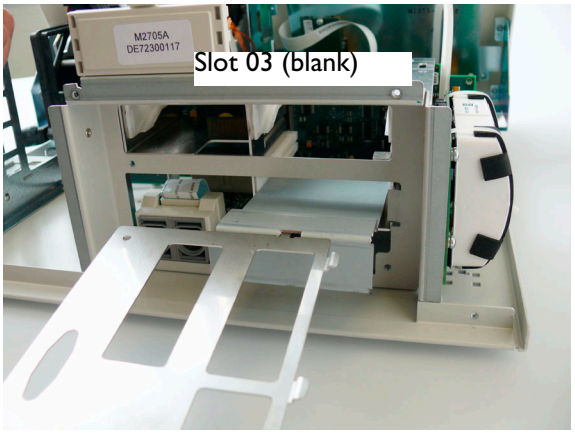




3 The connector panel incorporates a hook for removing the interface boards. Pull the board(s) out using this hook.







Refitting the Interface Boards

If the main CPU board was removed, refit it first (see page 98). Then slot the interface boards into the interface board cage.

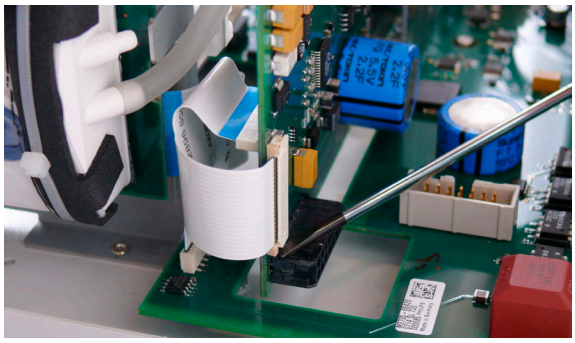
Removing the Main CPU Board

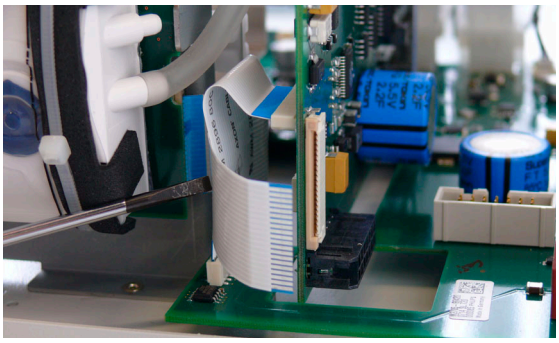
To remove the main CPU board, proceed as follows:

1 Remove the top cover (see page 87).

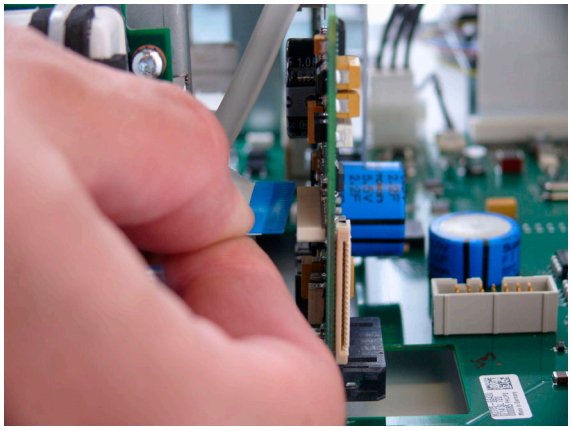
2 Remove any interface boards that are fitted (see page 95).

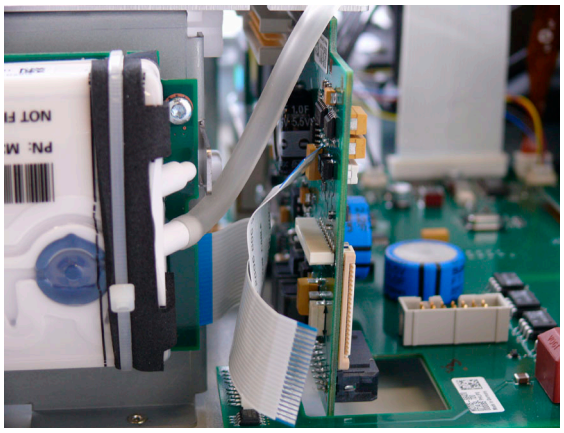
3 After disengaging the cable lock, disconnect the ribbon cable for the noninvasive blood pressure assembly from the main CPU board.





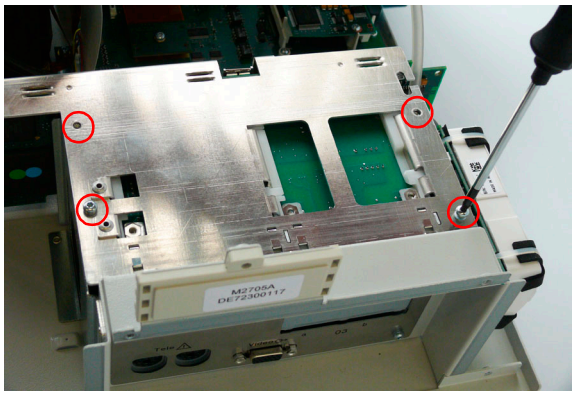
4 Disconnect the ribbon cable connecting the main CPU board to the API board.



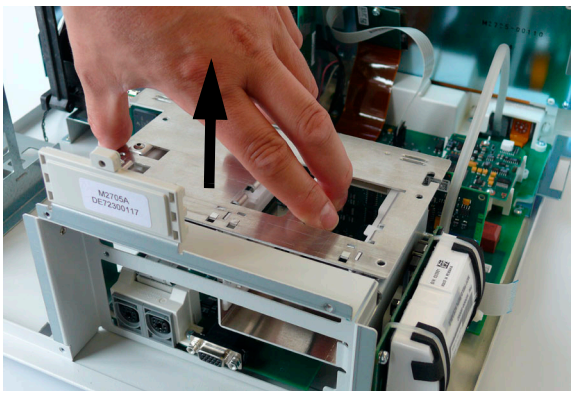


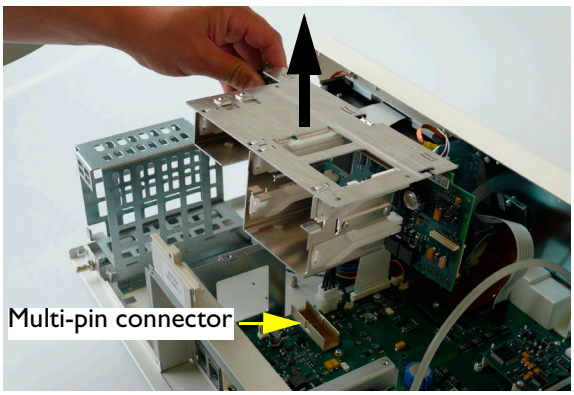
5 Remove the four screws holding the interface board cage, which also holds the main CPU board.

◯ Screw locations

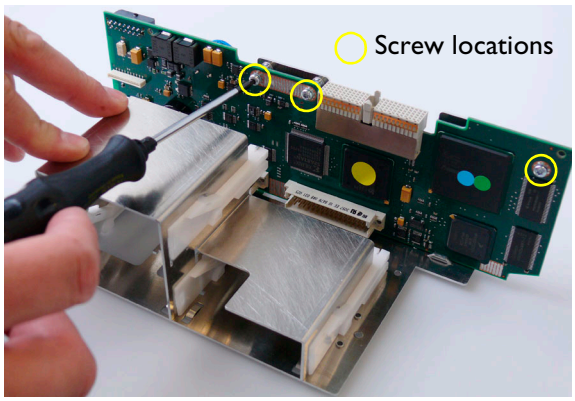


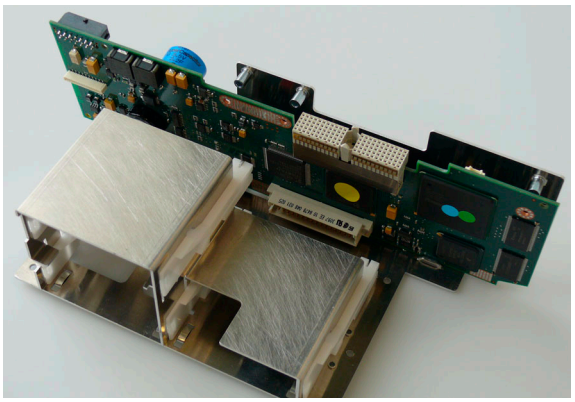
6 The main CPU board is connected to the API board via a multi-pin connector. Lift the interface board cage/main CPU assembly straight up to avoid stressing the pins.



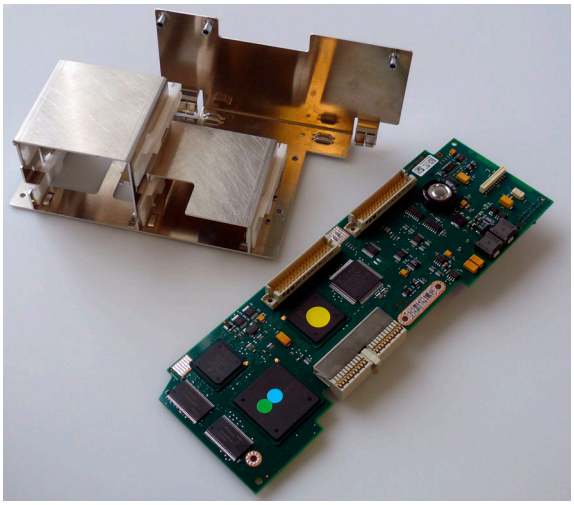


7 Next, separate the main CPU board from the interface board cage, remove the three screws.





8 Remove the main CPU board by lifting it straight up.



Refitting the Main CPU Board

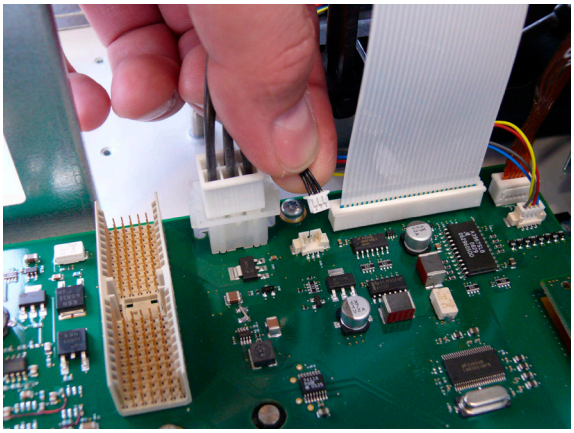
The procedure to refit the main CPU board is a reversal of the removal procedure. Ensure all the cables are properly reconnected.

Removing the Front Bezel Assembly

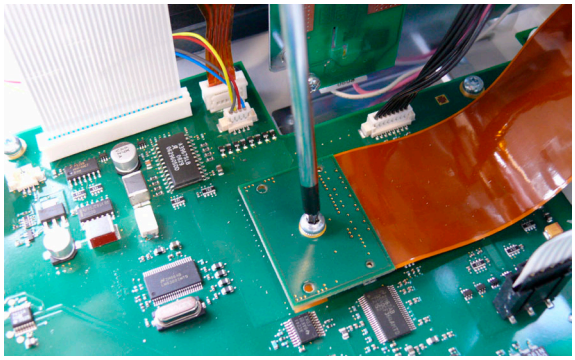
There is a version of the front bezel with text and a version with symbols. The two versions are shown in the section “Front Bezel Assembly” on page 75.

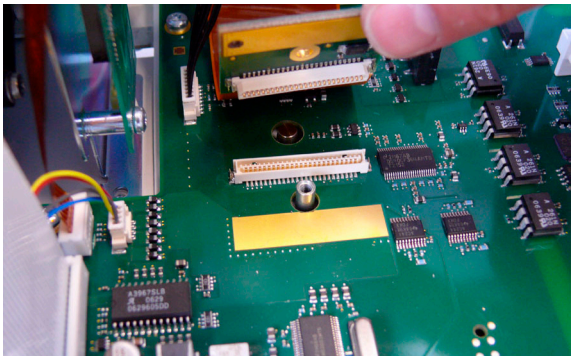
1 Remove the top cover (see page 87).

2 Disconnect the power switch cable connector from the API board.

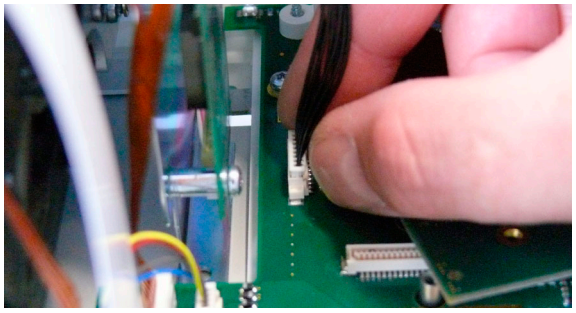


3 Disconnect the display ribbon cable from the connector on the API board, after first removing the screw securing the connector.

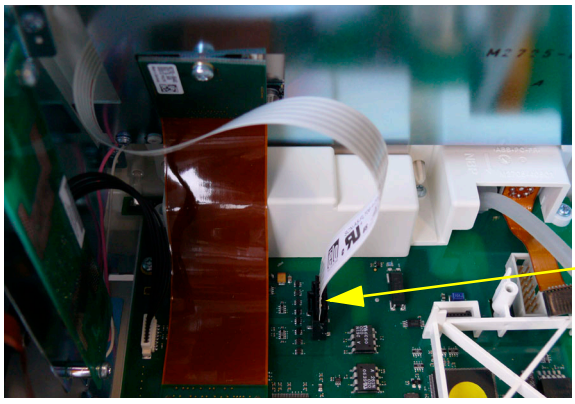




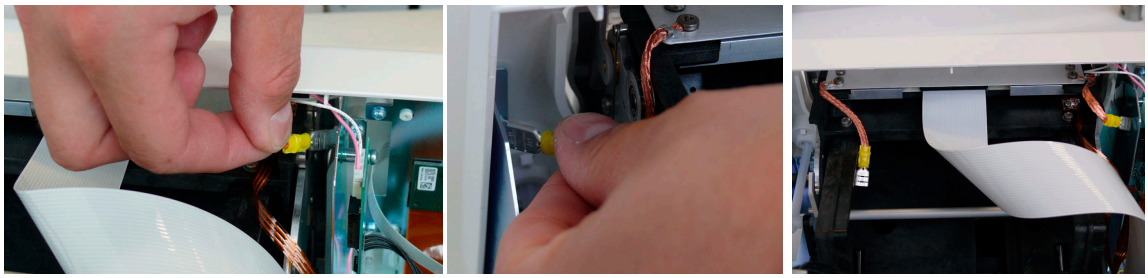
4 Disconnect the backlight inverter cable connector from the API board.



5 Noting which way round the cable is connected for correct refitting (the printed side should face the recorder), disconnect the touch cable connector from the API board.

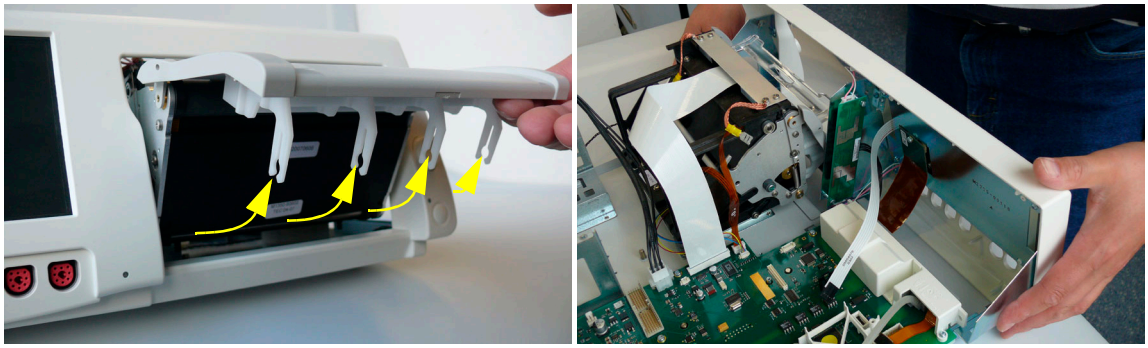


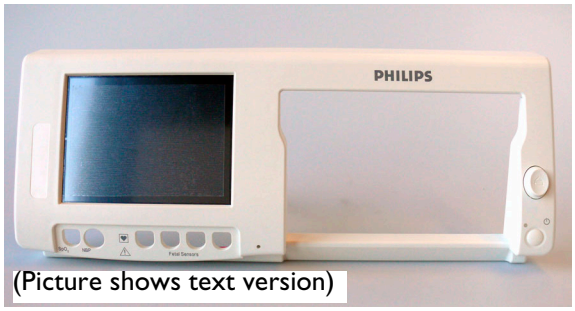
6 Disconnect the two braided copper (recorder assembly) earthing wires from the front bezel metal frame by detaching the spade connectors.



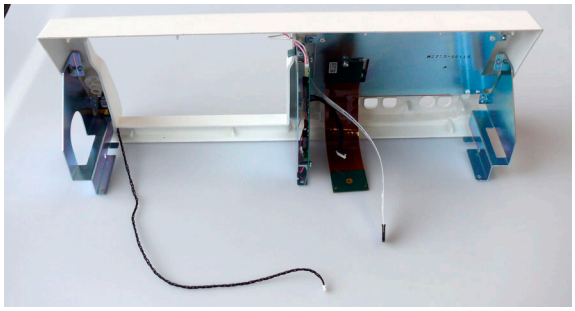
7 Remove the three screws holding the front bezel assembly to the chassis.

8 Unclip the bottom of the recorder paper table from the recorder assembly, and remove the front bezel assembly.





(Picture shows text version)

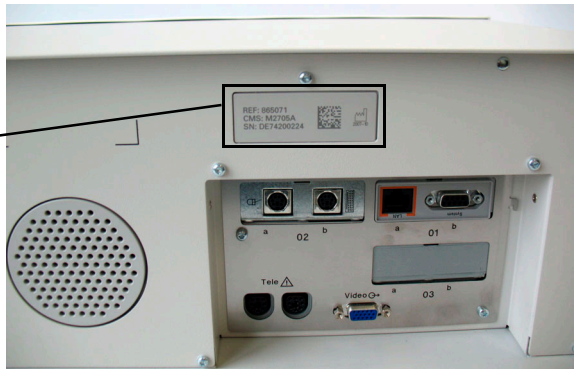


Refitting the Front Bezel Assembly

The procedure to refit the front bezel assembly is a reversal of the removal procedure. Ensure that all cable connectors are firmly reattached and cable locks engaged where relevant. There is a version with text and a version with symbols. The two versions are shown in the section “Front Bezel Assembly” on page 75, along with the necessary labels.

When you have completed the refitting of the front bezel, fit the appropriate labels.

1 Identify the monitor model by reading the plate at the rear of the monitor.



2 M2704A is the model identifier for the FM40, and M2705A is the model identifier for the FM50.

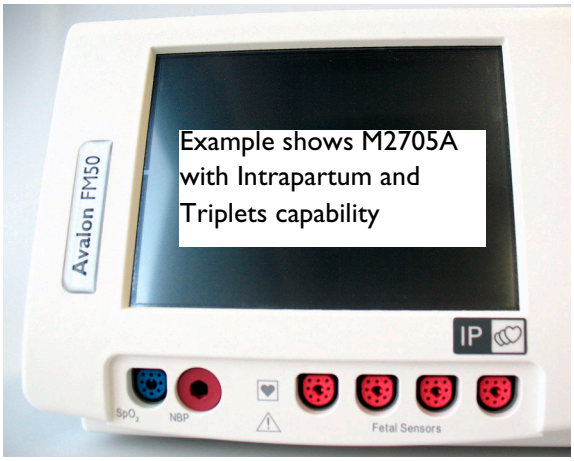
3 Identify the built-in options for the monitor using the Support Tool.

4 Take the appropriate labels, and fit them in the locations shown:

Labels for options (choose correct one)

Label for M2704A

Label for M2705A



Example shows M2705A with Intrapartum and Triplets capability

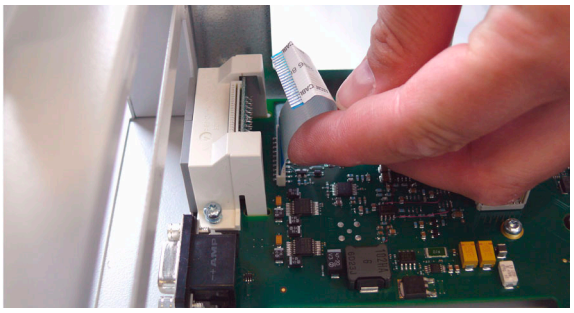
Removing the Telemetry Socket Connector Block

1 Remove the top cover (see page 87).

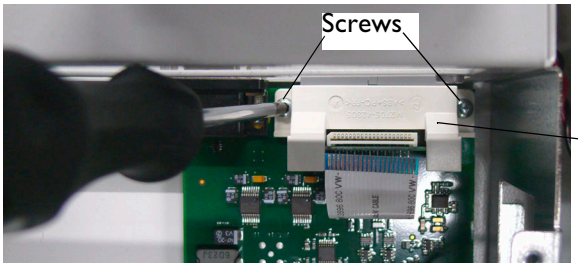
2 Remove the interface boards (see page 95).

3 Remove the main CPU board (see page 96).

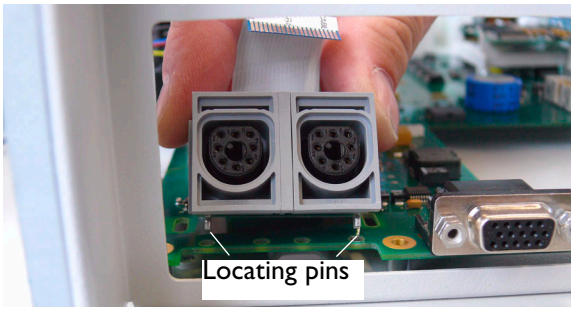
4 Disconnect the ribbon cable connecting the telemetry sockets to the API board.



5 Remove the two screws securing the telemetry socket connector block frame, then lift the frame straight up to remove it.



6 Remove the telemetry socket connector block (it is located on the API board by two pins protruding from the bottom of the connector block).



Refitting the Telemetry Socket Connector Block

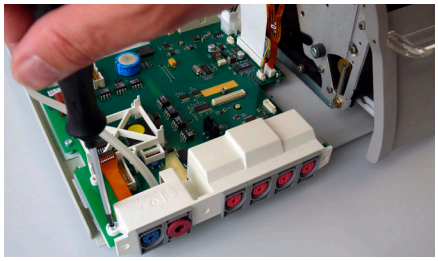
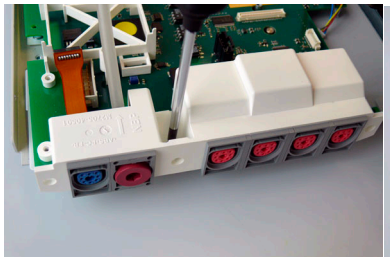
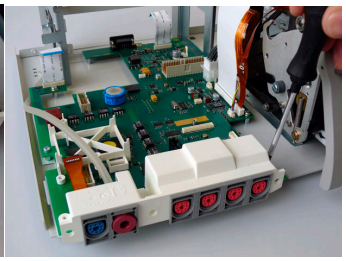
The procedure to refit the telemetry socket connector block is a reversal of the removal procedure.

Removing the Sensor Socket Connector Block

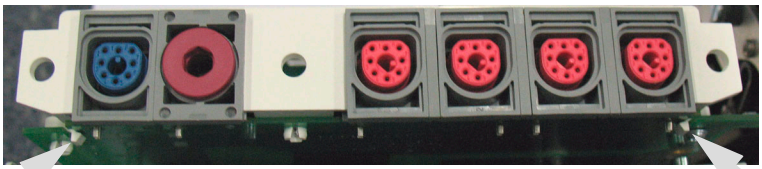
1 Remove the top cover (see page 87).

2 Remove the front bezel assembly (see page 99).

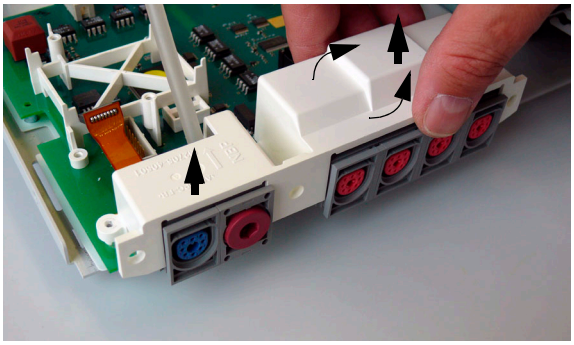
3 Remove the three screws securing the sensor socket connector block.

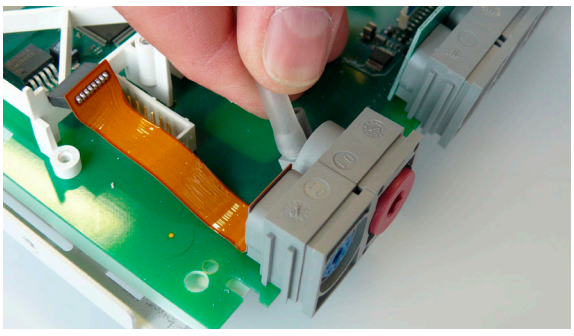
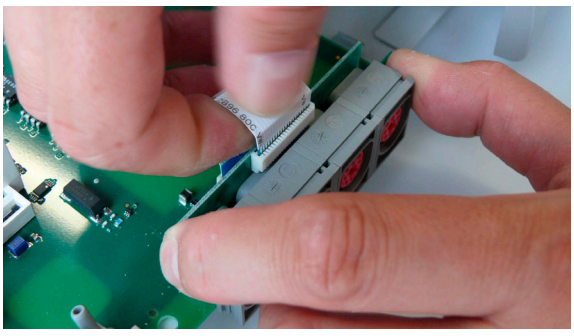
4 Release the two clips holding the connector block frame to the underside of the API board.



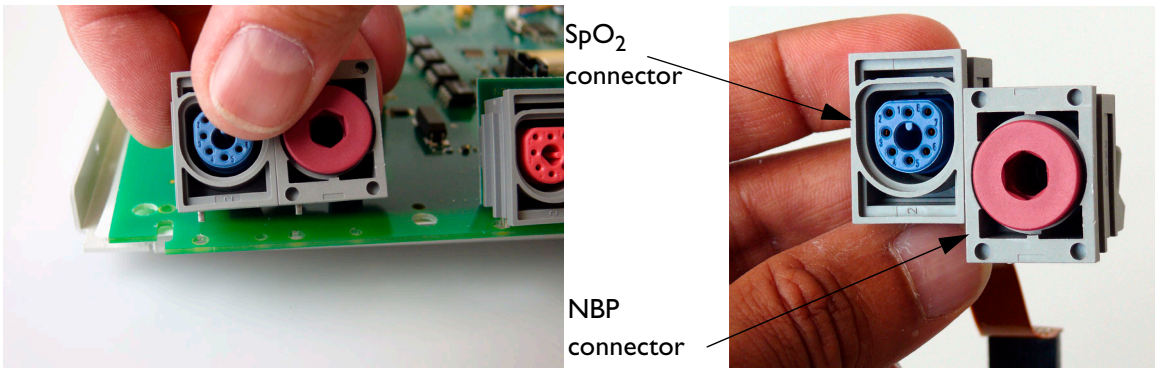
5 Remove the white connector block frame by applying a gentle rocking motion while pulling up, to help free it from the API board. When refitting the connector block frame, always use a new frame contained in the connector block kit, as the screw fixing is only designed to be used once.



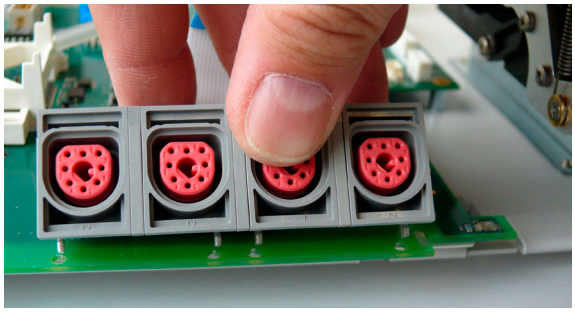
6 Remove the NBP tubing form the NBP socket, and remove the flat ribbon cable from the fetal sensor socket block.

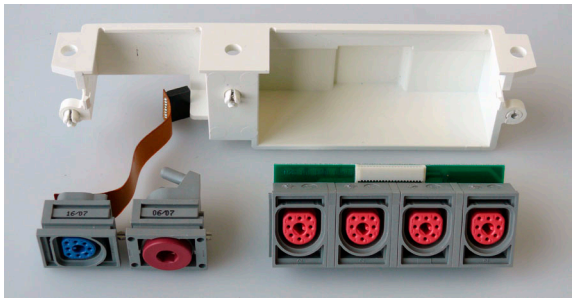



7 Remove the NBP/SpO_2 connectors. Note that these sockets slide together.



8 Remove the fetal sensor connector block.





Refitting the Sensor Socket Connector Block Assembly

The procedure to refit the sensor socket connector block assembly is a reversal of the removal procedure. Use a new connector block frame (do not reuse the original frame).

Removing the API Board

1 Remove the top cover (see page 87).

2 Remove the SpO_2 assembly (see page 94).

3 Remove the interface boards (see page 95).

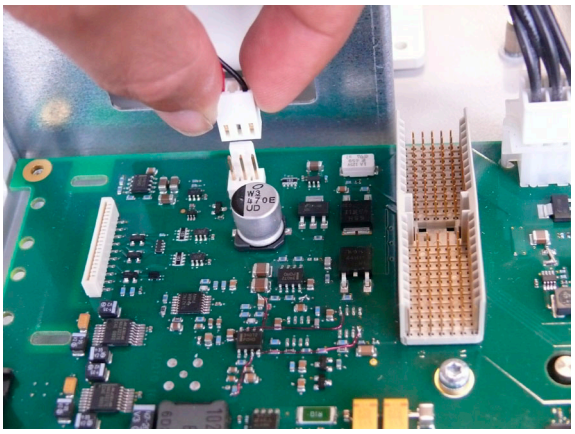
4 Remove the main CPU board (see page 96).

5 Remove the front bezel assembly (see page 99).

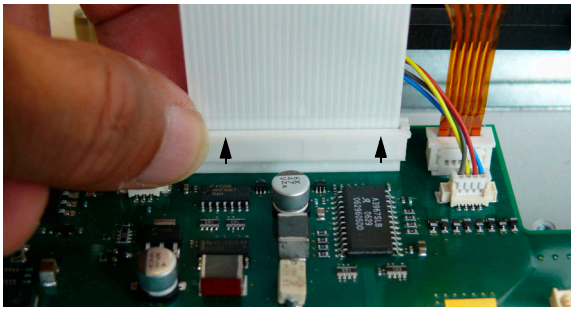
6 Remove the telemetry socket connector block (see page 102).

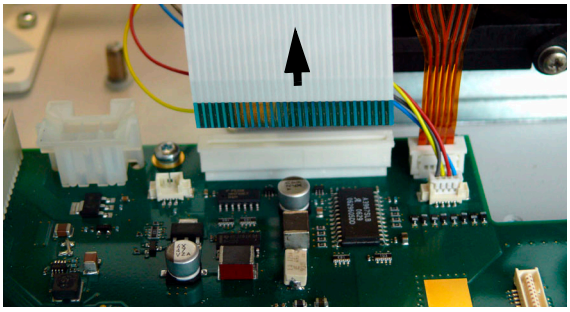
7 Remove the sensor sockets connector block (see page 103).

8 Disconnect the loudspeaker cable.

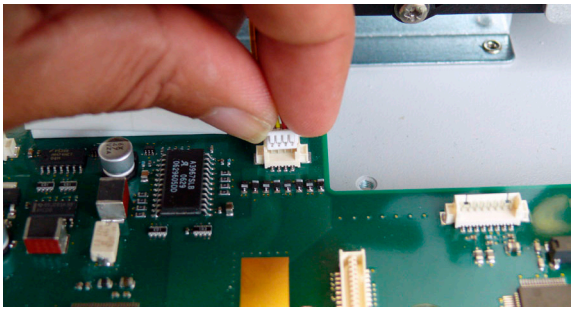


9 Noting which way round the cable is connected (for correct refitting), disconnect the fetal recorder ribbon cable after disengaging the cable lock.

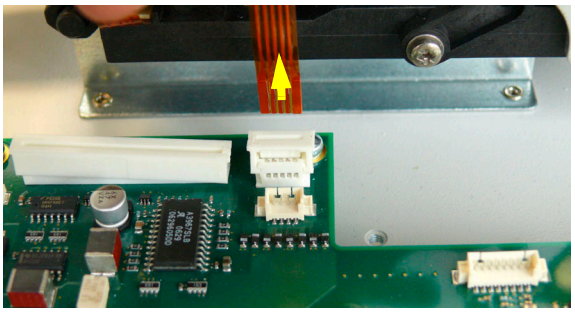




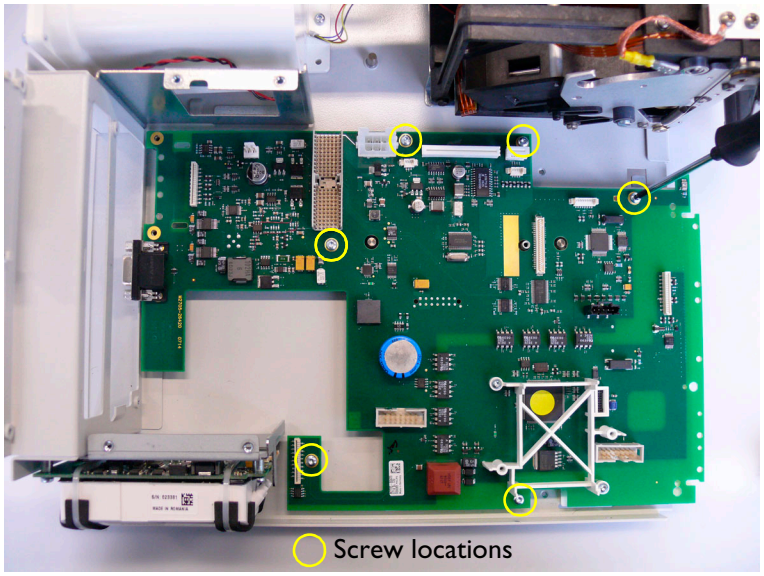
10 Disconnect the stepper motor cable.



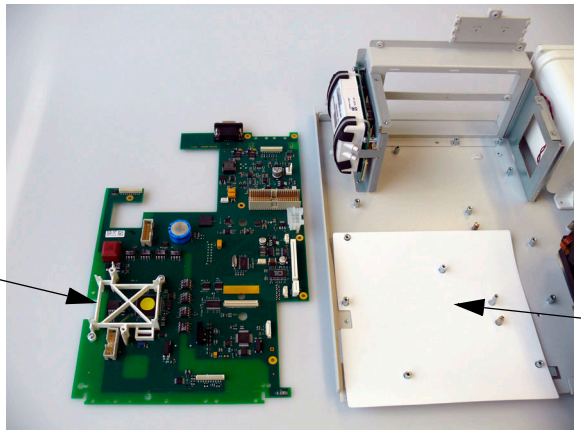
11 Noting which way round the cable is connected (for correct refitting), disconnect the flat paper sensor cable after first disengaging the cable lock with a small flat-bladed screwdriver.



12 Remove the six screws securing the API board to the metal chassis, and remove the API board.



A new API board is supplied with a new SpO_2 holder



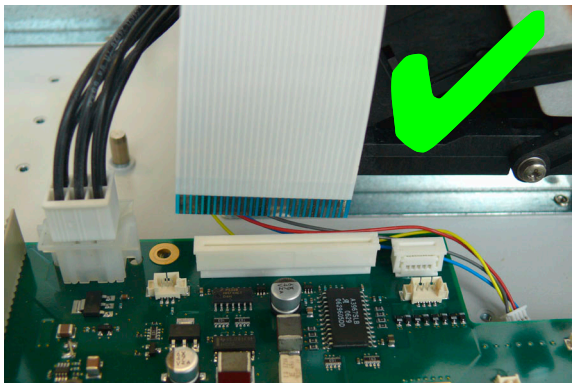
Reuse the plastic isolator sheet for reassembly

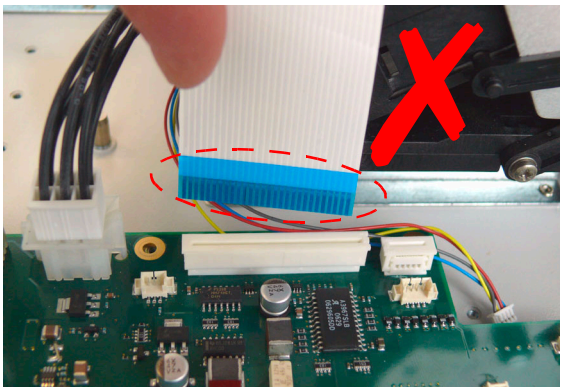
Refitting the API Board

The procedure to refit the API board is a reversal of the removal procedure. Ensure that all cable connectors are firmly reattached and cable locks engaged where relevant.

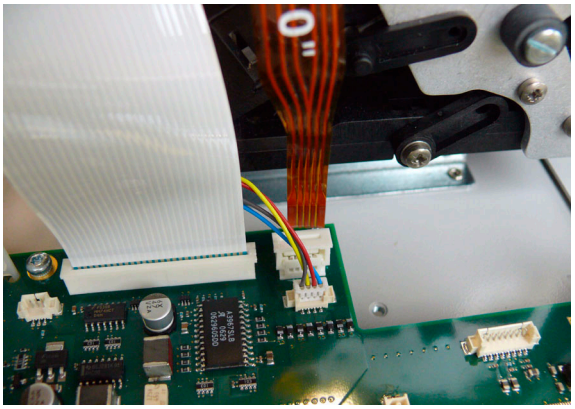
In particular:

- Make sure that the fetal recorder ribbon cable is refitted the right way round (with the blue side facing the recorder):





- Make sure that the paper sensor cable is refitted the right way round:

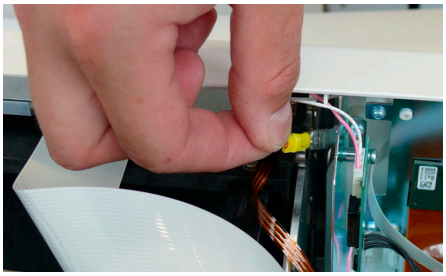


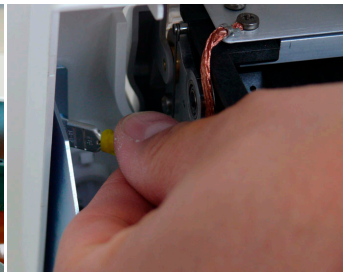
The marking "O" should be facing the outside

Removing the Recorder Assembly

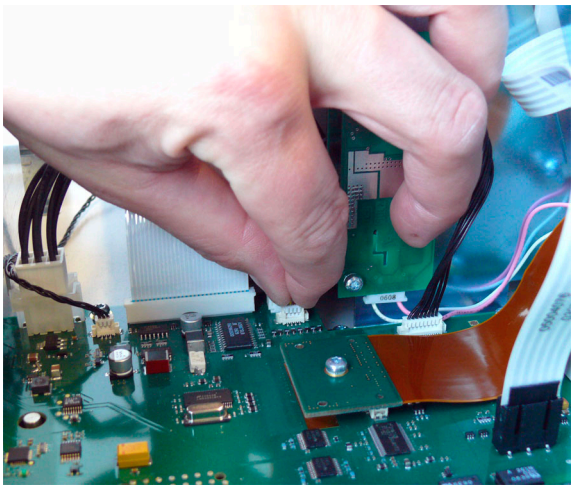
1 Remove the top cover (see page 87).

2 Disconnect the two braided copper (recorder assembly) earthing wires from the front panel metal frame by detaching the spade connectors.

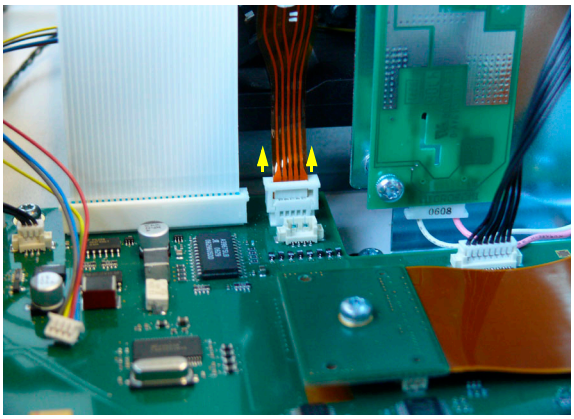


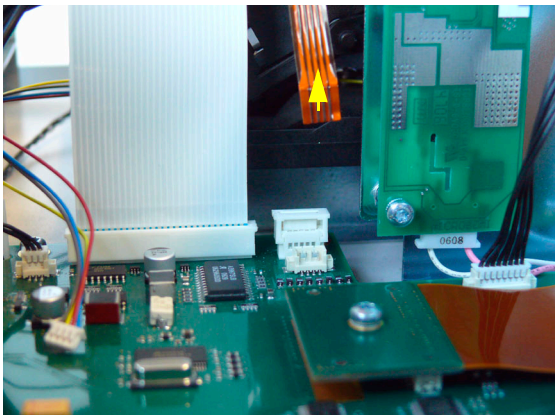


3 Disconnect the stepper motor cable connector from the API board.

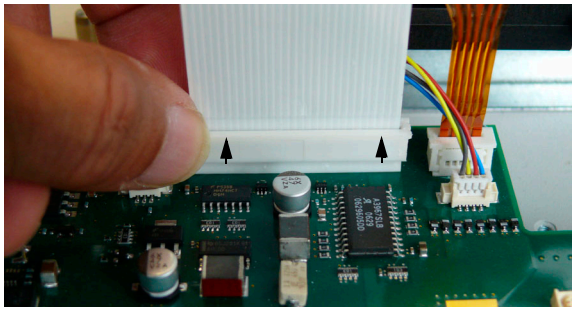


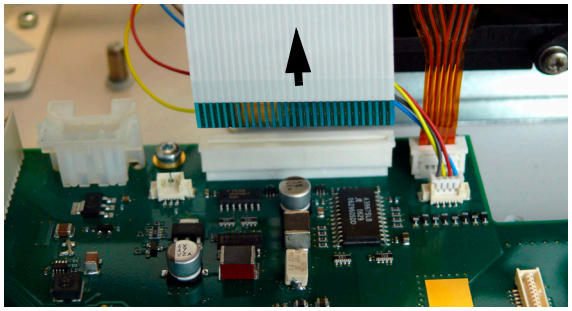
4 Disconnect the paper sensor cable after first disengaging the cable lock.



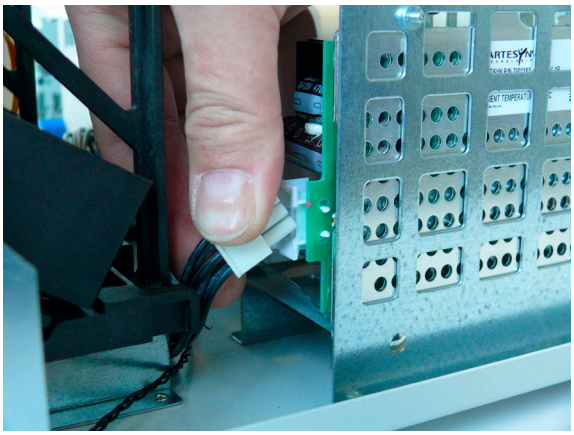


5 Disconnect the fetal recorder ribbon cable after first disengaging the cable lock.

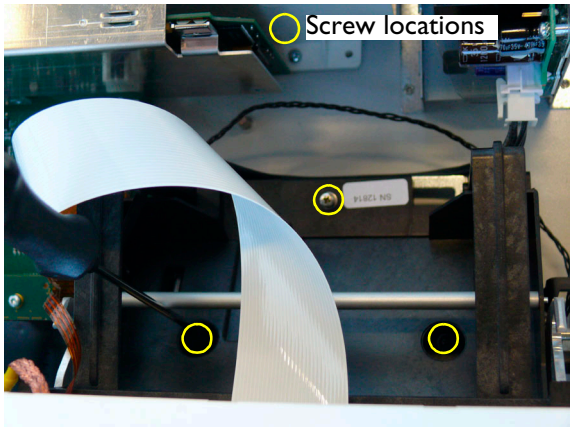


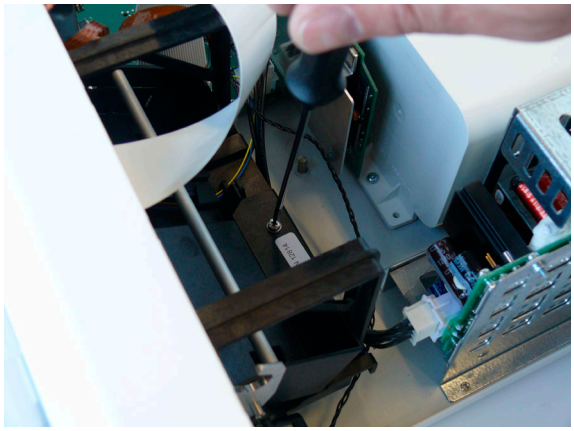


6 Disconnect the power supply cable from the connector on the power supply.

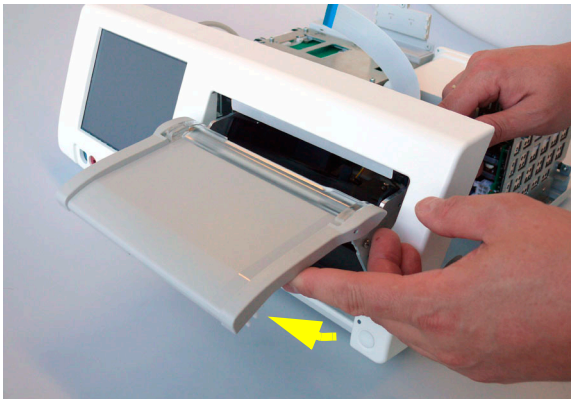


7 Unfasten the three T-10 screws holding the recorder assembly to the chassis. The screws incorporate a thread lock so that they stay in place even when unfastened. Do not remove them completely.

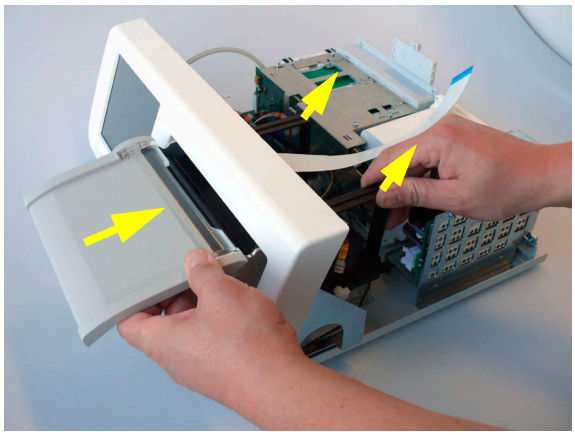


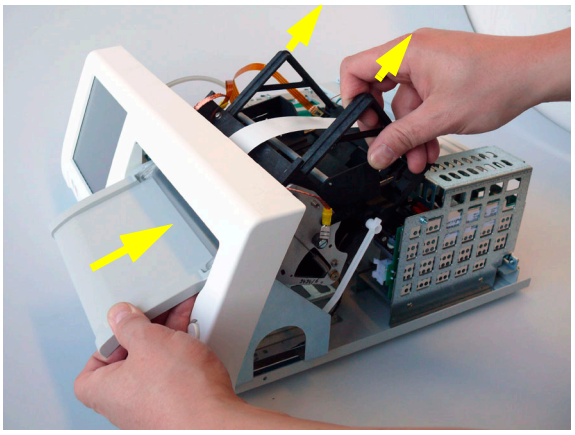


8 Open the recorder drawer and unclip the bottom of the paper table so that it pivots freely on the mounting points on either side of the roller.

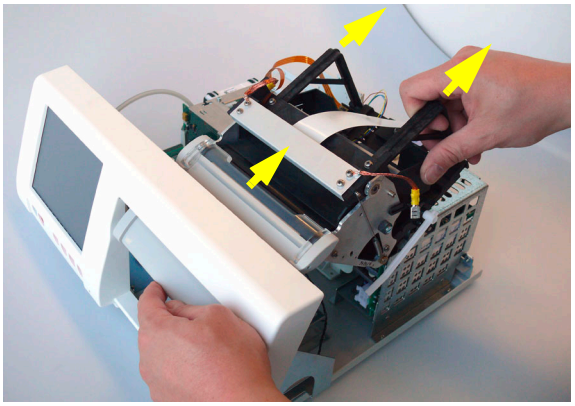


9 Holding the paper table as shown, slide the whole recorder assembly towards the rear of the monitor, while lifting the rear of the recorder assembly at the same time...





...then lift the recorder assembly out.



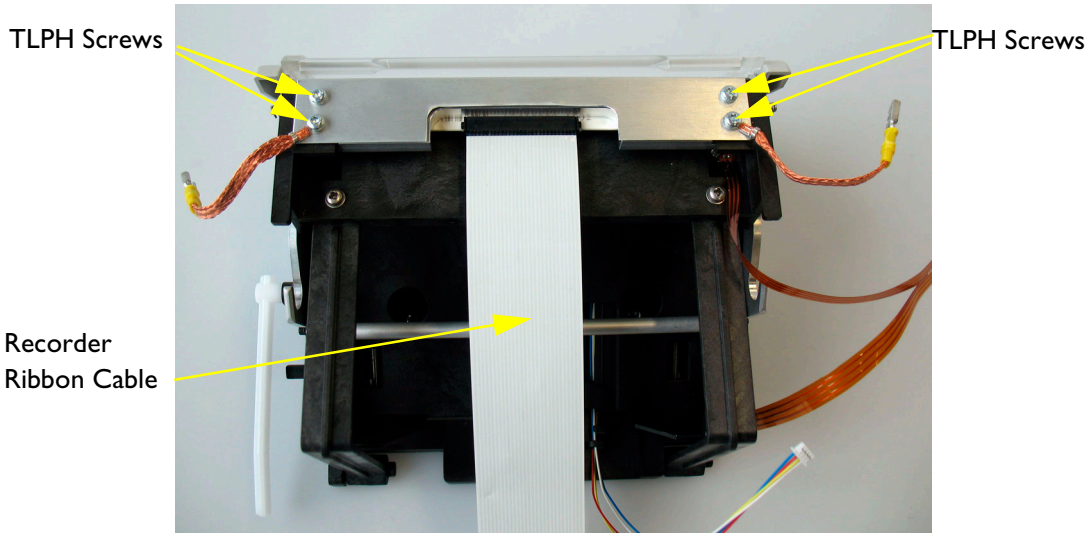
Refitting the Recorder Assembly

The procedure to refit the recorder assembly is a reversal of the removal procedure. Ensure that all cable connectors are firmly reattached and cable locks engaged where relevant.

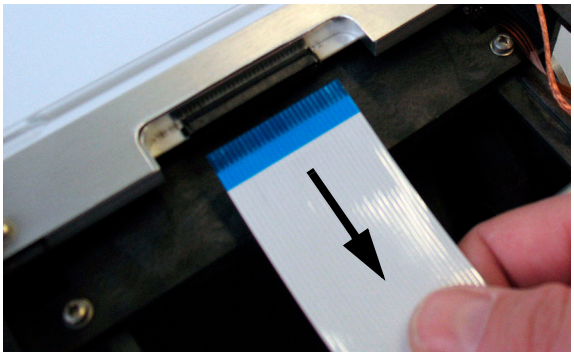
Refer also to the section “Refitting the API Board” on page 107 for pictures showing the correct refitting of the ribbon cables.

Removing the Thermal Line Printhead (TLPH)

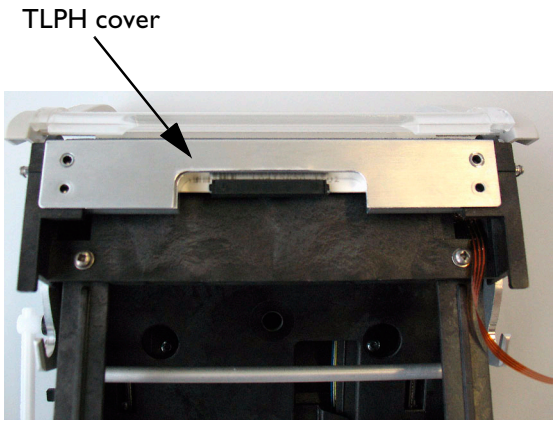
1 Remove the recorder assembly (see “Removing the Recorder Assembly” on page 107).

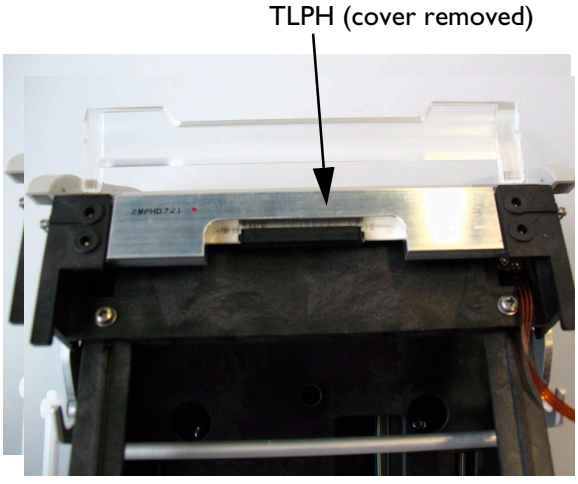


2 Disconnect the recorder ribbon cable from the TLPH.

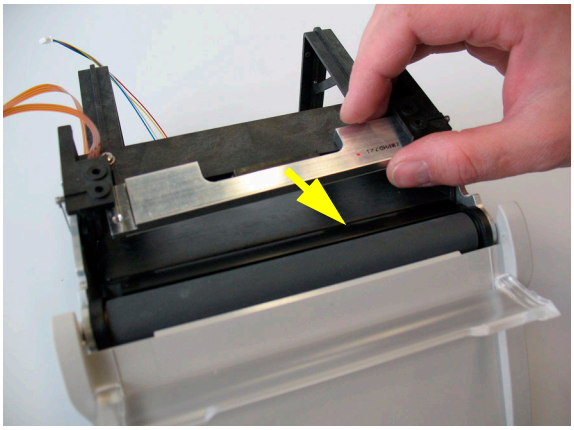


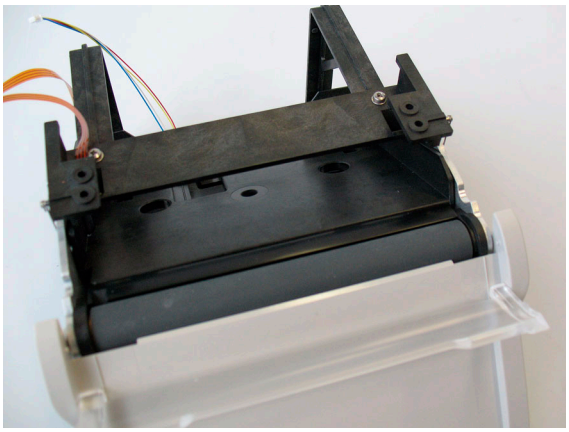
3 Remove the four screws securing the Thermal Line Printhead (TLPH) to the recorder assembly. Keep the copper earthing straps in a safe place for later refitting. Remove the TLPH cover.





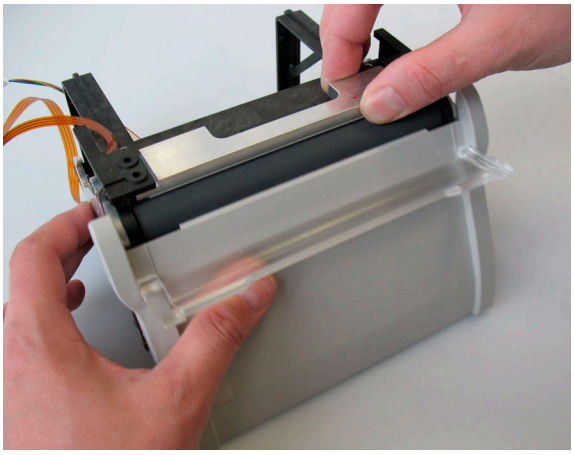
4 Open the paper drawer to release the TLPH, then remove the TLPH.

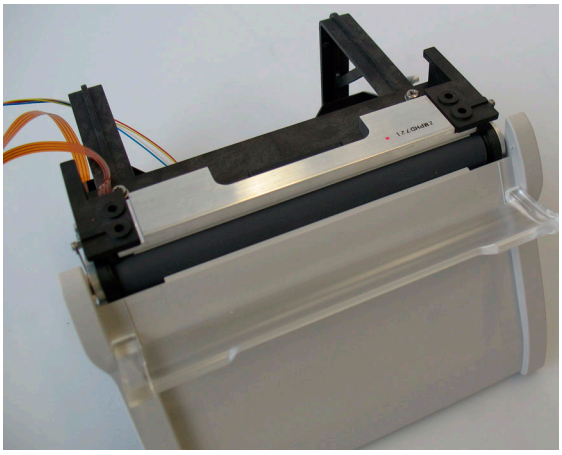




Refitting the TLPH

1 Place the TLPH in position in the holder (with the screw holes aligned), then close the paper drawer so that the roller makes gentle contact with the TLPH.





2 Replace the TLPH cover, and fasten the four screws to secure the TLPH, remembering to refit the copper earthing straps. Reconnect the recorder ribbon cable.

3 After reinserting the recorder into the monitor, perform a recorder calibration.

Transducer Disassembly/Reassembly

This section describes the disassembly and reassembly operations for the transducers.

Exchanging the Transducer Cable

See the “Transducer Cable Assembly (M2735-64201)” on page 69 for items that come with the cable.

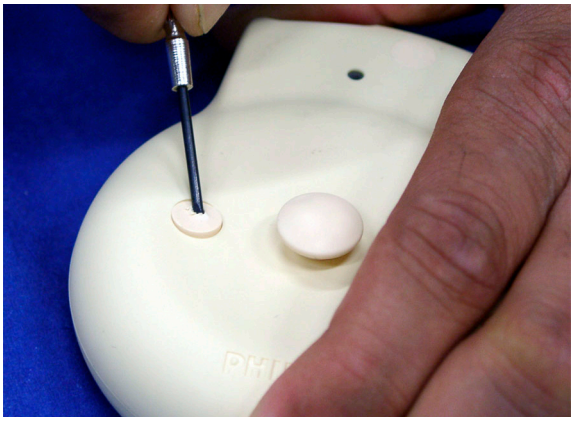
WARNING Transducers are calibrated at the factory, and the calibration data for the measurement is stored on the CPU board. Therefore NEVER replace the CPU board with one from another transducer.

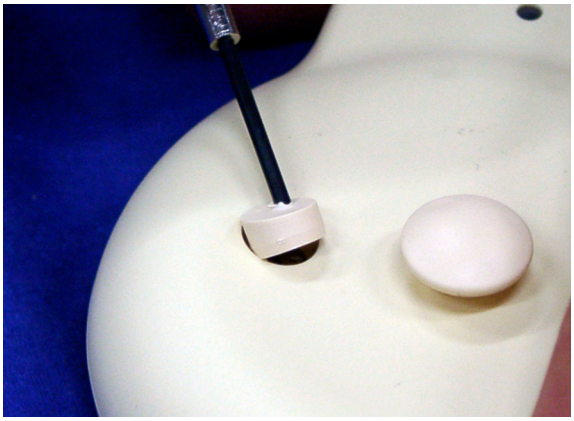
Important when fitting the screw covers! Do NOT remove the screw covers from the frame to which they are attached. Leave them in place, as it is the only way to align the screw covers correctly. They detach from the frame when you press them into position.

To exchange a transducer cable:

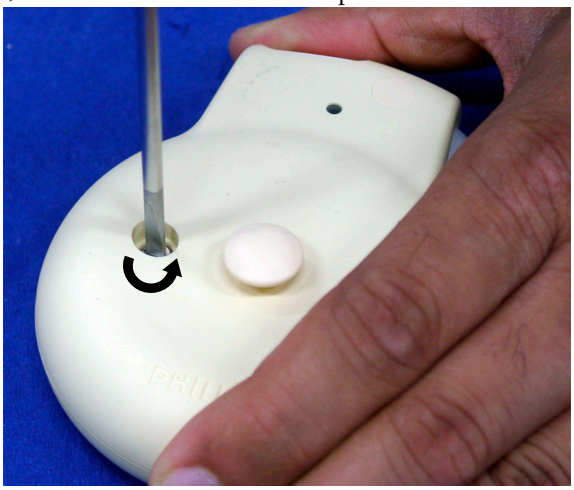
1 Pierce a screw cover with a small, flat-bladed screwdriver. **Important! Do NOT try to prise out a screw cover from the side, without piercing it, as this will damage the transducer top cover.**

1 Gently rock the screwdriver back and forth until the screw cover comes out. Repeat to remove all three screw covers.

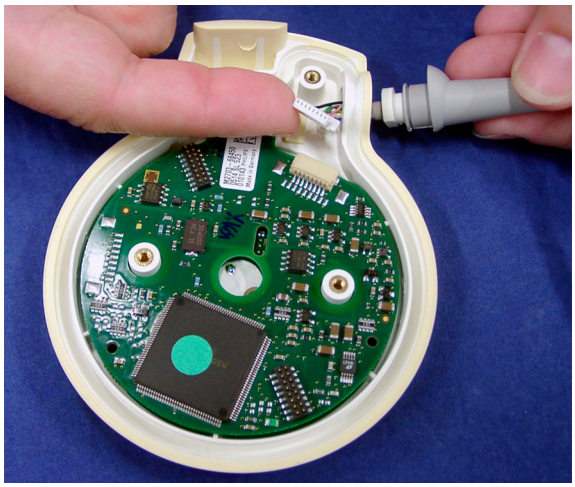




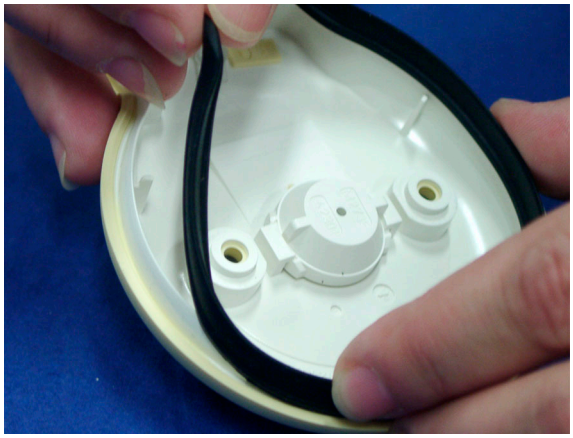
2 Remove the three screws, and remove the transducer top cover.

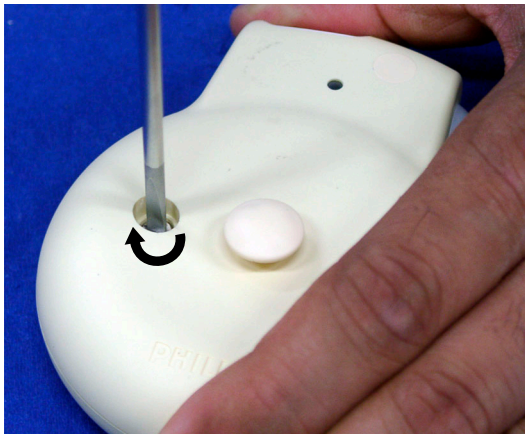


3 Disconnect the small cable connector, remove the old cable, and fit the new cable (as a reversal of the removal procedure).

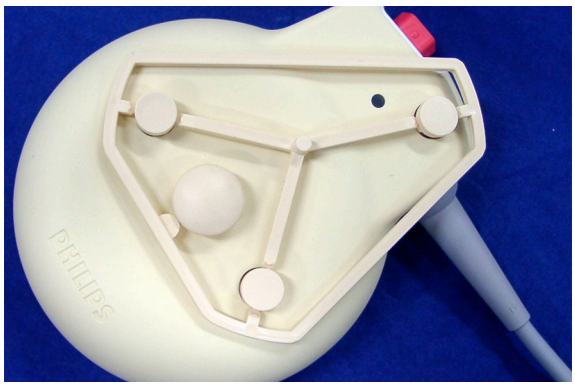


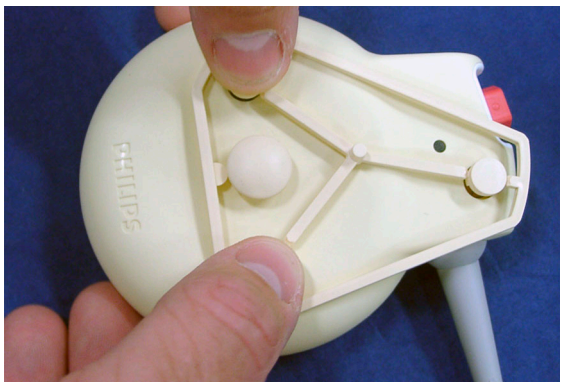
4 Remove the sealing gasket from the top cover, and replace it with the new one supplied with the cable. **While handling a Toco/Toco+ transducer, take care not to displace the strain gauge.** Fit a new gasket to the top cover, ensuring the gasket is properly seated, replace the top cover and secure it with the three screws.





5 Leaving the screw covers attached to the frame, carefully align the screw covers with the screw recesses in the top cover. Next, partially press in two of the covers at the same time, then press in the third one (they detach from the frame as you push them in). Then make sure all three covers are pushed completely into the recesses.





Exchanging the Transducer Belt Button

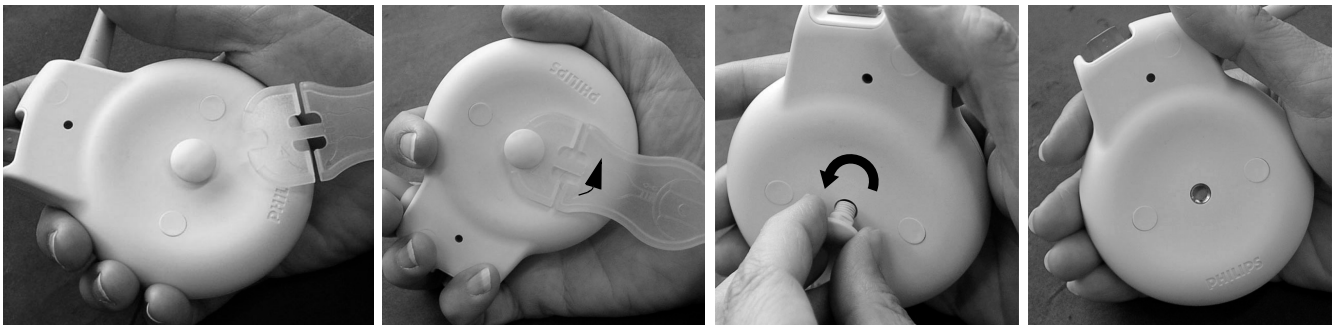
CAUTION NEVER immerse a transducer in liquid if the belt button has been removed, or is loose, broken or damaged.

M2703-64204
Replacement Belt Button Kit
Contents:

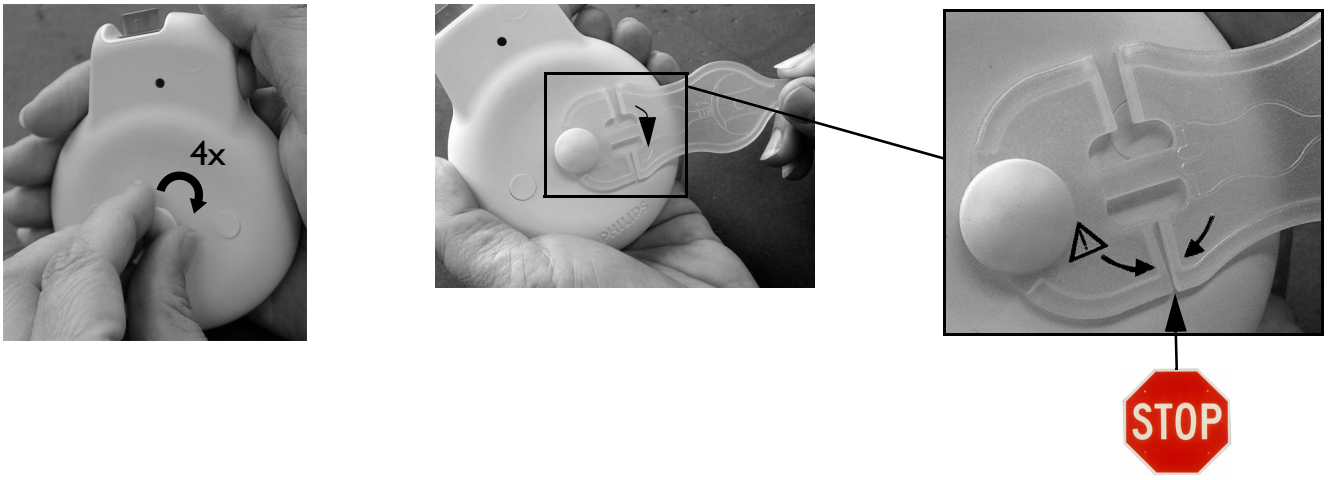
 x5

 x1

1 Remove the belt button using the tool provided with the belt button kit.

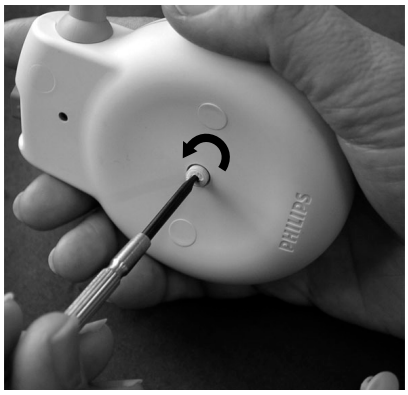


2 Dispose of the old belt button. Take a new belt button and fit it to the transducer. Initially, screw the button in by hand about four turns, then complete the job with the supplied tool. Stop applying force when the head of the tool makes contact with the body of the tool at the point indicated by the arrows.



If the belt button is broken: 

1 Remove the threaded part left in the top cover with a small, flat-bladed screwdriver (2.0-3.0 mm).


2 Then fit a belt button as described on page 115.

11

Upgrades

This chapter lists the various upgrade options for the monitors, and describes how to carry out these upgrades.

FM40/50 Upgrade Options

Upgrade options for the FM40 are prefixed with **M2704AU**.

Upgrade options for the FM50 are prefixed with **M2705AU**.

FM40/50 Upgrade Options					
Option Number	Option Adds	Parts included with Option			
		Description	Part Number	Contents/Comments	Qty
C73	Triplets monitoring capability.	Customer letter - English	M8000-9399A	Asks customer to contact Philips Support to arrange a software upgrade	1
J22	Dual PS/2 Interface for connecting a keyboard and mouse.	Input device assembly	M8086-67501	"Plug & Play" interface	1
J70	System Interface, 1 x RS232 port and 1 x LAN port.	RS232/LAN I/O card assembly	M2703-67501	"Plug & Play" interface	1

Installing Upgrade Options

This section covers how to install the options.

Option C73

You enable this feature upgrade to triplets capability using the Support Tool. Refer to the *Support Tool Instructions for Use* for details of the upgrade procedure.

Options J22 and J70

The interfaces require no special upgrade procedures as they are “plug and play” boards.

Software and Firmware Upgrades

The software of the monitor and the firmware of the transducers and other system components can be upgraded by a software download from a PC running the Support Tool. You connect the monitor to the PC via a LAN connection. You need:

- Industry standard PC
- Support Tool
- LAN / RS232 system interface
- LAN interface cable for the Support Tool

Several Avalon fetal monitors can be upgraded in parallel with the Support Tool. All monitors in an installation can be upgraded at once, if desired.

The transducers can be upgraded one at a time, even though more than one may be plugged into the monitor at the same time.

When upgrading to a new monitor software revision, we recommend that you check that all system hardware components have the latest firmware revision, and upgrade these if necessary.

Refer to the *Support Tool Instructions for Use* for details of the upgrade procedure. Contact Philips Support for further details.

For tests to perform after upgrading, see “When to Perform Test Blocks” on page 26.

12

Understanding Configuration

This chapter, together with the Settings appendix, is for anyone making permanent changes to the configuration of an Avalon Fetal Monitor. You must understand English, be familiar with the monitor and its *Instructions for Use*, know how to make changes to measurements and settings in Monitoring Mode, and understand the clinical implications of any changes you make.

WARNING Changing the configuration may alter the way the monitor performs when monitoring patients. Do not change anything unless you are aware of the possible consequences, especially if you are monitoring a patient while in Configuration Mode.

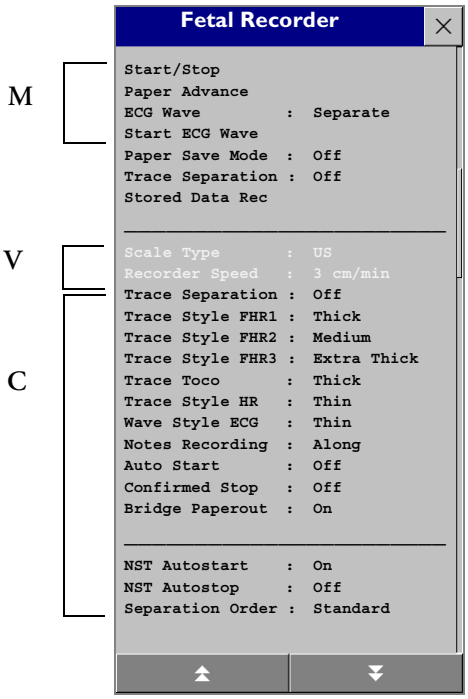
What is Configuration Mode?

Configuration Mode is a password-protected operating mode that lets expert users make permanent changes to the monitor configuration. It is an extension of Monitoring Mode; it contains all of the settings available in Monitoring Mode plus the settings that are accessible only in Configuration Mode.

For example, the **`Fetal Recorder`** menu accessible in Monitoring Mode contains the settings marked **M** (not necessarily in exact order).

Items that are visible in Monitoring Mode but that can only be changed in Configuration Mode are marked **V**.

In Configuration Mode you can change the additional settings marked **C**.



Configuration Mode is a password-protected operating mode that lets expert users make permanent changes to the monitor configuration. It is an extension of Monitoring Mode; it contains all of the settings available in Monitoring Mode plus the settings that are accessible only in Configuration Mode.

In Monitoring Mode, you do not see all possible menu entries. There are two types of menu entry you will see:

- Items in black text are those items you can operate or access to change the setting.
- Items that a grayed out are those items that you can see but not operate or access to change the setting.

Understanding Settings

You can change two main categories of settings in Configuration Mode: Global Settings, and the monitor and measurement settings stored in User Defaults. The monitor ships with preset configurations for Global Settings and the Factory Default settings that are suitable for common monitoring situations. This guide tells you how to develop your own configurations.

Active Settings are the current settings the monitor uses, including any adjustments made by the last user. Active Settings are not permanent, but are retained after a loss of mains power.

The User Defaults is a complete configuration of monitor and measurement settings blocks stored in the monitor's long-term memory. You can change individual settings and store them in the User Defaults. In other words, you can store the Active Settings, modified to your preference, in the User Defaults. Alternatively, you can load a complete configuration (taken from another monitor, for example) into the User Default from the Support Tool. The User Defaults is the user's preferred configuration, and these personalized settings can be restored by loading the User Defaults.

Following a patient discharge, or if the monitor was turned off for more than one minute, the User Defaults is automatically loaded if **`Automat. Default`** is set to **`Yes`**.

The Factory Default is a complete configuration predefined at the factory. You cannot modify it. In Configuration mode, you can load the Factory Default as the Active Settings. You can use the Factory Default as the basis for producing your own User Defaults.

Global Settings are typically set once at monitor installation by service personnel and include settings such as **`Line Frequency`**, or **`QRS Type`**. Global settings are independent of the User Defaults, so when you load the Factory Defaults, Global Settings remain as they were. They can only be changed in Configuration Mode and are automatically stored to the monitor's permanent memory with each change. Global settings can be cloned.

Hardware Settings are typically set once at monitor installation by service personnel. Most hardware settings can only be changed in Service mode. Hardware settings include settings such as **`Keyboard`** layout or the **`Intensity`** setting for the thermal printhead. Like Global settings, they are independent of the User Defaults, and any changes you make to the Hardware Settings configuration are automatically stored, there is no need to save them in an extra step. Unlike Global Settings, hardware settings must be entered for each monitor individually, because they **cannot be cloned.**

Entering and Leaving Configuration Mode

Only people authorized to do so by their institution should make changes in Configuration Mode. They require the Configuration password.

Switching between Monitoring and Configuration Mode does not affect the active settings. You can even continue to monitor patients while in Configuration Mode. The password for Configuration Mode is given in Chapter 1.

To enter Configuration Mode:

1 In the **Main Setup** menu, select **Operating Modes**.

2 Select **Config** and enter the password.

The monitor displays **Config** in the center of the Screen while you are in Configuration Mode.

Before you leave Configuration Mode, always be sure to store any changes you made. You must store the changes you made in the User Default.

To leave Configuration Mode either:

- In the **Main Setup** menu, select **Operating Modes** and then select the operating mode you require or
- Switch the monitor off, then switch it on again.
  - If you switch the monitor off and then on again after less than one minute, it returns in Monitoring Mode with the same settings ("hotstart").
  - If you leave the monitor switched off for more than one minute, the User Default is loaded when you switch back on if **Automat. Default** is set to **Yes**.

Storing Changes in the User Defaults

You can load a complete configuration for the monitor via the Support Tool, or you can change individual settings within the Active Settings. The monitor remembers any changes made when you switch between Monitoring Mode and Configuration Mode. The changes made in Configuration Mode can be stored permanently in the User Defaults.

1 Make the changes to the individual measurements or monitor settings.

2 Select the **Defaults** SmartKey  .

3 Select **Store Defaults** from the pop-up keys at the bottom of the screen.

Load Defaults	**Store Defaults**		**Factory Default**

4 Select Confirm to store the settings in the User Default.

To store the current settings as user defaults select Confirm	**Confirm**	**Cancel**

Be aware that if you don't store changes they will be reset to the monitor's stored configuration when you:

- change from Configuration or Monitoring Mode to Service or Demonstration Mode.
- switch off the monitor for more than one minute and **Automat. Default** is set to **Yes**.

Loading the Factory Default

Load the Factory Default to restore the Active Settings to those that were set at the factory and shipped with the monitor. You may want to do this to fall back to a known, reliable configuration, or you may want to use the default settings as a basis for making your own customized settings that you would save as the User Defaults.

To load the Factory Defaults:

1 Select the **Defaults** SmartKey  .

2 Select **Factory Default** from the pop-up keys at the bottom of the screen.

Load Defaults	Store Defaults		Factory Default

3 Select Confirm to load the settings stored in the User Defaults.

To reset the current settings to the factory defaults select Confirm	Confirm	Cancel

4 Check the paper scale type setting after loading the Factory Default, and change it if necessary.

When you load the Factory Default, note that:

- Global Settings are not reset.
- Hardware Settings are not reset.

Loading the User Defaults

Load the User Defaults to restore the Active Settings to the stored customized settings:

1 Select the **Defaults** SmartKey  .

2 Select **Load Defaults** from the pop-up keys at the bottom of the screen.

Load Defaults	Store Defaults		Factory Default

3 Select Confirm to load the settings stored in the User Defaults.

To reload the user default settings select Confirm	Confirm	Cancel

When you load the User Defaults, note that:

- Global Settings are not reset.
- Hardware Settings are not reset.

Loading Configurations Using the Support Tool

Use of the Support Tool is restricted to technical personnel who have been trained in its use by Philips.

Using the Support Tool you can clone multiple monitor configurations and store the configuration file in a format that can be e-mailed.

The Support Tool lets you make a backup of your configuration and any changes you make. See the Support Tool *Instructions for Use* for details about storing, cloning, and maintaining your configurations.

If you make a lot of configuration changes to monitors throughout your institution, you are strongly advised to acquire the Support Tool so that you can backup this work and restore configurations if necessary.

About Configuration Files (.cfg)

Each.cfg file contains all the settings saved in a configuration. These are complete configurations including all measurement and monitor settings. Files of the format.cfg can only be read and modified using the Support Tool. A checksum protects the contents of the configuration files, checking for example whether files were corrupted during e-mail transfer. Corrupted files will be rejected by the Support Tool.

There are two kinds of configurations:

- **initial configurations** are configurations provided by the factory. Each initial configuration supports all languages that the monitor is currently shipped with. Initial configuration files cannot be modified using the Support Tool. When an initial configuration is cloned to a monitor, the configuration is automatically adjusted to incorporate some monitor-specific attributes, for example, the language and product options. Cloning this configuration from the monitor back to the Support Tool changes it to a single-language user configuration that can then be modified using the Support Tool.
- **user configurations** are configurations that can be edited, deleted, or added to using the Support Tool. They can either be copied from a monitor or from a configuration stored with the Support Tool files on your computer. As user configurations are language dependent, always use a configuration taken from a monitor with the correct language. If you clone a user configuration to a monitor with a different language, all user adjustable texts are reset to factory defaults the first time you switch the monitor on.

Selecting the Correct Configuration

When cloning configurations, always use a configuration designed for the target device, and with the same options for application area (Hxx Option) and number of waves (Axx Option).

This is an example of an Avalon configuration file:
`H70 A01, 60Hz, Scale 240, VGA, FM40-50, initial, F.0X.xx, Rev xxx.cfg`

The name of a configuration file consists of codes to identify, where appropriate:

- the **`Hxx`** (application area) option and **`Axx`** (wave number) it is optimized for.
- the line frequency (50Hz or 60Hz).

- the paper scale type.
- the resolution of the majority of screens supplied with the config file.
- the monitor model (**`FM40 and FM50`** in our example) that the config file is optimized for.
- the word "**`initial`**" to mark an initial configuration provided by the factory.
- the software revision of the product it is optimized for. The letter "**x**" is a placeholder for any number from 0 to 9.
- the revision code used to track changes during the configuration creation process (only the latest revision is bundled with the tool).

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Configuration Settings Appendix

The monitor is pre-configured with factory defaults settings when it is shipped. This section documents these factory default configuration settings. If you change the User Defaults, this document will no longer reflect your configuration, so you must note any changes you make in the editable version of this appendix provided on the documentation DVD-ROM. The initial configuration of your monitor may vary slightly depending on your geography and on the options purchased.

In most cases, there is one set of factory default settings listed in the tables under "Factory Defaults". Where there is more than one set of defaults (due to geography-specific options, for example), these are noted in the tables. The tables contain a blank section called "User Defaults", where you can document your preferred, customized settings saved to the User Defaults.

Documenting Monitor Configurations

To help you document your monitor's configuration, the configuration tables from this appendix are also provided as a Word document on the documentation DVD-ROM supplied with the monitor. To document the configurations you create, edit this document using a word-processing program to reflect the configuration and then save it under an appropriate name.

As Philips cannot take responsibility for changes made to this document in the *.doc format, you must only use the.pdf version of this appendix as a reference for the initial configuration settings supplied with the monitor.

The configuration implications are only provided in the.pdf version of this appendix. You must read this document before you modify monitor configurations.

*Word is a registered trademark of the Microsoft Corporation.

Using the Configuration Tables

The "breadcrumb trail" at the top of each table indicates the path you should follow to access the settings in the table: in this example, to configure the fetal recorder settings, in the **`Main Setup`** menu, select **`Measurements`** and then select **`Fetal Recorder`**.

Configuration Table Example

This is a (shortened) example of a configuration table, as you will find it in the following sections of this manual.

Item Name	Factory Defaults	Choice	User Defaults
Scale Type	Geography-specific	US (scale = 30-240) Internat'l (scale = 50-210)	
Recorder Speed	3 cm/min	1, 2, 3 cm/min	
Trace Style FHR1	Thick	Thin, Medium, Thick, Extra Thick	
Trace Style FHR2	Medium		
Trace Style FHR3	Extra Thick		
Trace Style HR	Thin		
Wave Style ECG	Thin		
ECG Wave	Separate	Separate, Overlap	
Auto Start	Off	Off, On	

Item Name The leftmost column in each table lists the individual configuration items. These items correspond to the menu items in the relevant setup menu in the monitor.

Factory Defaults This section deals with the factory default settings for each configuration item.

Choice This lists the possible choices for the settings you can configure.

User Defaults In each table, columns are left blank for you to enter the settings you change.

NOTE You cannot print out the configuration from the monitor: these tables are your only documentation of the configuration you implement for each monitor. We strongly recommend that you always write down any changes you make and keep this record safely.

Understanding Configuration Implications

When you permanently change any element of the configuration, you must consider the effect of the new configuration on both patient and application behavior. For more information on the context of the configuration settings, see the monitor *Instructions for Use*. Always ensure that the monitor users are aware of the configuration settings.

Measurement-Related Settings

This section lists all the measurement-related settings. They define how the monitor measures patient data. Document the settings you configure in the empty columns.

Read any information on Configuration Implications at the end of the sections before you make any configuration changes.

Color Configuration

The color setting for each measurement defines the color for its numeric (and wave, if applicable). The color setting for Pulse is taken from the active pulse source. The choice for color is: **Red, Green, Yellow, Blue, Magenta, Cyan, White, Pink, Orange, Light Green, Light Red**

Configuring FHR (Ultrasound)

Main Setup --> Measurements --> FHR(1/2/3)

Item Name	Factory Defaults	Choice	User Defaults
FHR Sound Volume	6	0..10	
High Limit	150 bpm	70..210 bpm, in 10 bpm steps	
Low Limit	110 bpm	60..200 bpm, in 10 bpm steps	
Alarms	On	Off, On	
Fetal Movement	On	Off, On	
High Delay	60 sec	10..300 sec, in 10 second steps	
Low Delay	60 sec	10..300 sec, in 10 second steps	
SignalLoss Delay	60 sec	10..300 sec, in 10 second steps	
Color	Orange	See “Color Configuration” on page 127	

FHR Configuration Implications

High Limit/Low Limit, High Delay/Low Delay, SignalLoss Delay All FHRs, including DECG, share the same alarm limits and delays, and can be set from any FHR channel.

Alarms This lets you switch **On** FHR alarms. Your monitor must be configured to alarm mode **All** to enable the FHR alarms.

Fetal Movement Fetal movement profile can be enabled from any FHR channel, even though the fetal movement detection itself only applies to FHR1.

Configuring Toco

Main Setup --> Measurements --> Toco

Item Name	Factory Defaults	Choice	User Defaults
Toco Gain	100%	50%, 100%	
Color	Green	See "Color Configuration" on page 127	

Configuring IUP

Main Setup --> Measurements --> IUP

Item Name	Factory Defaults	Choice	User Defaults
IUP Unit	mmHg	mmHg, kPa	
Color	Green	See "Color Configuration" on page 127	

Configuring DFHR (DECG)

Main Setup --> Measurements --> DFHR

Item Name	Factory Defaults	Choice	User Defaults
FHR Sound Volume	6	0..10	
High Limit	150 bpm	70..210 bpm, in 10 bpm steps	
Low Limit	110 bpm	60..200 bpm, in 10 bpm steps	
Alarms	On	Off, On	
ArtifactSuppress	On	Off, On	
High Delay	60 sec	10..300 sec, in 10 second steps	
Low Delay	60 sec	10..300 sec, in 10 second steps	
SignalLoss Delay	60 sec	10..300 sec, in 10 second steps	
Color	Orange	See "Color Configuration" on page 127	
ECG Wave	Off	On/Off	

DFHR Configuration Implications

Your monitor must be configured to alarm mode **All** to enable the FHR alarms.

High Limit/Low Limit, High Delay/Low Delay, SignalLoss Delay All FHRs, including DECG, share the same alarm limits and delays, and can be set from any FHR channel.

Alarms This lets you switch **On** FHR alarms.

ArtifactSuppress This lets you switch artifact suppression **On** (artifacts are suppressed) and **Off** (no artifact suppression: use this setting if you suspect fetal arrhythmia).

Configuring MHR (ECG)/Pulse

Main Setup --> Measurements --> ECG

Main Setup --> Measurements --> Pulse

Item Name	Factory Defaults	Choice	User Defaults
High Limit	120 bpm	31..300 bpm in steps of 1 bpm (31 to 40 bpm) in steps of 5 bpm (40 to 300 bpm)	
Low Limit	50 bpm	30..295 bpm in steps of 1 bpm (30 to 40 bpm) in steps of 5 bpm (40 to 295)	
Alarms	On	Off, On	
QRS Volume	1	0..10	
Δ ExtrTachy	20 bpm	0..50 bpm, in steps of 5 bpm	
Tachy Clamp	200 bpm	150..240 bpm, in steps of 5 bpm	
Δ ExtrBrady	20 bpm	0..50 bpm, in steps of 5 bpm	
Brady Clamp	40 bpm	30..100 bpm, in steps of 5 bpm	
Color	Red (ECG) Cyan (Pulse from SpO_2)	See "Color Configuration" on page 127	

ECG/Pulse Configuration Implications

Your monitor must be configured to alarm mode **All** to enable the MHR/Pulse alarms.

High Limit/Low Limit MHR (MECG) and Pulse share the same alarm limits. These alarm limits apply to the current alarm source, either HR or Pulse. Note that if you change the High/Low alarm limits in the Setup ECG menu, this will also change the High/Low alarm limits in the Setup Pulse menu and vice versa.

Alarms This lets you switch **Off** HR alarms. If you change the **Alarms** setting in the Setup ECG menu, this will also change the **Alarms** setting in the Setup Pulse menu and vice versa.

Δ ExtrTachy, Δ ExtrBrady Extreme bradycardia and extreme tachycardia alarms are based on the HR/Pulse limit alarms. In Configuration Mode, you use the **Δ ExtrTachy** and **Δ ExtrBrady** setting to define the difference between the heart rate limit and the extreme limit. For example, if the heart rate high limit is 120 bpm and the difference is 20 bpm then the extreme tachycardia limit is 140. HR and Pulse share the same alarm limits. The **Δ ExtrTachy** and **Δ ExtrBrady** settings apply to the current alarm source, either HR or Pulse. If you change the **Δ ExtrTachy** or **Δ ExtrBrady** setting in the Setup ECG menu, this will also change the **Δ ExtrTachy** or **Δ ExtrBrady** setting in the Setup Pulse menu and vice versa.

Tachy Clamp, Brady Clamp The Brady and Tachy clamp allows you to configure a safety threshold for the extreme bradycardia and tachycardia alarm limits. For example, if the low heart rate limit is 50 bpm and the **Δ ExtrBrady** setting is 20 bpm (50 bpm - 20 bpm = 30) with a Brady clamp set at 40, the resulting extreme bradycardia limit would be 40 bpm (instead of 30 bpm). If the clinician sets the HR alarm limit above or below the limit clamps for an individual patient, the limit clamps become the extreme brady or extreme tachy alarm (these are red alarms). Be sure to set the clamps beyond the configured HR limits.
HR and Pulse share the same alarm limits. The **Tachy Clamp** and **Brady Clamp** settings apply to the current alarm source, either HR or Pulse. If you change the **Tachy Clamp** or **Brady Clamp** setting in the Setup ECG menu, this will also change the **Tachy Clamp** or **Brady Clamp** setting in the Setup Pulse menu and vice versa.

Alarms Off Note that changing the **Alarms Off** setting in the Setup ECG menu also changes the **Alarms Off** setting in the Setup Pulse menu and vice versa.

Configuring SpO_2

Main Setup --> Measurements --> SpO_2

Item Name	Factory Defaults	Choice	User Defaults
High Limit	100	51..100 bpm, in 1 bpm steps	
Low Limit	90	50..99 bpm, in 1 bpm steps	
Desat Limit	80	50..99 bpm, in 1 bpm steps	
Alarms	On	Off, On	
QRS Volume	1	0..10	
Tone Modulation	Yes	Yes, No	
Tone Mod. Type	Enhanced	Enhanced, Standard	
Average	10 sec	20, 10, 5 sec	
High Alarm Delay	10 sec	0..30 sec, in 1 second steps	
Low Alarm Delay	10 sec	0..30 sec, in 1 second steps	
Desat Alarm Delay	20 sec	0..30 sec, in 1 second steps	
NBP Alarm Suppr.	On	Off, On	
Color	Cyan	See “Color Configuration” on page 127	

SpO_2 Configuration Implications

SpO_2 The **On/Off** state of the SpO_2 measurement cannot be preconfigured. SpO_2 is automatically switched **On** when an SpO_2 sensor is connected to the monitor.

Average The SpO_2 numeric represents an average value calculated from the sum of SpO_2 values measured during the averaging time. **Average** lets you adjust the averaging time between **5**, **10**, and **20** seconds.

High/Low/Desat Alarm Delay The alarm delay defines the amount of time that the averaged SpO_2 value needs to be above or below the corresponding alarm limits before an alarm is activated.

NBP Alarm Suppr. Set **NBP Alarm Suppr.** to **On** to suppress INOPs that would otherwise be generated when you measure NBP on the same limb as SpO_2. If **NBP Alarm Suppr.** is configured to **On**, the monitor automatically remembers the SpO_2 value measured before cuff inflation and suppresses any SpO_2 INOPs while the cuff is inflated.

Configuring Noninvasive Blood Pressure (NBP)

Main Setup --> Measurements --> NBP

Item Name	Factory Defaults	Choice	User Defaults
Pulse(NBP)	On	Off, On	
Alarms from	Systolic	Sys., Dia., Mean, Sys & Dia, Dia & Mean, Sys & Mean, Sys&Dia&Mean	
Sys. High	160	95..270 mmHg	
Sys. Low	90	30..155 mmHg	
Dia. High	90	55..245 mmHg	
Dia. Low	50	10..85 mmHg	
Mean High	110	65..255 mmHg	
Mean low	60	20..105 mmHg	
Alarms	On	Off, On	
NBP	On	Off, On	
Repetition Time	15 min	1, 2, 2.5, 3, 5, 10, 15, 20, 30, 45, 60, 120 min	
Auto/Manual	Manual	Auto/Manual	
Unit	mmHg	mmHg, kPa	
Done Tone	Off	Off, On	
Start Time	Synchronized	Synchronized, NotSynchron.	
VP Pressure	60 mmHg	20..120 mmHg in 5 mmHg steps	
Reference	Auscultatory	Auscultatory, Invasive	
NBP Time	Meas Time	Meas Time, Next Meas	
Color	Red	See “Color Configuration” on page 127	
Closevalves[1]	Off	Off, On	

1.Service Mode only.

NBP Configuration Implications

Start Time If you set **Start Time** to **Synchronized**, the monitor will time the second measurement in a series to coincide with the next easy-to-document time. For example, if you start the first measurement at 08:23, and the **Repetition Time** is set to 10 minutes, the monitor will automatically perform the next measurement at 8:30, then 8:40 and so on.

Done Tone Set **Done Tone** to **On** if you want to hear a short prompt tone at completion of each NBP measurement.

VP Pressure This setting determines the cuff pressure used during a Veni Puncture inflation. The cuff deflates automatically after a set time (170 seconds) if it is not manually deflated beforehand.

Reference The NBP measurement reference method can be **Auscultatory** or **Invasive**. **Invasive** delivers NBP values that very closely approximate values measured intra-arterially. **Auscultatory** delivers NBP values that very closely approximate values measured using the manual cuff method. The two references can exhibit a difference of 20 to 30 mmHg in patients with elevated pressures, with the auscultatory reference registering the lower values.

Monitor-Related Settings

This section lists all the monitor-related settings (anything other than measurements). Read any information on Configuration Implications at the end of the relevant tables before you make any configuration changes.

Configuring Alarms

Main Setup --> Alarms --> Alarm Settings

Item Name	Factory Defaults	Choice	User Defaults
Alarm Volume	5	0..10	
Alarms Off	3 min	1, 2, 3 min, infinite	
Visual Latching	Red&Yell	Red&Yell, Red Only, Off	
Audible Latching	Red&Yell	Red&Yell, Red Only, Off	
Alarm Sounds	Traditional	Traditional, ISO	
Alarm Low	4	0..10	
Alarm Text	Standard	Standard, Extended	
Alarm Mode	INOP Only	All, INOP Only	

Alarm Settings Configuration Implications

Alarm Volume Use this setting to define the base volume of the red and yellow audible alarm indicators and the INOP tones.

Alarms Off Use this setting to determine how long the monitor's alarm capabilities will be switched off when the user selects the **Alarms Off** or **Pause Alarms** key. Possible choices are: **1min**, **2min**, **3min**, **Infinite**. Be aware that if you configure **Alarms Off** to **Infinite**, all of the monitor's alarming capabilities will be permanently switched off when the user selects the **Alarms Off** key.

Alarm Low Use this setting to define a minimum value for the alarm volume. The alarm volume cannot be set lower than this value.

Alarm Sounds Use this setting to change the alarm sound of the monitor to suit the alarm standards valid in your hospital.

- **Traditional**: The traditional ("Carenet") sounds used in previous HP/Agilent/Philips patient monitor generations.
- **ISO**: A new set of alarm sounds that complies with the ISO/IEC Standard 9703-2.

Alarm Text Use this setting to define how alarm messages are presented on the monitor screen:

- **Standard**: Alarm texts are displayed in text form, for example ** **FHR1 LOW**

– **Extended**: Alarm texts are displayed as numeric values, for example, ** **FHR1 94 < 110**, where the second number shows the current alarm limit, and the first number shows the maximum amount by which this limit was exceeded.

Alarm Mode There are possible alarm modes for the monitor:

– **All**: Patient alarms and INOPs are enabled, with all audible and visual indicators active.

– **INOP only**: Only INOPs are enabled, with audible and visual indication active. This the default alarm mode. Note that in **INOP only** mode, no patient alarms are enabled or indicated. No alarm limits or alarm off icons are displayed. No patient alarm settings are available in the setup menus.

Configuring the NST Timer

Main Setup --> NST Timer

Item Name	Factory Default	Choice	User Default
Run Time	20 min	10..60 minutes, in increments of 5 minutes	
Notification	Sound	Alarm, Sound, No Sound	
Timer	Off	Off, On	
Timer Volume	4	0..10	

NST Timer Configuration Implications

Run Time The run time can be set between 10 and 60 minutes.

Notification When the NST timer expires, its color changes from blue to green, and a message appears in the monitor status line on the Main Screen. The setting **Notification** lets you configure an alarm or a single tone as additional means of notification:

- Select **Alarm** to receive an INOP alarm when the timer expires.
- Select **Sound** to hear a single tone when the timer expires.
- Select **No Sound** for no additional notification.

Timer The timer is not displayed on the screen as default.

Configuring Fetal Recorder Settings

`Main Setup --> Fetal Recorder`

Item Name	Factory Defaults	Choice	User Defaults
Scale Type	Geography-specific	US (scale = 30-240) Internat'l (scale = 50-210)	
Recorder Speed	3 cm/min	1, 2, 3 cm/min	
Trace Style FHR1	Thick	Thin, Medium, Thick, Extra Thick	
Trace Style FHR2	Medium		
Trace Style FHR3	Extra Thick		
Trace Style Toco	Thick		
Trace Style HR	Thin		
Wave Style ECG	Thin		
ECG Wave	Separate	Separate, Overlap	
Notes Recording	Along	Along, Across	
Auto Start	Off	Off, On	
Confirmed Stop	Off	Off, On	
Bridge Paperout	On	Off, On	
NST Autostart	On	Off, On	
NST Autostop	Off	Off, On	
Paper Save Mode	Off	Off, On	
Trace Separation	Off	Off, On	
Separation Order	Standard	Standard, Classic	
Cal. Offset[1]	Calibrated at factory	0=right, 10=left	
Intensity[1]	Set at factory	1..5	

1.Can be changed in Service Mode only

Recorder Configuration Implications

`Scale Type` The initial setting depends on the geography-specific factory configuration, in conjunction with Line Frequency.

`Cal. Offset` See "Checking the Fetal Recorder Offset" on page 49 and "Setting the Fetal Recorder Offset" on page 49.

Configuring User Interface Settings

Main Setup --> User Interface

Item Name	Factory Defaults	Choice	User Defaults
QRS Volume	1	0..10	
QRS Low	0	0..10	
QRS Type[1]	QRS Tone	QRS Tone, QRS Tick	
Prompt Volume	8	0..10	
Tone Modulation	Yes	Yes, No	
Tone Mod. Type	Enhanced	Standard, Enhanced	
Global Speed	25mm/s	6.25, 12.5, 25, 50 mm/sec	
Touch ToneVolume	1	0..10	
Timer Volume	4	0..10	
Global SmartKeys	not applicable, these settings are stored as unique monitor settings: see “Configuring Global SmartKeys” on page 138.		
Brightness	Optimum	1..10, Optimum	
Standby Brightn.	Optimum	1..10, Optimum	
Display Units	No	Yes, No	
Alarm Limits	Yes	Yes, No	
NBP Time	Meas Time	Meas Time, Next Meas	
NBP Sys/Dia Only	Yes	Yes, No	
Wave Line Style	Thin	Thin, Medium, Thick, Extra Thick	

1.This setting can also be changed in Global settings.

User Interface Configuration Implications

QRS Volume Sets the default volume of the QRS tone.

QRS Low Defines the minimum QRS tone volume that can be selected by the user while in Monitoring Mode.

QRS Type Select **QRS Tone** or **QRS Tick**. If **Tone Modulation** is set to **Yes**, the **QRS Type** automatically switches to **QRS Tone**.

Prompt Volume Defines the volume of the tone the monitor emits to draw the user’s attention to a prompt message shown in the monitor’s prompt/status line.

Tone Modulation if you set **Tone Modulation** to **Yes**, the pitch of the SpO_2 tone will change with the measured SpO_2 level.

Tone Modulation Type This setting lets you choose between **Standard** and **Enhanced**. **Standard** is the regular Nellcor behavior. **Enhanced** results in a larger (and therefore more obvious) frequency decrease for each drop in SpO_2 level.

Global Speed The **Global Speed** setting defines the speed of ECG waves on the screen.

Touch Tone Volume The **Touch Tone Volume** setting defines the volume of the tone you hear every time you select a field on the monitor screen. You may want to set this to 0 if you want to operate the monitor in a quiet environment.

Timer Volume determines the volume of the notification tone for the NST timer.

Brightness Defines the default brightness for monitoring.

Standby Brightn. Lets you choose a brightness setting for when the monitor is in Standby.

Wave Line Style This setting lets you configure the thickness of all waves on the screen. For better visibility over a distance you might want to use **Medium** or **Thick**. The choices are: **Thin**, **Medium**, **Thick**, **Extra Thick**.

Alarm Limits If **Alarm Limits** is set to **Yes**, the alarm limits are displayed next to the measurement numerics.

NBP Time If **NBP Time** is set to **Meas Time**, the time shown beside the NBP numeric will show the timestamp of the most recent NBP measurement. If set to **Next Meas**, and NBP mode is set to Auto, and the time until the next automatic measurement is shown.

NBP Sys/Dia Only If the **NBP Sys/Dia Only** setting in the User Interface menu is set to **Yes**, then only systolic and diastolic values are displayed.

Configuring Global SmartKeys

Main Setup -> User Interface

Smartkeys			
Item Name	**Factory Defaults**	**Complete List of SmartKeys**	**User Defaults**
Global SmartKeys	TocoBaseline	TocoBaseline	
	FRStart/Stop	FRStart/Stop	
	PaperAdvance	PaperAdvance	
	Admit/Dischg	Admit/Dischg	
	Enter Notes	Enter Notes	
	Start/Stop (NBP)	Start/Stop (NBP)	
	Stop All (NBP)	Stop All (NBP)	
	Repeat Time (NBP)	Repeat Time (NBP)	
	Pause Alarms/Alarms Off	Pause Alarms/Alarms Off	
	Stored Data Rec	Stored Data Rec	
	Monitor Standby	Monitor Standby	
	Main Setup	Main Setup	
		Start NBP	
		Stop NBP	
		Start Recordng	
		Stop Recordng	
		Start ECG	
		Zero IUP	
		Timer	
		Set Marker	
		Defaults	

Global SmartKeys Configuration Implications

Global SmartKeys. This lets you define the selection and sequence of the global SmartKeys.

Changing the Selection and Sequence of Global SmartKeys

To change the selection of the Global SmartKeys:

1 Select **Main Setup -> User Interface -> Global SmartKeys**.

2 From the pop-up key line, select **Add** to open the **Choices** menu that contains all available SmartKeys.

3 From the **Choices** menu, select the desired SmartKey. This adds the new key to the bottom of the list of configured SmartKeys (on the left).

To delete a SmartKey from the list of configured SmartKeys,

♦ select it in the list, then select the pop-up key **Delete**.

To move a SmartKey to a different position,

♦ use the **Sort Up** and **Sort Down** pop-up keys.

Hardware Settings

This section lists all the Hardware settings. These settings are set once per monitor. Any changes you make to the Hardware Settings configuration are automatically stored, there is no need to save them in an extra step. Hardware settings must be entered for each monitor individually, they are stored in the monitor, and they are **not cloned**.

Document the settings you configure in the empty column.

`Main Setup` - -> **`Hardware`**

Item Name	Factory Default	User Defaults
Calibrate Touch	n/a	
Keyboard[1]	US	
MIB/RS232[1]	n/a	

1.Service mode only.

`Keyboard` This setting is available in **Service Mode only** and allows technical personnel to select the language of the keyboard that is connected to the P/S2 interface connector.

Global Settings

This section lists all the Global Settings. Global Settings are set once per monitor and are independent of the User Defaults. Any changes you may configure are automatically stored, there is no need to save them.

Document the settings you configure in the empty column of the table below.

Read any information on Configuration Implications at the end of the sections before you make any configuration changes.

`Main Setup` - -> **`Global Settings`**

Item Name	Factory Defaults	Choice	User Defaults
Line Frequency	Geography-specific	50 Hz, 60 Hz	
QRS Type	QRS Tone	QRS Tone (most countries) QRS Tick (Japan)	
Automat. Default	Yes	Yes, No	

Global Settings Configuration Implications

`Line Frequency` Use the **`Line Frequency`** setting to configure the correct line frequency for the AC Power, either 50 Hz or 60 Hz. If the Line Frequency is incorrectly set, this may affect the ECG signal quality.

`QRS Type` Select **`QRS Tone`** or **`QRS Tick`**. If **`Tone Modulation`** is set to **`Yes`**, the **`QRS Type`** automatically switches to **`QRS Tone`**.

`Automat. Default`

– If **Automat. Default** is set to **Yes**, and the monitor is switched off for more than one minute, the User Defaults is reloaded in the monitor. Any unstored changes made to the active settings are lost.
– If **Automat. Default** is set to **No**, and the monitor is switched off for more than one minute, the active settings from the most recent session are retained. Automatic Default does not affect the monitor behavior when you discharge a patient. After discharge, the User Defaults is always restored.

If the monitor is switched off and then on again in less than one minute, all active settings are retained, irrespective of the **Automat. Default** setting.

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