

Instructions for Use

Avalon Fetal Monitor

FM20/30, FM40/50

Release G.0 with Software Revision G.02.xx

Patient Monitoring

PHILIPS

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1

Introduction

Who this Book is For

This book is for trained healthcare professionals using the Avalon FM20, FM30, FM40 and FM50 fetal/maternal monitors. It describes how to set up and use the monitor and transducers. Familiarize yourself with all instructions including warnings and cautions before starting to monitor patients. Read and keep the Instructions for Use that come with any accessories, as these contain important information about application and care and cleaning that is not repeated in this book.

You should be:

- Trained in the use of fetal heart rate (FHR) monitors.
- Trained in the interpretation of FHR traces.
- Familiar with using medical devices and with standard fetal monitoring procedures.

For information on how to configure and service the monitor, refer to the *Service Guide*, or contact your authorized service provider.

Your monitor may not have all of the features and options described in this guide. The exact appearance of the monitor may differ slightly from that shown in the illustrations.

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 to 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.
- **Monitor** refers to the entire fetal/maternal monitor. **Display** refers to the physical display unit. **Screen** refers to everything you see on the monitor's display, such as measurements, alarms, patient data and so forth.

FM30
- Whenever a monitor's identifier appears to the left of a heading or paragraph, it means that the information applies to that monitor only. Where the information applies to all models, no distinction is made.

Confirm Fetal Life Before Using the Monitor

Fetal monitoring technology available today is *not always* able to differentiate a fetal heart rate (FHR) signal source from a maternal heart rate (MHR) source in *all* situations. Therefore, you should confirm fetal life *by independent means* before starting to use the fetal monitor, for example, by palpation of fetal movement or auscultation of fetal heart sounds using a fetoscope, stethoscope, or Pinard stethoscope. If you cannot hear the fetal heart sounds, and you cannot confirm fetal movement by palpation, confirm fetal life using obstetric ultrasonography. Continue to confirm that the fetus is the signal source for the FHR during monitoring.

Be aware that:

- a MHR trace can exhibit features that are very similar to those of a FHR trace, even including accelerations and decelerations. Do not rely solely on trace pattern features to identify a fetal source.
- Fetal Movement Profile (FMP) annotations on a fetal trace *alone* may not always indicate that the fetus is alive. The body of a deceased fetus can move and cause the monitor to annotate fetal body movements.

Here are some examples where the MHR can be misidentified as the FHR.

- **When using an ultrasound transducer:**
  - It is possible to pick up maternal signal sources, such as the aorta or other large vessels.
  - Misidentification may occur when the MHR is higher than normal (especially when it is over 100 bpm).
- **When using a fetal scalp electrode:**
  - Electrical impulses from the maternal heart can sometimes be transmitted to the fetal monitor through a recently deceased fetus via the spiral scalp electrode cable, appearing to be a fetal signal source.
  - The recorded MHR (and any artifact) can be misinterpreted as a FHR (especially when it is over 100 bpm).
- **When Fetal Movement Profile (FMP) is enabled:**

  FMP annotations in the absence of fetal life may be a result of:
  - Movement of the deceased fetus during or following maternal movement.
  - Movement of the deceased fetus during or following manual palpation of fetal movement (especially if the pressure applied is too forceful).
  - Movement of the ultrasound transducer.
  - The ultrasound transducer detecting a maternal movement source, such as the mother coughing.

See also the chapters “Monitoring FHR and FMP Using Ultrasound” on page 95 and “Monitoring FHR Using DECG” on page 137.

To reduce the possibility of mistaking the MHR for FHR, it is recommended that you monitor both maternal and fetal heart rates. The monitor's cross-channel verification (CCV) facility can help by automatically detecting when a MHR coincides with a FHR. For further details, see “Cross-Channel Verification” on page 97.

Introducing the Avalon Family of Fetal Monitors

The Avalon family of fetal monitors consists of the Avalon FM20, FM30, FM40 and FM50. While the FM20/FM30 and the FM40/FM50 have different form factors, the method of operation is very similar for all monitors. The Avalon fetal monitors also share the same transducers, accessories, software, and are compatible with the Avalon CTS Cordless Fetal Transducer System (M2720A).

Intended Use

The Philips Avalon FM20 (M2702A), FM30 (M2703A), FM40 (M2704A) and FM50 (M2705A) Fetal/Maternal Monitors are intended for:

- non-invasive monitoring of fetal heart rates and movements.
- non-invasive monitoring of maternal heart rates, maternal pulse rates, uterine activity, maternal noninvasive blood pressure, and maternal oxygen saturation.
- invasive monitoring of fetal Direct ECG and intrauterine pressure and for displaying and recording of fetal and maternal ECG waves. (FM30 and FM50 only)
- displaying, storing and recording patient data and parameter values and for generating alarms from fetal and maternal parameters.
- transmitting patient data and parameter values to a patient information and surveillance system.
- use by trained health care professionals.
- use in antepartum testing areas, in labor and delivery rooms and during postpartum recovery in the hospital environment. They are not intended for use in intensive care units or operating rooms.
- transport situations in healthcare facilities, for healthcare facilities outside hospitals, such as doctors' offices, and for use in private households. (FM20 and FM30 only)

WARNING

The fetal/maternal monitors are not intended for:

- use during defibrillation, electro-surgery, or magnetic resonance imaging (MRI).
- ECG measurements on patients connected to electrical stimulators or with cardiac pacemakers.
- use of the invasive measurements IUP and fetal DECG and use of the patient module (M2738A) in domestic establishments and those connected directly to the public low-voltage supply network that supplies buildings used for domestic purposes.

CAUTION

US federal law restricts this device to sale by, or on the order of, a physician.

Indications for Use

Avalon Fetal/Maternal Monitor FM20:

Indicated for use by trained health care professionals whenever there is a need for monitoring of the physiological parameters uterine activity, heart rate, oxygen saturation, non-invasive blood pressure, pulse rate of pregnant women and the fetal heart rates of single fetuses, twins, and triplets in labor and delivery rooms, in antepartum testing areas, in private households and during transports in healthcare facilities.

Avalon Fetal/Maternal Monitor FM30:

Indicated for use by trained health care professionals whenever there is a need for monitoring of the physiological parameters uterine activity, heart rate, ECG, oxygen saturation, non-invasive blood pressure, and pulse rate of pregnant women and the fetal heart rates of single fetuses, twins, and triplets in labor and delivery rooms, in antepartum testing areas, in private households and during transports in healthcare facilities.

Avalon Fetal/Maternal Monitor FM40:

Indicated for use by trained health care professionals whenever there is a need for monitoring of the physiological parameters uterine activity, heart rate, oxygen saturation, non-invasive blood pressure, and pulse rate of pregnant women and the fetal heart rates of single fetuses, twins, and triplets in labor and delivery rooms and in antepartum testing areas.

Avalon Fetal/Maternal Monitor FM50:

Indicated for use by trained health care professionals whenever there is a need for monitoring of the physiological parameters uterine activity, heart rate, ECG, oxygen saturation, non-invasive blood pressure, and pulse rate of pregnant women and the fetal heart rates of single fetuses, twins, and triplets in labor and delivery rooms and in antepartum testing areas.

2

Installation

Installation should be carried out by qualified service personnel, either by the hospital's biomedical department, or by Philips Support.

As the first step in preparing the monitor for use, follow the installation instructions given in this chapter.

For a list of conventions used in this guide, see "Basic Operation" on page 19.

Not all accessories and supplies may be available in all geographies. Please contact your local Philips sales representative for details of availability.

Installation Checklist

Use this checklist to document your installation.

Step	Task	Check Box when Task Done
1	Perform initial inspection of delivery, unpack and check the shipment (see "Unpacking and Checking the Shipment" on page 14)	☐
2	Mount the monitor as appropriate for your installation (see "Mounting the Monitor" on page 15)	☐
3	Connect the fetal monitor to AC mains using the supplied power cord. This configuration varies, depending whether an external power supply/battery option is used. (see "External Power Supply M8023A" on page 58)	☐
4	Perform Safety Tests (see "Safety Tests" on page 18)	☐
5	Check that default settings (including the line frequency) are appropriate for your institution	☐
6	Check/set the paper scale (see "Checking/Setting Paper Scale" on page 42)	☐
7	Load paper into the recorder (see "Loading Paper: FM20/FM30" on page 44 or "Loading Paper: FM40/FM50" on page 45, depending on your monitor)	☐
8	Check/set the time and date (see "Setting the Date and Time" on page 35)	☐

Step	Task	Check Box when Task Done
9	Check/set paper speed (see "Choosing Paper Speed" on page 48)	☐
10	Perform System Test as necessary (see the *Service Guide*)	☐
11	For monitors with the battery option (#E25) chosen, confirm that the battery can be charged, and that the monitor can be powered by the battery.	☐
12	Test Transducers (see "Testing Ultrasound Transducers" on page 112 and "Testing Toco Transducers" on page 132)	☐

Unpacking and Checking the Shipment

The monitor and any supporting options ordered are supplied packed in protective shipping cartons.

Initial Inspection

Before unpacking, visually check the packaging and ensure that there are no signs of mishandling or damage.

Open the package carefully and remove the instrument and accessories.

Check that the contents are complete and that the correct options and accessories have been delivered.

System Components, Accessories and Supplies	FM20	FM30	FM40	FM50
Toco+ Transducer (with belt clip)	-	optional	-	optional
Toco MP Transducer (with belt clip)	1	1	1	1
US Transducer (with belt clip)	1	1	1	1
Patient Module for DECG/MECG/IUP	optional[1]	optional	optional[1]	optional
DECG Reusable Legplate Adapter Cable	-	1	-	1
MECG Adapter Cable	-	1	-	1
IUP Adapter Cable[2]	-	optional	-	optional
External Power Supply and MSL Cable	optional	optional	-	-
Event Marker	optional	optional	optional	optional
Fetal Paper Pack (country-specific, installed)	1	1	1	1
Powercord	1	1	1	1
Printed Instructions for Use	1	1	1	1
Documentation DVD: includes FM20/30 Service Guide, FM40/50 Service Guide, Instructions for Use (including localized versions), and Training Guide	1	1	1	1

[1] For assessment of maternal heart rate only.

[2] Ships with Patient Module (K03).

Claims for Damage

If the shipping cartons are damaged, contact the carrier.

If any of the equipment is damaged, contact both the carrier and your local Philips service organization for repair or replacement arrangements.

Repacking

Retain the original packing carton and material, in case you need to return equipment to Philips for service. If you no longer have the original packing materials, Philips can advise you on alternatives.

Mounting the Monitor

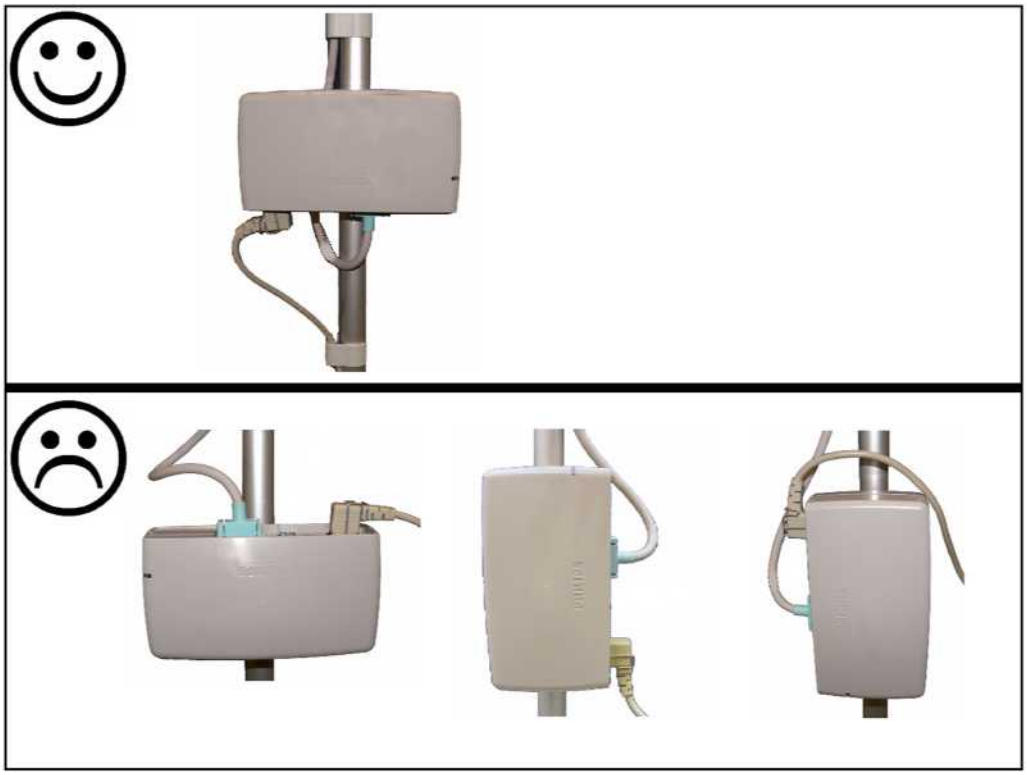
FM20/30 The monitor can be rested on a flat surface, set at an angle using the built-in stand, or mounted on a wall, on a cart or on a rollstand. See the *Service Guide* for details.

FM40/50 The monitor can be rested on a flat surface, or on a cart. See your monitor's *Service Guide* for details.

Mounting the External Power Supply (M8023A)

The external power supply (M8023A option #E25) can be rested on its rubber feet on a flat, level surface, or mounted as described in the *Service Guide*.

The following pictures show examples of correct ☺ and incorrect ☹ ways to mount the power supply.



Connecting the Monitor to AC Mains

FM20/30 The monitor is an electrical Class II device in which the protection against electric shock does not rely on basic insulation and a protective earth conductor but on double and/or reinforced insulation.

FM40/50 The monitor is an electrical Class I device. Protection against electric shock is provided by a protective earth conductor.

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 or 60 Hz (± 5%).

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.
- Check that the line frequency is correctly set for your institution (50 Hz or 60 Hz) before putting the monitor into service.
- **FM20/FM30 only:** The protective earth conductor is required for EMC purposes. It has no protective function against electric shock! The protection against electric shock in this device is provided by double and/or reinforced insulation.
- Do not use AC mains extension cords or multiple portable socket-outlets.

How and When to Carry Out the Test Blocks

The following table defines which test and inspection blocks need to be performed, and when they are required.

Test Block	Test or Inspection to be Performed	Test Block Required for Which Events?
Visual	Inspect the monitor, transducers and cables for any damage. Are they free of damage?	Installation Preventive Maintenance
Power On	Power on the monitor. Does it boot up successfully without errors? After boot up the monitor sounds a tone, and can you see the monitoring main screen. If recorder power-on auto-start is configured to On, does the recorder print **Selftest: OK** across the trace paper? (See "Switching the Recorder On and Off" on page 49 for details.)	Installation Preventive Maintenance
Functionality Test	**FM20/30 with Battery Option #E25 Only** After power up, touch the battery status indicator in the bottom right of the screen. The battery status window should open. Check to see if there is an exclamation mark flashing in the gauge. Press the **Main Screen** key to close the window and return to the main screen.	Installation Preventive Maintenance
Safety Tests (1) to (4)	Perform safety tests (1) to (4), as described in your monitor's *Service Guide,* for standalone devices if required by local regulations, and each time you combine equipment to form a system, or exchange system components.	Installation Preventive Maintenance
Performance	Test the transducers (see "Testing Ultrasound Transducers" on page 112 and "Testing Toco Transducers" on page 132).	Installation Preventive Maintenance
System	Perform the system test according to IEC/EN 60601-1-1/ IEC/EN 62353, if applicable, after combining equipment to form a system (see your monitor's *Service Guide*).	Combining system components

For test and inspection information regarding repairs, upgrades and all other service events, refer to your monitor's *Service Guide*.

Safety Tests

Details of the safety tests and procedures required after an installation or an exchange of system components are described in your monitor's *Service Guide*. These safety tests are derived from international standards but may not be sufficient to meet local requirements.

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.

3

Basic Operation

This chapter gives you an overview of the monitor and its functions. It tells you how to perform tasks that are common to all measurements (such as entering data, switching a measurement on, changing some monitor settings, and setting up the recorder). The alarms section gives an overview of alarms. The remaining sections tell you how to perform individual measurements, and how to care for and maintain the equipment.



Supported Measurements

The following **Fetal** Measurements are supported:

Fetal Monitor or Model	Fetal Heart Rate (FHR) via US (including Twins)	Triple FHR via US	Toco	FHR via Direct ECG (DECG)	Intrauterine Pressure (IUP)
FM20	Standard	Optional	Standard	-	-
FM30	Standard	Optional	Standard	Standard	Standard
FM40	Standard	Optional	Standard	-	-
FM50	Standard	Optional	Standard	Standard	Standard

The following **Maternal** Measurements are supported:

Fetal Monitor or Model	Maternal Heart Rate (MHR) via Maternal ECG Electrodes	Maternal ECG (MECG)	Maternal Pulse from Toco	Non-invasive Blood Pressure with Pulse Rate	Pulse Oximetry (Maternal SpO_2) with Pulse Rate
FM20	Standard	-	Standard	Optional	-
FM30	Standard	Standard	Standard	Optional	Optional
FM40	Standard	-	Standard	Standard	Standard
FM50	Standard	Standard	Standard	Standard	Standard

Avalon FM20 and FM30

This section outlines the capabilities of your monitor.



Avalon FM20

The Avalon FM20 fetal/maternal monitor provides a solution for external fetal monitoring applications, and optional non-invasive maternal vital signs.

You can monitor fetal heart rates (FHRs) externally using ultrasound, uterine activity and maternal pulse using an external Toco transducer, and the maternal heart rate (MHR) via maternal ECG electrodes, and optionally, non-invasive blood pressure.

Measurements are displayed on a 6.5-inch color display as numerics. The display is a touchscreen, and you operate the monitor using this touchscreen interface. The integrated recorder documents fetal and maternal measurements as well as user defined annotations.

You can connect the monitor to an OB TraceVue system via the RS232 connection, or over a LAN connection (with OB TraceVue Revision E.00.00 and later).

Avalon FM30

The Avalon FM30 fetal/maternal monitor offers a solution for both external and internal fetal monitoring applications, and optional non-invasive maternal vital signs.

The Avalon FM30 shares all the features and capabilities of the Avalon FM20. In addition, you can monitor one FHR internally via direct fetal electrocardiogram (DECG), uterine activity internally using an intra-uterine pressure (IUP) catheter together with a Toco^{+} transducer or patient module, and optionally, maternal oxygen saturation (SpO_2).

The Avalon FM30 carries the IP label, indicating that it is capable of intrapartum monitoring.

FM20/30 with Battery Option #E25 Only

The battery option for the FM20/30 provides support for the in-transport monitoring of all measurements when disconnected from a power supply. Existing data storage is automatically uploaded to OB TraceVue after reconnecting to the system. Trace printing during transport is also possible.

Avalon FM40 and FM50

This section outlines the capabilities of your monitor.



Avalon FM40

The Avalon FM40 fetal/maternal monitor provides a solution for external fetal monitoring applications, and non-invasive maternal vital signs.

You can monitor fetal heart rates (FHRs) externally using ultrasound, uterine activity using an external Toco transducer, and the maternal heart rate (MHR) via maternal ECG electrodes, and non-invasive blood pressure and maternal oxygen saturation (SpO_2).

Measurements are displayed on a 6.5-inch color display as numerics. The display is a touchscreen, and you operate the monitor using this touchscreen interface. The integrated recorder documents fetal and maternal measurements as well as user defined annotations.

You can connect the monitor to an OB TraceVue obstetrical documentation and surveillance system via the RS232 connection, or over a LAN connection (with OB TraceVue Revision E.00.00 and later).

Avalon FM50

The Avalon FM50 fetal/maternal monitor offers a solution for both external and internal fetal monitoring applications, and non-invasive maternal vital signs.

The Avalon FM50 shares all the features and capabilities of the Avalon FM40. In addition, you can monitor one FHR internally via direct fetal electrocardiogram (DECG), and uterine activity internally using an intra-uterine pressure (IUP) catheter together with a Toco^{+} transducer or patient module.

The Avalon FM50 carries the 

label, indicating that it is capable of intrapartum monitoring.

Cordless Monitoring

All monitors are compatible with the Avalon CTS Cordless Fetal Transducer System (M2720A). Note the following points regarding cordless monitoring:

- One Avalon CTS Cordless Fetal Transducer System can be connected to a monitor at a time.
- Monitoring multiple pregnancies using cordless transducers is not supported.
- Using a mixture of wired and cordless fetal transducers is not supported. You can use *either* wired *or* cordless fetal transducers. If sufficient signal quality cannot be achieved using cordless fetal transducers, then switching to wired transducers is recommended.
- When the monitor recognizes an Avalon CTS interface cable M2731-60001 (red connector) or M2732-60001 (black connector, for rear connection on FM40/FM50 only), it gives confirmation by showing the following status indicator in the lower right-hand corner of the screen:

Indicator	Meaning
	Avalon CTS interface cable is connected to the monitor, but the Avalon CTS base station is not connected to the interface cable, disconnected from AC mains, or is in Standby.
	Avalon CTS interface cable is connected to the monitor, Avalon CTS base station is connected, powered on, and cordless transducers are ready to use, but no cordless transducers are currently active (all are still docked in the base station).
	Avalon CTS interface cable is connected to the monitor, Avalon CTS base station is connected, powered on, and at least one cordless transducer has been taken out of the base station and is active. As cordless transducers have priority over wired transducers, any connected wired transducers are disabled.

- Cordless transducers have priority over wired transducers. When an Avalon CTS base station is connected via the appropriate interface cable to the fetal monitor, and there are also wired transducers connected to the monitor, the wired transducers are disabled whenever a cordless transducer is active. To change back to using wired transducers, dock the cordless transducers in the Avalon CTS base station or switch the base station to Standby, and continue monitoring with the wired transducers. Note that if a sufficient ultrasound signal quality cannot be achieved by transducer repositioning, change to wired transducers.
- When using a cordless ultrasound transducer from an Avalon CTS system, the monitor automatically sets the Fetal Movement Profile (**FMP**) to **Off**. You can enable the FMP again should you wish, (see “Switching FMP On and Off” on page 101), but you should refer to the sections “Cordless Monitoring - Important Considerations” on page 97 and “Fetal Movement Profile” on page 100.

Getting to Know Your Avalon FM20/FM30

Overview



1 Touchscreen Display (tilt and fold)
2 Power LED
3 Paper Drawer
4 Paper Drawer release
5 Connectors (see Left Side view)

Right Side



6 On/Off Switch
7 Power Connector

with Battery Option



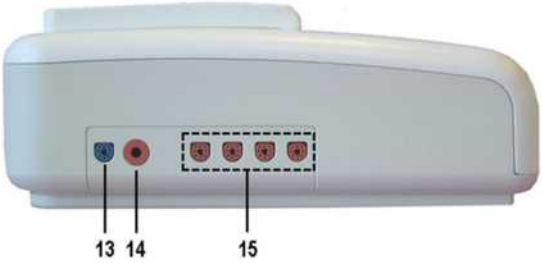
8 On/Standby Switch
9 MSL Connector

Rear



10 Display Release
11 Carrying Handle
12 Built-in Stand

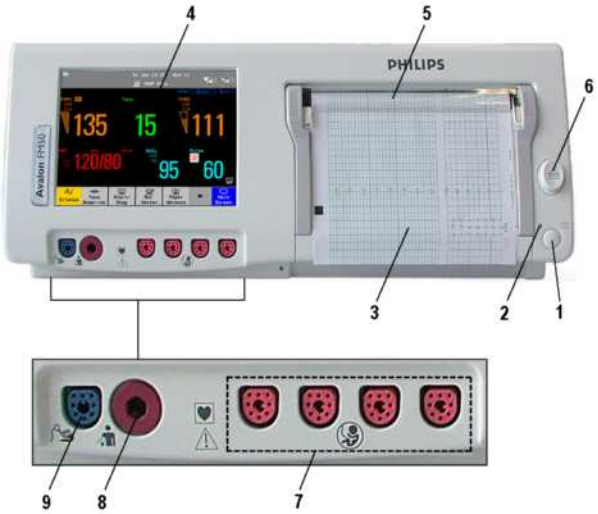
Left Side



13 SpO_2 Socket (optional)
14 Noninvasive Blood Pressure Socket (optional)
15 Fetal Sensor Sockets - each socket accepts any fetal transducer, an Avalon CTS Cordless Fetal Transducer System base station (connected via the interface cable M2731-60001), or event marker

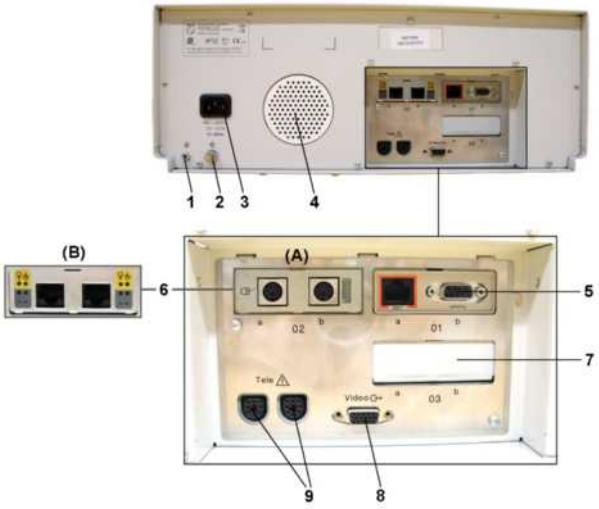
Getting to Know Your Avalon FM40/FM50

Front



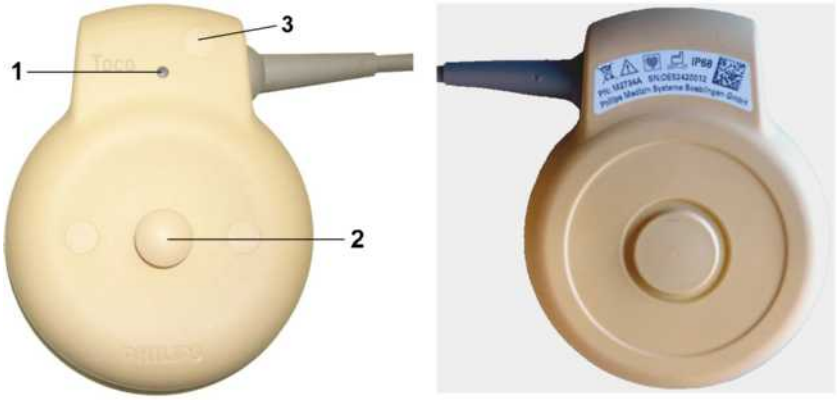
1 On/Standby Switch
2 Power LED
3 Recorder Paper Table
4 Touchscreen Color Display
5 Transparent Paper Guide with tear-off edge
6 Paper Eject Button. Press to open paper drawer. Press again and hold when removing paper.
7 Fetal Sensor Sockets. Connect any fetal sensor or patient module here, including Avalon CTS via M2731-60001 interface cable (with red connector).
8 Noninvasive Blood Pressure Socket
9 SpO_2 Socket

Rear



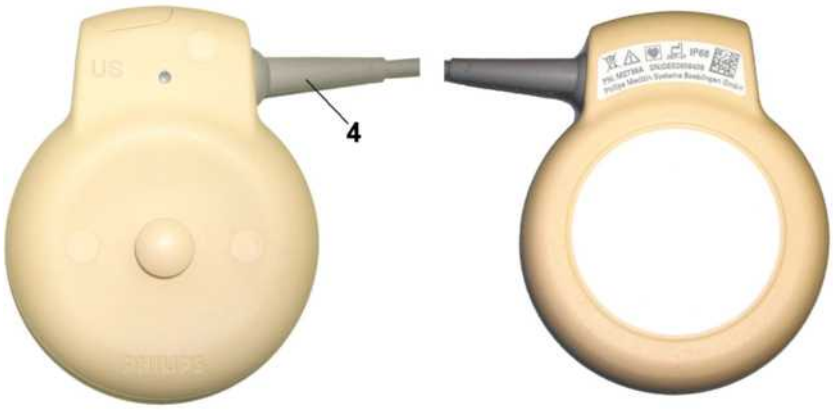
1 Reserved for future use: protective earth intended for use in system installations.
2 Equipotential Grounding Point
3 Power Cord Connector
4 Loudspeaker
5 Slot 01 for optional LAN / RS232 system interface (for connection to an obstetrical information and surveillance system)
6 Slot 02 for optional 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).

Transducers



Toco and Toco MP Transducer (M2734A, M2734B)

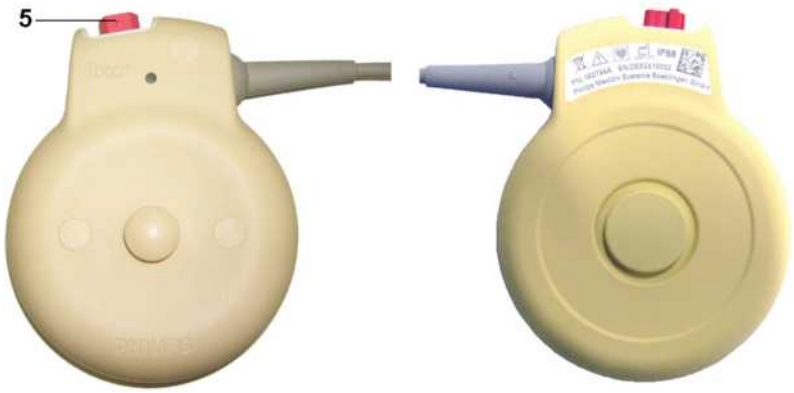
1 Transducer Finder LED - lights up on the transducer providing the measurement source.
2 Belt Button
3 "MP" for M2734B "Toco MP" transducers (additionally capable of providing the maternal pulse measurement)



Ultrasound Transducer (M2736A)

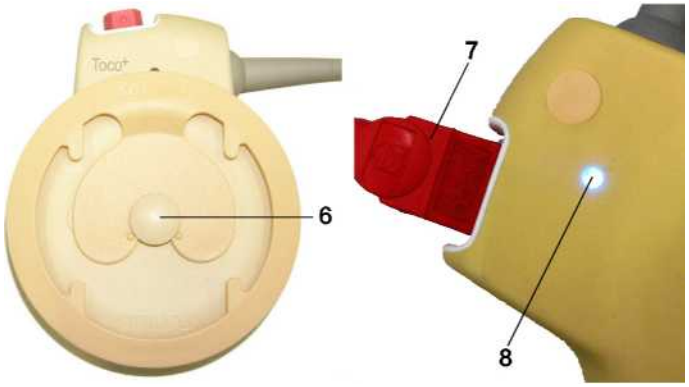
4 Cable - connects to any of the four Fetal Sensor Sockets on the monitor

Note that the The M2736AA US transducer is identical to the M2736A US transducer, including all specifications.



Toco^{+} Transducer with ECG/IUP capability (M2735A)

5 Connector - for connecting ECG/IUP adapter cables (M2735A Toco^{+} transducer only)



6 Butterfly Belt Clip (shown fitted; for use with belts without button holes)

7 Close-up of MECG adapter cable connected to Toco^{+} transducer

8 Close-up of active Finder LED



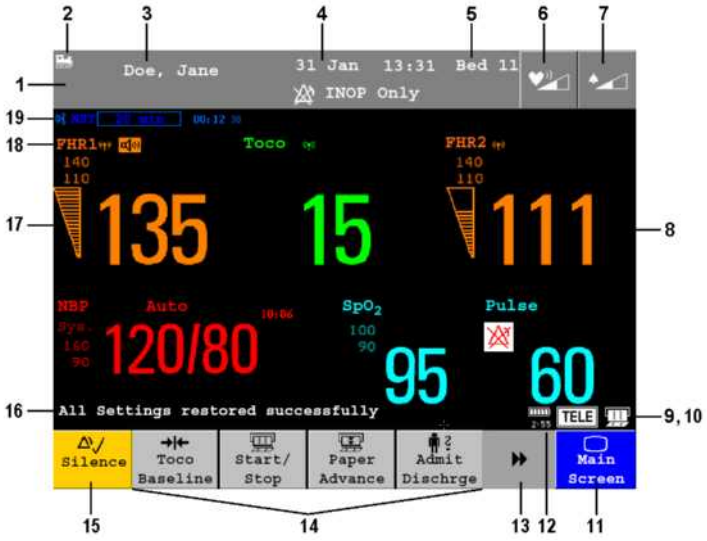
Patient Module for ECG/IUP (M2738A)

9 Connector - for connecting ECG/IUP adapter cables (same as for Toco^{+} transducer)
10 Cable - connects to any of the four Fetal Sensor Sockets on the monitor

Operating and Navigating

Your monitor has a touchscreen. Everything you need to operate the monitor, other than to turn it on and off, is contained on its screen. Most screen elements are interactive. Screen elements include measurement numerics, screen keys, information fields, status indicators, alarms fields and menus.

FM40/50 If an optional external touch display with a MIB interface board are connected to the monitor, you can operate the monitor using the external touch display.



Screen Elements

Monitor Information Line

1 INOP and alarm status area - shows active alert messages

2 LAN connection status indicator only. RS232 system connection is not indicated. Either the Monitor is connected to OB TraceVue , the LAN cable is connected but no connection to OB TraceVue ; or, if no indicator is shown, there is no network connection.

3 Patient identification

4 Date and time

5 Bed label (when connected to a Philips OB TraceVue system)

6 Fetal heart sound volume adjust/indicator

7 Alarm volume adjust/indicator

8 Numeric/measurement values

9 Fetal Trace Recorder - status indicator

Fetal recorder is On



Fetal recorder is Off (when Paper Save Mode is off)



Fetal recorder is Off (when Paper Save Mode is on)



There is a Recorder problem that can be solved by the user (for example, paper out, paper jam, wrong paper scale set)



Fetal recorder is defective: call service.



10 Avalon CTS System - status indicator:

Avalon CTS interface cable is connected to the monitor, but Avalon CTS base station is not connected to the interface cable, disconnected from AC mains, or is in Standby.



Avalon CTS interface cable is connected to the monitor, Avalon CTS base station is connected, powered on, and cordless transducers are ready to use, but no cordless transducers are currently active (all are still docked in the base station).



Avalon CTS interface cable is connected to the monitor, Avalon CTS base station is connected, powered on, and at least one cordless transducer has been taken out of the base station and is active. Any connected wired transducers are disabled.



11 Close all open menus and windows and return to main screen

12 Battery Status Indicator

13 Scroll to display more SmartKeys

14 SmartKeys - these can vary according to your monitor's configuration

15 **Silence** - key which acknowledges all active alarms by switching off audible alarm indicators

16 Status line - shows status and prompt messages

17 Signal quality indicator



Good / full



acceptable / medium



Poor / no signal

18 Measurement label (a cordless measurement from a connected Avalon CTS system is indicated by the  symbol)

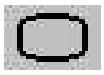
19 NST timer, if configured (default is Off)

Keys

The monitor has three different types of keys.

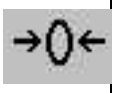
Permanent Keys

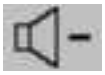
A permanent key is a graphical key that remains permanently on the screen, giving you fast access to functions.

	**Silence** - acknowledges all active alarms by switching off audible alarm indicators.
	**Main Screen** - closes all open menus and windows and returns to the main screen.

SmartKeys

SmartKeys are configurable graphical keys, located at the bottom of the main screen. They give you fast access to functions. The selection of SmartKeys available on your monitor depends on your monitor configuration and on the options purchased.

	**Main Setup** - enter main setup menu.		Recorder **Start/ Stop** - turn the trace recorder on or off.
	**Pause Alarms** - pauses alarm indicators. Pause duration depends on monitor configuration. If pause duration is infinite, this key is labeled **Alarms Off**. Select again to immediately re-enable alarm indicators.		**Paper Advance** - advance the paper automatically to the next fold.
	**Start Recordng** - turn the trace recorder on.		**Stop Recordng** - turn the trace recorder off.
	**Start ECG**- start printing the MECG, DECG or both waves, when both are available.		**Stored Data Rec** - print trace data from the monitor's memory.
	**Admit/ Dischrge** - enter patient identification menu to admit/ discharge		**Enter Notes** - enter notes
	**Toco Baseline** - reset Toco baseline/whichever is available (see below)		**Timer** - enters NST timer window
	**Zero IUP** - zero IUP measurement/whichever is available (see above)		**Set Marker** - mark an event

	**Start/ Stop**: - start/stop manual noninvasive blood pressure measurement - start auto series - stop current automatic measurement within series		**Stop All** - stop all noninvasive blood pressure measurements
	**Start NBP**: - start manual noninvasive blood pressure measurement - start auto series		**Stop NBP**: - stop manual noninvasive blood pressure measurement - stop current automatic measurement within series
	**Repeat Time** - set the time interval between two noninvasive blood pressure measurements		**Defaults** - load User Default
	**Sound Vol. Up** - increases the Fetal Heart Rate volume		**Sound Vol. Down** - decreases the Fetal Heart Rate volume
	**Monitor Standby** - enter Standby mode, suspends monitoring. All numerics and waves disappear from the display. All settings and patient data information are retained.		**NST Report** - initiate an NST trace interpretation and obtain a Non-Stress Test (NST) Report

Pop-Up Keys

Pop-up keys are context-sensitive graphical keys that appear automatically on the monitor screen when required. For example, the **Confirm** pop-up key appears when you need to confirm a change.

Using the Touchscreen

Select screen elements by pressing them directly on the monitor's screen.

Disabling Touchscreen Operation

To temporarily disable touchscreen operation of the monitor, press and hold the **Main Screen** permanent key for about three seconds. A red padlock will blink on the **Main Screen** permanent key.



Press and hold the **Main Screen** permanent key again for about three seconds to re-enable the touchscreen operation.

Selecting Screen Elements

Select a screen element to tell the monitor to carry out the actions linked to the element.

You access most screen elements by touching that element directly. For example, select the FHR1 numeric to call up the **Setup FHR1** menu, or select the **Start/ Stop** SmartKey to start or stop the fetal trace recorder.

However, some smaller screen elements are grouped together at the top of the screen in the information area. To access one of these elements, touch anywhere in the information area, and select the element from the selection list that appears. For example, to view alarm messages:

1 Touch the alarm status field, or anywhere else in the information area at the top of the screen. The window with the selection list opens.

2 Select **Alarm Messages** from the list. This opens the **Alarm Messages** window, from where you proceed to view the alarm messages.

Operating Modes

When you switch the monitor on, it starts up in monitoring mode. To change to a different mode:

1 Select the **Main Setup** menu.

2 Select **Operating Modes** and choose the mode you require.

Your monitor has four operating modes. Some are passcode protected.

- **Monitoring Mode**: This is the normal mode for monitoring patients. You can change elements such as alarm limits, and so forth. When you discharge the patient, these elements return to their default values. Changes can be stored permanently in Configuration Mode. You may see items, such as some menu options, that are visible but "grayed out" so that you can neither select nor change them. These are for your information and can be changed in Configuration Mode.
- **Demo Mode**: Passcode protected, this is for demonstration and training purposes. You must not change into Demonstration Mode during monitoring. When transducers are connected to the monitor and the recorder is on, a demo trace is recorded, but this is not transmitted to an information and surveillance system such as OB TraceVue.
- **Configuration Mode**: Passcode protected, this is for personnel trained in configuration tasks. These tasks are described in the *Service Guide*. During installation the monitor is configured for use in your environment. This configuration defines the default settings you work with when you switch on.
- **Service Mode**: Passcode protected, this is for trained service personnel.

When the monitor is in Demonstration Mode, Configuration Mode, or Service Mode, this is indicated by a box containing the mode name. Select this field to change to a different mode.

Automatic Screen Layouts

Your monitor's preconfigured screen layouts define how measurement information is arranged on screen. The monitor automatically applies the correct screen layout for the measurements you are monitoring. No user action is required.

Connecting or disconnecting transducers, or switching the noninvasive blood pressure measurement on or off, results in an automatic adjustment of the screen layout. When a measurement is off, its numerics are removed from the monitor's screen. The monitor stops acquiring data and generating alarms for this measurement. If you disconnect a transducer while it is performing a measurement, the monitor issues a disconnect INOP (and in the case of SpO_2, replaces the measurement numeric with question marks).

Settings

This section describes the various settings available on the monitor.

Active Settings

What the monitor displays, and the way it operates, is controlled by its settings. They determine screen content, layout, high and low alarm limits and so forth.

The "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.

There are also two preconfigured default settings:

- User Default
- Factory Default

User Default

The User Default is a complete configuration stored in the monitor's long-term memory. You can change individual settings and store them in the User Default. In other words, you can store the active settings, modified to your preference, in the User Default (in configuration mode).

In monitoring mode, you can load the User Default settings to return to your preferred settings:

1 Select the **Defaults** SmartKey .

2 Select **Confirm** in the dialog box to load the User Default.

To reload the user default settings select Confirm	Confirm	Cancel

Factory Default

The Factory Default is a complete configuration pre-defined at the factory. You cannot modify it. In configuration mode, you can load the Factory Default as the active settings.

CAUTION

This resets all settings to factory defined values, but be aware that some values will differ from those with which the monitor was originally shipped from the factory (recorder speed and paper scale type will need to be corrected, for instance). After loading the Factory Default, please check the settings and, if necessary, change them to the settings you normally use.

You can use the Factory Default as the basis for producing your User Default. See the *Service Guide* for details.

Global Settings

General monitor configuration settings are stored in the Global Settings. These include settings for line frequency, QRS type and whether the monitor is automatically reset to the User Default after a power interruption of more than one minute. You can change the Global Settings in Configuration Mode.

Changing Measurement Settings

Each measurement has a setup menu in which you can adjust all of its settings. You can enter a setup menu:

- via the measurement numeric - select the measurement numeric on the screen to enter its setup menu. For example, to enter the **Setup FHR1** menu, select the **FHR1** (fetal heart rate 1) numeric.
- via the **Main Setup** SmartKey - if you want to setup a measurement when the measurement is switched off, use the **Main Setup** SmartKey and select **Measurements**. Then select the measurement name from the pop-up list. With this SmartKey you can access any setup menu in the monitor.

This guide always describes the entry method using the measurement's setup menu. You can use the method you prefer.

Switching the Noninvasive Blood Pressure Measurement On and Off

The noninvasive blood pressure measurement is the only measurement for which you can manually switch on and off. To do this:

1 Enter the noninvasive blood pressure measurement's setup menu.

2 Select **NBP** to toggle between on and off. The screen display indicates the active setting.

Changing Monitor Settings

To change monitor settings such as brightness, or touch tone volume:

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

2 Select the setting you want to change, or select **User Interface** to enter a submenu where you can change user interface settings.

Adjusting the Screen Brightness

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

2 Select **User Interface**.

3 Select **Brightness**.

4 Select the appropriate setting for the screen brightness. 10 is the brightest, 1 is the least bright. **Optimum** is suitable for most situations.

Adjusting Touch Tone Volume

The touch tone volume is the tone you hear when you select any field on the monitor screen. To adjust the touch tone volume,

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

2 Select **User Interface**.

3 Select **Touch ToneVolume**, then select the appropriate setting for the touch tone volume: 10 is the loudest and 1 is the quietest. Selecting zero switches the touch tone volume off.

Setting the Date and Time

1 Select the date and time screen element from the monitor's info line to enter the **Date, Time** menu.

2 Select, in turn, the **Year**, **Month**, **Day**, **Hour** (in 24 hour format) and **Minute**, as necessary.

3 Select **Store Date, Time** to change the date and time.

If connected to a Philips OB TraceVue system, the monitor uses the OB TraceVue system date and time, including daylight saving time changes.

WARNING

Changing the date and time while the monitor is connected to an OB TraceVue system can result in a mismatch in the time and date between the monitor and the OB TraceVue system.

When disconnected from AC power, the monitor retains the date and time setting for at least two months.

Checking Your Monitor Revision

1 Select **Main Setup** -> **Revisions** to open the **Monitor Revision** menu.

2 From the **Monitor Revision** menu, select the monitor component for which you need revision information.

Preparing to Monitor

Confirm fetal life before you begin fetal monitoring. Familiarize yourself with the basic operation principles before you start to monitor.

Switching On: FM20/FM30

FM20/30

- Connect the monitor to AC mains and switch the monitor on.
- The green power-on LED comes on.
- The monitor performs a self-test as it starts up. **Selftest: OK**, the serial number, and revisions for the software and firmware are printed on the fetal trace paper (if recorder **Auto Start** is configured to **On**).
- The monitor display comes on.
- There is a start-up tone from the loudspeaker.

FM20/30 (with Battery Option)

- If this option has been chosen, the green power-on LED on both the External Power Supply and the Battery LED indicator will come on.

Switching On: FM40/FM50

FM40/50

- Connect the monitor to AC mains. The green LED comes on.
- Press the On/Standby switch.
- The monitor performs a self-test as it starts up. **Selftest: OK**, the serial number, and revisions for the software and firmware are printed on the fetal trace paper (if recorder **Auto Start** is configured to **On**).
- The monitor display comes on.
- There is a start-up tone from the loudspeaker.

Adjusting the Display Angle (FM20/FM30)

FM20/30

You can tilt the display on the FM20 and FM30 to one of five different positions, or you can fold it completely down. The tilt/fold mechanism works on a one-way ratchet system. You hear a click as each of the five positions is reached. The screen can be folded back down only after tilting the display forwards as far as it will go.

To tilt the display from the folded position:

1 Unlock the display by releasing the catch.

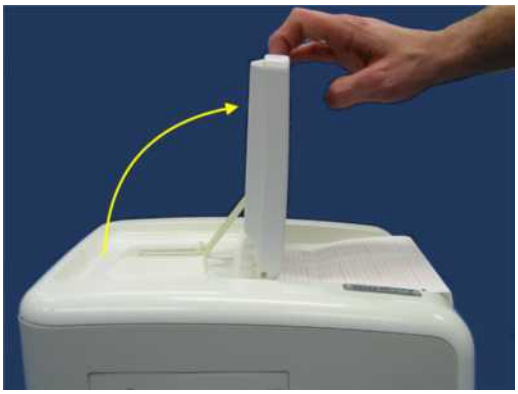


2 Lift the display forwards. You hear a click as the first position engages. If you want to tilt the display further, lift the display further forwards until you reach the desired angle.

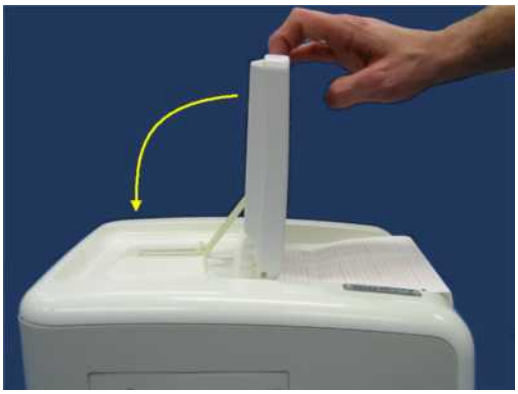


To fold the display:

1 Pull the display forwards as far as it will go.



2 Then push it all the way back until it **clicks** shut.



If your monitor is wall-mounted, the display should be folded flat.

Fastening Belts and Transducers

You can use more than one belt if, for example, you are monitoring uterine activity and FHR simultaneously. There are two basic ways to fasten belts and transducers:

- Belts with button fixings.
- Velcro belts together with the butterfly belt clip.

Using Belts with Button Fixings

1 Place the transducer belt across the bed, ensuring that the fixing button will face away from the mother when it is fastened.

2 Lie the patient on the bed and arrange the belt around her until it is tight but still comfortable.

3 Fasten the belt by pushing the fixing button through the overlapping section of the belt. Ensure that the fixing button and the loose ends of the belt are at the patient's side.



4 When you have positioned a transducer satisfactorily, you can attach it to the belt by pushing the belt button on the transducer through one of the holes in the belt.

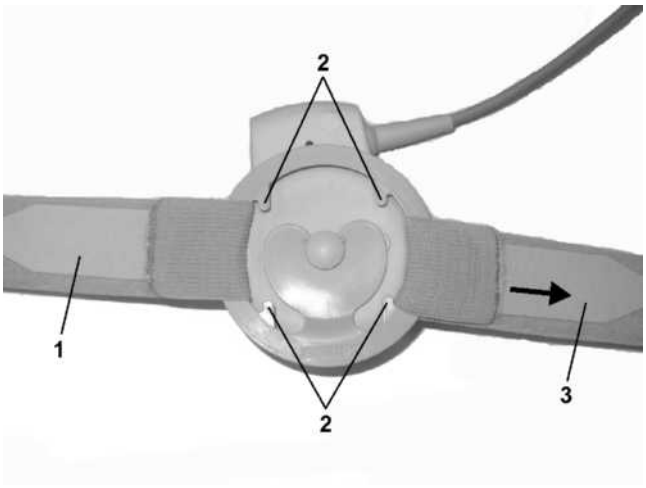


Alternatively, attach the butterfly belt clip to the transducer belt button and use this to attach the transducer to the belt. The clip allows you to slide the transducer for easy repositioning.



Using Belt with Velcro Fixings

Insert one end of the belt between the belt guides on one side of the butterfly belt clip, and secure with the velcro fixing. Insert the other end of the belt between the belt guides on the other side of the butterfly belt clip, adjust for the correct tension, then secure with the velcro fixing.



1 Fasten one end with velcro fixing

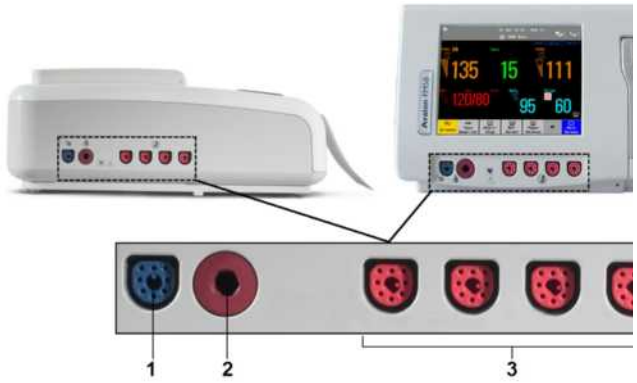
2 Belt guides

3 Pull the other end through, adjust for tension, and secure with velcro fixing

WARNING

When connecting devices for acquiring measurements, always position cables and NBP tubing carefully to avoid entanglement or potential strangulation.

Connecting a Transducer to the Monitor



1 SpO_2 socket
2 Noninvasive blood pressure socket
3 Fetal sensor sockets

You can plug a fetal transducer, a ECG/IUP patient module, an Avalon CTS Cordless Fetal Transducer System interface cable (M2731-60001, red connector), or an external event marker into any of the four fetal sensor sockets marked or "Fetal Sensors" (depending on geography). For measuring maternal SpO_2, connect the sensor to the socket marked or "SpO_2" (depending on geography), and for maternal non-invasive blood pressure, connect the cuff to the socket marked or "NBP" (depending on geography).



For the FM40 and FM50, you can connect an Avalon CTS Cordless Fetal Transducer System interface cable (M2732-60001, black connector) to one of the two dedicated black sockets marked "Tele" at the rear of the monitor, as an alternative to using one of the fetal sensor sockets at the front.



1 M2732-60001 interface cable to Avalon CTS Cordless Fetal Transducer System.
2 Connect the black connector to one of the two black sockets (marked "Tele") on the rear of the monitor.

When you connect a transducer or sensor:

- The appropriate measurement is shown on the display. For fetal measurements using an Avalon CTS system, the  symbol appears additionally next to the measurement label, indicating that the measurement is being made by a cordless transducer.



1 Measurement label
2 Cordless measurement symbol

- Fetal heart rate measurements are labeled in the order in which you plug in the transducers for those measurements. It does not matter which fetal sensor socket you use, as the monitor allocates a channel automatically. For instance, when monitoring triplets, the first transducer you connect is automatically allocated a channel, and the measurement is labeled **FHR1**, the second **FHR2**, and the third **FHR3**. See also chapters "Monitoring Twin FHRs" on page 113 and "Monitoring Triple FHRs" on page 121.
- When you touch a measurement numeric on the screen, the setup menu for that measurement opens. The fetal sensor socket to which the transducer for this measurement is connected is identified by the transducer position indicator in the blue setup menu header:

  for FM20/30;

  for FM40/50.

- The blue Finder LED on a wired fetal transducer illuminates when you touch the measurement on the screen, allowing you to identify the corresponding transducer.



1 Finder LED

- The recorder prints an annotation showing the date, time, paper speed, and monitoring mode. It repeats this every 10 minutes.

Checking/Setting Paper Scale

You can check the paper **Scale Type** (**US** for USA, or **Internat'l** for other geographies) in the **Fetal Recorder** menu. In Monitoring Mode, you can see these settings (grayed out), but you cannot change them. They 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**.

Paper Guide: FM40/FM50

FM40/50 The recorder in the FM40 and FM50 features a transparent paper guide which:

- facilitates correct alignment of the paper, both during loading and while the recorder is running. See "Loading Paper: FM40/FM50" on page 45.
- incorporates a tear-off edge, which not only allows you to tear off the trace paper where you like (not necessarily at a fold), but also helps to avoid paper misalignment while doing so (see "Tearing Off the Paper: FM40/FM50" on page 48).
- is removable (see "Removing the Paper Guide: FM40/FM50" on page 42).

Removing the Paper Guide: FM40/FM50

FM40/50 The paper guide is removable, and you can use the recorder without it. When **not** using the paper guide, ALWAYS tear off the paper along the perforation to avoid possible paper misalignment (see "Tearing Off the Paper: FM40/FM50" on page 48).

To remove the paper guide:

1 Press the paper eject button to open the paper drawer.



2 Hinge the transparent paper guide forward.



A - Protrusion holds paper guide in closed position

3 Release the paper guide from one side of the holder...



4 ....then remove the paper guide.





Refitting is a reversal of the removal procedure.

Loading Paper: FM20/FM30

CAUTION

Using recorder paper that is not approved by Philips can result in accelerated paper fading and can damage the thermal line printhead. This type of damage is not covered by warranty.

FM20/30 To load a pack of paper:

1 If the recorder is on, press the recorder **Start/ Stop** SmartKey  or the **Stop Recordng** SmartKey to turn it off before loading a new pack of paper.

2 Press the paper table release to unlock the paper drawer and then pull the table forward to open it fully.





3 Lift out any remaining paper from the tray.

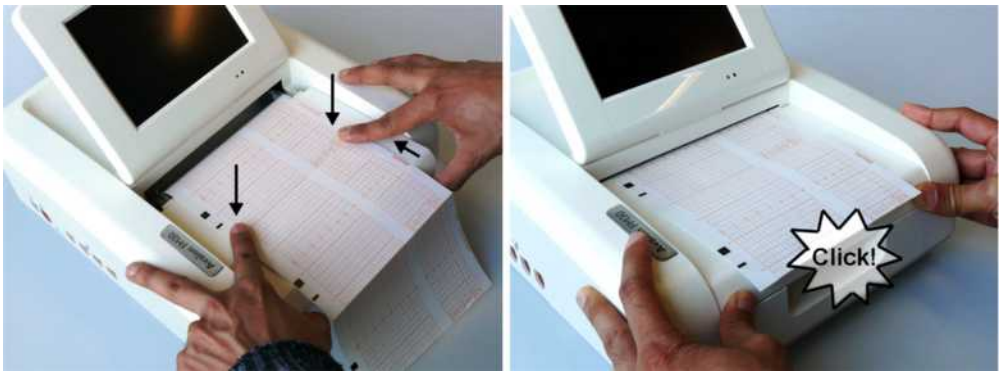
4 Prepare to place the new pack of paper in the tray with the bottom side down. The bottom side is indicated by the word STOP printed on the final page of the new pack.

5 Unfold the top page of the pack and position the uterine activity scale on the right.

6 Slide the pack into the tray.



7 Push the paper drawer back until it "clicks" closed.



8 Press the recorder **Start/ Stop** SmartKey  or the **Start Recordng** SmartKey to switch on the recorder.

9 Annotations of trace information are printed on the trace paper (see "Switching the Recorder On and Off" on page 49 for details).

Loading Paper: FM40/FM50

CAUTION

Using recorder paper that is not approved by Philips can result in accelerated paper fading and can damage the thermal line printhead. This type of damage is not covered by warranty.

FM40/50 To load a pack of paper:

1 If the recorder is on, press the recorder **Start/ Stop** SmartKey  or the **Stop Recordng** SmartKey to turn it off before loading a new pack of paper.

2 Press the paper eject button to open the paper drawer.



3 Lift out any remaining paper from the tray. Press and hold the paper eject button to partially eject the paper, thus making it easier to remove.

4 Hinge the transparent paper guide forward. It is held in the closed position by a small protrusion on each side of the holder.



A - Protrusion holds paper guide in closed position

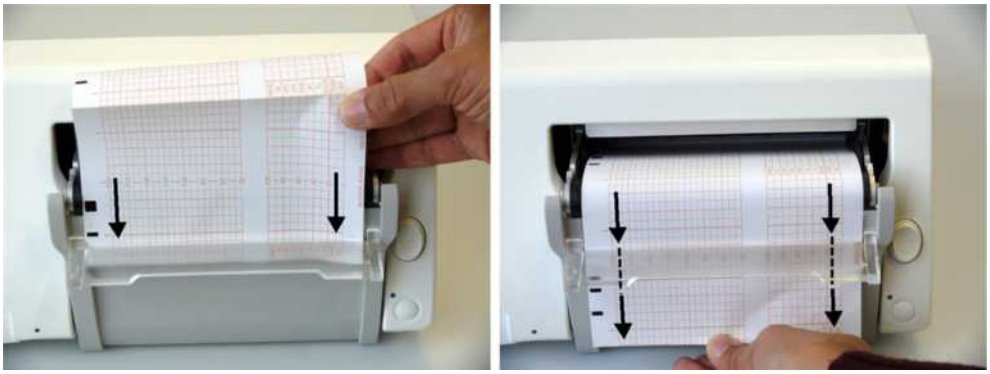
5 Prepare to place the new pack of paper in the tray with the bottom side down. The bottom side is indicated by the word STOP printed on the final page of the new pack.

6 Unfold the top page of the pack and position the uterine activity scale on the right.

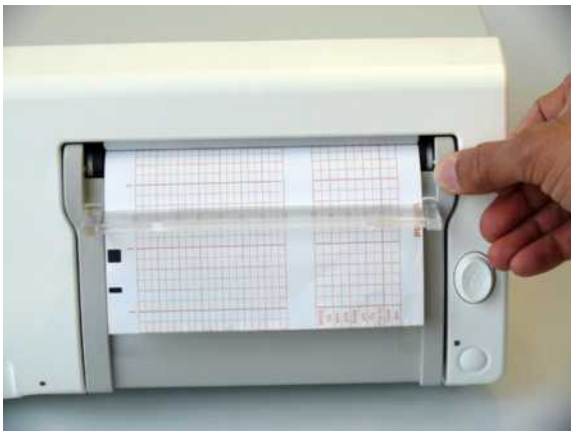
7 Slide the pack into the tray.



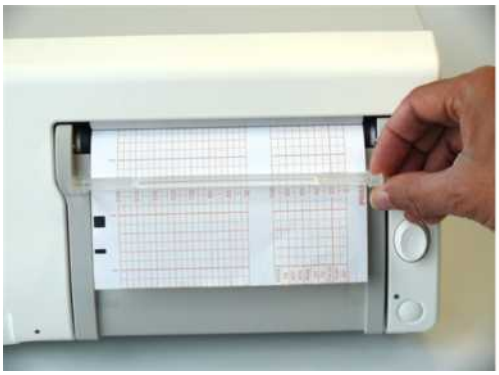
8 Feed the paper evenly through the paper guide. Do not close the paper guide yet.

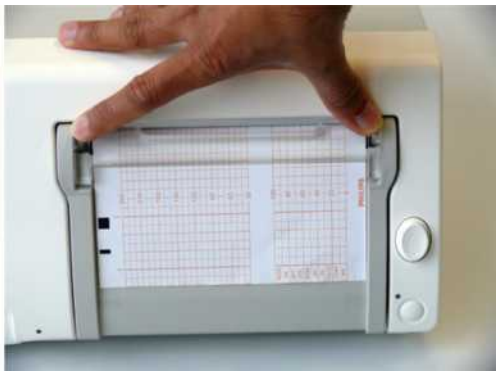


9 Close the paper drawer.



10 Now close the paper guide.





11 Press the recorder **Start/ Stop** SmartKey  or the **Start Recordng** SmartKey to switch on the recorder.

12 Annotations of trace information are printed on the trace paper (see "Switching the Recorder On and Off" on page 49 for details).

Paper-Out Indication

Each pack of paper has 150 pages. The monitor issues a paper-out warning in the status line at the bottom of the screen, when there are five pages to go. If you switch on the recorder or press the paper advance key when there are fewer than five pages remaining, it may take two pages before the alert is activated. Load a new pack in time.

If the recorder runs out of paper, an audible paper-out alert is sounded, if so configured.

Fetal traces continue to be recorded into the monitor's backup memory, and can be retrieved and printed completely if new paper is loaded within one hour, when the **Bridge Paperout** setting is enabled in Configuration Mode. See "Recovering Traces on Paper" on page 167 for further information.

Choosing Paper Speed

You can choose a paper speed of 1, 2, or 3 centimeters per minute (cm/min). The default setting is 3 cm/min.

The ACOG technical bulletin on FHR monitoring states that "*accurate pattern recognition is difficult if not impossible at 1 cm/min and that 1 cm/min is only recommended for more economic screening. When FHR abnormalities arise, the faster paper speeds will enhance FHR pattern recognition*".

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

To set the paper speed (in Configuration Mode):

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

2 Select **Fetal Recorder**.

3 In the **Fetal Recorder** menu, you can see the current speed setting. Select **Recorder Speed** (only visible in monitoring mode).

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

Tearing Off the Paper: FM20/FM30

CAUTION

NEVER pull on the paper to advance it, as this can cause misalignment of the paper. ALWAYS tear off the paper along the perforation.

To tear off the trace paper after monitoring:

1 If the recorder is running (the "recorder on" status indicator  is displayed), turn off the recorder by selecting the fetal recorder **Start/ Stop** SmartKey  or the **Stop Recordng** SmartKey.

2 Select the **Paper Advance** SmartKey . This advances the paper automatically to the next perforation.

3 When the paper stops advancing, tear off the trace paper along the perforation.

Tearing Off the Paper: FM40/FM50

CAUTION

NEVER pull on the paper to advance it, as this can cause misalignment of the paper.

The recorder's paper guide incorporates a tear-off edge, allowing you to tear off the trace paper cleanly where you like (not necessarily at a fold). When **not** using the paper guide, ALWAYS tear off the paper along the perforation.

Using the Paper Guide

To tear off the trace paper after monitoring **using the paper guide**:

1 If the recorder is running (the "recorder on" status indicator  is displayed), turn off the recorder by selecting the fetal recorder **Start/ Stop** SmartKey  or the **Stop Recordng** SmartKey.

2 Tear off the paper as shown in the pictures. To ensure a clean tear, always tear in an upwards motion, as indicated by the arrows. You can start tearing from the left or right (right-handed user shown).



If you wish to tear off the paper at a fold, select the **Paper Advance** SmartKey  , wait for the paper to stop, then tear off.

Without the Paper Guide

To tear off the trace paper after monitoring **without** using the paper guide:

1 If the recorder is running (the "recorder on" status indicator  is displayed), turn off the recorder by selecting the fetal recorder **Start/ Stop** SmartKey  or the **Stop Recordng** SmartKey.

2 Select the **Paper Advance** SmartKey  . This advances the paper automatically to the next perforation.

3 When the paper stops advancing, tear off the trace paper along the perforation.

Switching the Recorder On and Off

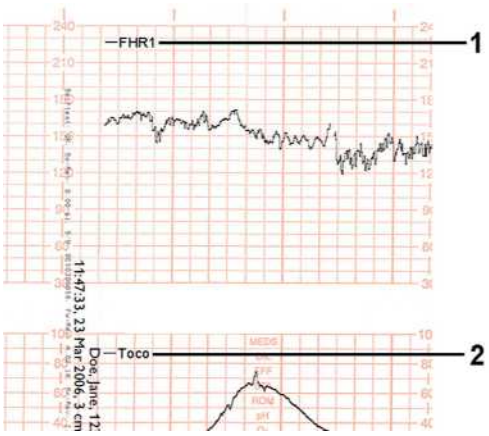
Note that in addition to the normal recording of real-time traces, you will sometimes see a trace recovery printout from the monitor's internal backup memory at high speed when the recorder is started. For details, see “Recovering Traces on Paper” on page 167.

For an explanation of the various symbols that can appear on the trace recording, see “Recorder Specifications” on page 201.

To switch the recorder on, select **Start/Stop** from the **Fetal Recorder** menu, or press one of the SmartKeys: fetal recorder **Start/ Stop**  or **Start Recordng**  .

When you switch on:

- The "recorder on" status indicator  is displayed in the bottom right-hand corner of the screen.
- The paper advances quickly for 2 cm and then returns to the set speed.
- Whenever the recorder is switched on, a trace header is printed vertically on the trace paper, containing the following:
  - **Selftest: OK**: confirmation that the monitor's self-test completed successfully, and that it is ready to use.
  - the software revision and firmware revision
  - the serial number
  - the time
  - the date
  - patient name and medical record number (if entered)
  - the paper speed

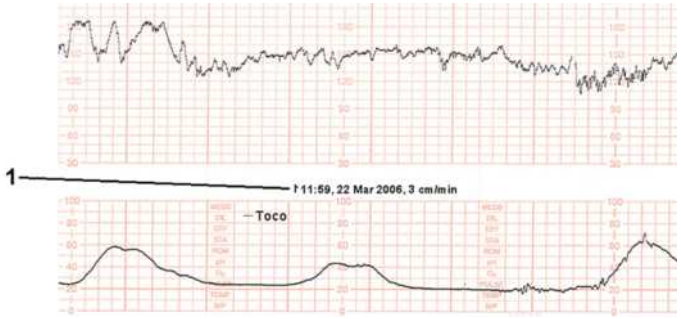


1 Fetal heart rate label
2 Uterine activity label

- The current monitoring modes (if any transducers are connected to the monitor) are printed.
- Whenever a transducer's mode is changed the following are printed:
  - the time
  - the date
  - trace identification symbols
  - the paper speed

The monitor prints the time, date, paper speed and monitoring modes in the trace header when first switched on, in a periodic time stamp every ten minutes after, and if the monitoring modes change.

The time stamp begins with the symbol.



1 Time stamp printed every ten minutes

Maternal parameters are also annotated on the trace. In the case of noninvasive blood pressure, the annotation is made at the end of the measurement. If the noninvasive blood pressure measurement repetition time is short, the noninvasive blood pressure numeric may not always be printed.

The recording of notes (see "Entering Notes" on page 52) or time/date information may be interrupted by connecting or unplugging a transducer or by a change in measurement-related setting (for example, artifact suppression, Toco sensitivity, or alarm settings).

A new patient admission or a change to the paper scale setting stops all annotations, and prompts a new vertical trace header to be printed.

To switch the recorder off:

- *Either* select **Start/Stop** from the **Fetal Recorder** menu.
- *Or* press one of the SmartKeys (depending on configuration): fetal recorder **Start/ Stop**  or **Stop Recordng**  .

If your recorder is configured with **Confirmed Stop** On (a Configuration Mode setting), you will need to confirm that you want to stop the recorder, before it will stop.

When the recorder is off, the "recorder off" status indicator is displayed in the bottom right-hand corner of the screen:  when Paper Save Mode is off, and  when Paper Save Mode is on.

Advancing the Paper

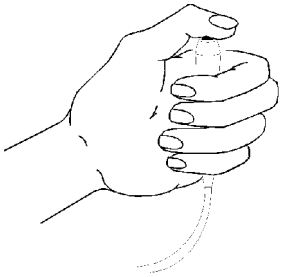
You can advance the paper automatically to the next fold by pressing the **Paper Advance** SmartKey  at any time except during a stored data recording. This is also possible using the **Fetal Recorder** menu.

Marking an Event

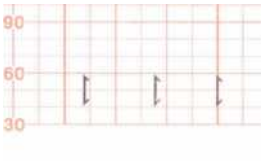
You can record significant events on the trace paper (for example, when pain medication is administered or when the mother changes position). The mother can use the remote event marker to mark events herself. You connect the remote event marker to any free fetal sensor socket.

To mark an event on the trace paper you can:

- Either select the **Set Marker** SmartKey  .
- Or press the button on the remote event marker. The remote event marker is connected to the monitor via any fetal transducer socket.



A small arrow is printed on the heart rate scale on the trace paper. This reflects exactly when the marker button was first pressed; keeping the button pressed has no influence on the annotation.



Entering Notes

Your monitor has a set of 15 factory pre-configured notes (see below). The maximum length of one single note is 30 characters. It is possible to edit the notes in Configuration Mode (please refer to the *Service Guide*).

To enter a note:

- Press the **Enter Notes** SmartKey  to open the **Enter Note** menu.
- Scroll if necessary, then select the note you wish to enter. A confirmation dialog box opens:

To store and record the note select Confirm. Select Cancel to reject the current note.	Confirm	Cancel

- Select **Confirm** to enter the note. The note is then shown in the status line of the display, and is annotated on the fetal trace if the fetal recorder is on.

By default, notes are printed lengthwise in the direction of the trace, in the space between the FHR grid and the uterine activity grid. If you prefer, you can configure the recorder to print across the trace. You can change this in Configuration Mode by changing the **Notes Recording** setting in the **Fetal Recorder** menu from **Along** (default) to **Across** (notes print widthwise across the trace).

The following are the pre-configured notes from which to choose:

1 **Patient Repositioned**

2 **Vaginal Examination**

3 MD Notified
4 Sitting
5 On Back
6 Left Lateral
7 Ambulating
8 Tocolytic Given
9 Membranes Ruptured
10 Amniotomy
11 Amniotic Fluid Clear
12 Amniotic Fluid Not Clear
13 Oxytocin
14 Urinary Catheter
15 Micro Blood Analysis

Up to two notes can be printed directly, and the monitor can temporarily store up to a further two notes, and these are printed after the first two have been recorded. Any further notes are discarded. For example, if you enter six notes in quick succession, the first two notes you entered are recorded right away, the next two are stored in memory and then printed when the first two have been recorded, and the last two are discarded.

If the printing of two notes happens to coincide with the regular recording of the time stamp that takes place once every ten minutes, the time stamp is delayed until the notes have finished printing.

Signal Quality

During monitoring, if the fetal heart rate signal quality fluctuates, and becomes poor, it does not necessarily mean that the transducer needs repositioning. The fluctuation may be caused by fetal movement. Allow time for the signal to stabilize before deciding whether to reposition the transducer (ultrasound) or apply a new electrode (ECG). For the best trace quality, the signal quality indicator should be full, indicating good signal quality, even though it may be possible to make traces at a lower signal quality level.

Starting Monitoring

Confirm fetal life before you begin fetal monitoring.

After you switch on the monitor:

1 Check that you have the correct patient cables and transducers plugged in for the measurement you want to monitor.

2 Admit your patient to the monitor (see “Admitting a Patient” on page 83).

3 Check that the alarm limits, alarm and fetal heart rate volumes, patient category and so forth are appropriate for your patient. Change them if necessary.

4 Refer to the appropriate measurement section for details of how to perform the measurements you require.

Switching the Monitor to Standby

To switch the monitor to Standby:

Either

Select the **Monitor Standby** SmartKey  .

Or

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

2 Select **Monitor Standby**.

Pressing any key or selecting any field on the screen will resume monitoring.

After Monitoring

1 Discharge the patient.

2 Remove the transducer from the patient and, using a soft tissue, remove any gel from it. Then clean the transducer.

3 Tear off the paper at the fold. To avoid misalignment of the recorder mechanism, NEVER pull on the paper to advance it, or try to tear it other than at a fold (unless using the paper guide with the FM40/FM50).

4 Switch off the monitor.

Disconnecting from Power

FM20/30 To disconnect the monitor from AC power, switch the monitor off using the On/Off switch located on the right side of the device, or unplug the power cord from the AC mains socket.

FM20/30 (with Battery Option) To disconnect from Battery power, switch the monitor off using the On/Standby switch located on the right side of the device.

FM40/50 and FM20/30 with Battery Option The On/Standby switch does not disconnect the monitor from the AC power source. To disconnect, unplug the power cord from the AC mains socket. Note that if the power cord is unplugged from the AC mains socket before the monitor is put into Standby, a beeper is activated. The beeper warns you if the monitor is accidentally disconnected from AC mains.

Troubleshooting

Problem	Possible Causes	Solutions
Light or no trace.	Wrong paper.	Use recommended paper.
	Dirty printhead.	Clean printhead. See “Cleaning the Printhead” on page 177.
	FM20/30 only: Paper misaligned due to drawer not being correctly shut.	Shut the drawer fully, pushing evenly with both hands.
End of paper noted when pack not finished.	Bad paper feed or wrong paper.	Check paper feed and use recommended paper.
CHECK PAPER INOP is displayed.		See “Patient Alarms and INOPs” on page 73.
FetRec EQUIP MALF INOP is displayed.		
PAPER END INOP is displayed.		
WRONG PAPER SCALE INOP is displayed.		

4

Using Batteries (with FM20/30 Battery Option)

You can switch between battery-powered and mains-powered (AC) operation without interrupting monitoring.

The monitor is connected to the AC mains power via the external power supply.

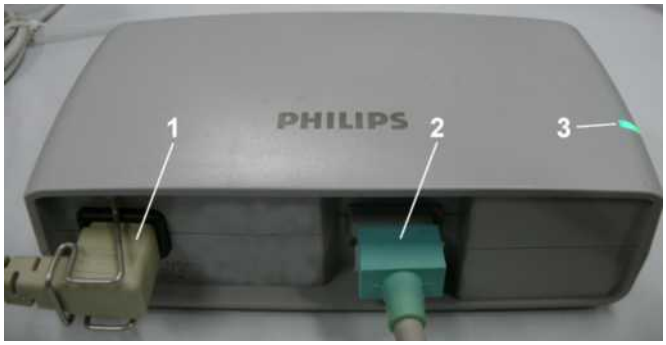


NOTE

The Battery Option is not available for the FM40/FM50.

External Power Supply M8023A

The external power supply M8023A (option #E25) allows you to operate the fetal monitor from an AC (alternating current) power source of 100 V to 240 V (± 10%) and 50/60 Hz (± 5%). If this option is used, then the M8023A (option #E25) power supply is included for FM20/30.



1. AC power cord. Connect to AC mains socket.
2. Measurement Link (MSL) cable. Supplies power to the monitor for operation and for battery charging.
3. Power-on LED. The green light is on when the external power supply is connected to AC mains.

WARNING

- Always use the supplied power cord with the earthed mains plug to connect the external power supply M8023A (option #E25) 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. If a multiple portable socket-outlet without an approved isolation transformer is used, the interruption of its protective earthing may result in enclosure leakage currents equal to the sum of the individual earth leakage currents, so exceeding allowable limits.
- Do not connect any devices that are not supported as part of a system.
- Any non-medical device placed and operated in the patient's vicinity must be powered via an approved isolation transformer that ensures mechanical fixing of the power cords and covering of any unused power outlets.

Battery Power Indicators

The battery LED and battery status information on the Main Screen, in combination with INOP messages and prompts, help you keep track of the battery power status. The indicators always show the remaining capacity in relation to the battery's actual maximum capacity, which may lessen as the battery ages. You can see the actual capacity in the **Battery Status** window.

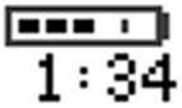
Battery LED

The battery LED on the right side of the monitor is indicated below.



Battery LED Colors	If the monitor is connected to mains power, this means	If the monitor is running on battery power, this means
Green	battery power is > 90%	
Yellow	battery charging (battery power < 90%)	
Red, flashing		less than 10 minutes power remaining
Red, flashes intermittently	battery or charger malfunction	battery malfunction

Battery Status on the Main Screen



Battery status information is permanently displayed on all screens. It shows the status of the battery, with the battery power remaining, with an estimate of the monitoring time this represents.

Battery power gauge: This shows the remaining battery power. It is divided into sections, each representing 20% of the total power. If three sections are filled, as in this example, this indicates that 60% battery power remains. If no data is available from the battery, a question mark is shown in the gauge.

Monitoring Time Available: Below the battery power gauge a time is displayed. This is the estimated monitoring time available with the current battery power. Note that this time fluctuates depending on the system load (the display brightness, the recorder configuration, and how many measurements you carry out).

Battery malfunction symbols: Normal battery function is indicated by the battery power gauge, together with the remaining operating time, on the Main Screen. You are informed of problems or changes in the status of the battery by the battery status/malfunction indicator. This consists of a blank battery gauge containing a **"!"** symbol. If the symbol is red, this indicates a critical situation. You can check the specific cause of the problem by looking at the symbol(s) displayed in the **Battery Status** window.

Battery Status Indicator		Battery Malfunction Indicator	
	Alternates with the battery gauge on the Main Screen. Check in the **Battery Status** window to see which status symbol is displayed to identify the cause.		The red ! flashes. Critical battery situation or malfunction. Check in the **Battery Status**window to see which malfunction indicator is displayed, or refer to the INOP, to identify the cause.

Checking Battery Charge

To check the charge status of a battery, refer to the battery power gauge on the screen or open the **Battery Status** window.

When Battery Lifetime is Expired

When the Lithium Ion battery is aged, either after 3 years from manufacturing date or after 500 charge/discharge cycles, it is recommended to replace the battery. To remind you of this a **Battery has aged, replacement is strongly recommended** message will appear in the **Battery Status** window. This message will only be displayed at the correct time when the date and time on the monitor is correct. Contact your service personnel.

Battery Status Window

- To access the **Battery Status** window and its associated pop-up keys, select the battery status information on the Screen, or select **Main Setup** -> **Battery**.

Capacity, **remaining** tells you how much power is left in the battery.

Capacity, **fullCharge** tells you how much power the battery can hold when fully charged.

TimeToEmpty tells you approximately how long you can continue to use the monitor without an AC connection. Note that this time fluctuates depending on the system load (the display brightness and how many measurements you carry out), and the remaining capacity of the battery.

TimeToFull is shown in place of **TimeToEmpty** if the monitor is connected to a power supply, and tells you how much time is left until the battery is charged to 90%. If >10 hrs is shown here, the battery may not charge completely when the monitor is in use.

Battery status/malfunction symbols: If a problem is detected with the battery, an INOP may be issued, and the following symbols are displayed in the **Battery Status** window, where they may be accompanied by a status message providing more details.

Symbols indicating critical situations are colored red.

Battery status symbols		Battery malfunction symbols	
	battery is empty		(red) incompatible battery
	battery not charging as the temperature is above or below the specified range		(red) battery malfunction
	battery requires maintenance		(red) battery has no power left
	charging stopped to protect the battery		(red) battery temperature too high
			(red) battery is missing, insert battery

Optimizing Battery Performance

The performance of rechargeable batteries may deteriorate over time. Battery maintenance as recommended here can help to slow down this process.

Display Brightness Setting

In the **Main Setup** menu, select **User Interface**, **Brightness**, then **Optimum**. This selects a level of brightness suitable for most monitoring locations that uses less battery power than brighter settings.

Ensure that the current level of brightness is suitable for your monitoring location.

Charging the Battery

To charge the battery,

1 Connect the monitor to the external power supply (M8023A).

2 Charge the battery until it is full, the battery LED is green, and the battery power gauge is filled.

In certain situations, where many measurements are in use (plus the recorder), the load on the monitor may be so high that the battery will not charge. In this case you must reduce the load by removing measurements, reducing the screen brightness or stopping the recorder. Internal temperature conditions could also cause the battery to not charge. This is necessary to protect the battery from damage and does not indicate a malfunction. Keep the monitor at room temperature and move it away from heat sources or out of direct sunlight. The battery will resume charging when the temperature is within range again. Note that the battery will charge more quickly when the monitor is switched off.

Storing the Battery

The battery should not remain inside the monitor if it is not used for a longer period of time. Batteries should be charged to a maximum of 50% for storage. For battery removal or exchange, contact your service personnel.

NOTE

The battery will discharge over time in a monitor that is not connected to AC via the external power supply (M8023A). The reported values for "remaining capacity" and "runtime" will become less accurate when the battery is stored in this way for a longer period of time (that is, several weeks).

Conditioning the Battery

You must condition the battery when the "battery requires maintenance" symbol shows on the Screen. Do not interrupt the charge or discharge cycle during conditioning.

CAUTION

Do not use a monitor currently being used in order to condition batteries. The monitor switches off automatically when there is no battery power left.

To condition the battery,

1 Charge the battery until it is completely full. Open the **Battery Status** window and check that the **Batt Fully Charged** message is displayed.

2 Disconnect the monitor from mains power, and let the monitor run until there is no battery power left and the monitor switches itself off.

3 Reconnect the monitor to mains power and charge the battery until it is full for use or charge to 50% for storage.

Battery Safety Information

WARNING

Use only Philips batteries part number M4605A. Use of a different battery may present a risk of fire or explosion.

Do not open batteries, or dispose of them in fire, or cause them to short circuit. They may ignite, explode, leak or heat up, causing personal injury.

If battery leakage should occur, avoid contact with skin. Refer to qualified service personnel.

Dispose of used batteries promptly and in an environmentally-responsible manner. Do not dispose of the battery in normal waste containers. Consult your hospital administrator to find out about local arrangements.

CAUTION

Do not disassemble, heat above 100°C (212°F) or incinerate the batteries, to avoid the risk of fire and burns. Keep batteries out of the reach of children and in their original package until you are ready to use them.

If battery leakage should occur, use caution in removing the battery. Avoid contact with skin. Refer to qualified service personnel.

5

Alarms

The alarm information here applies to all measurements. Measurement-specific alarm information is contained in the sections on individual measurements.

The fetal monitor has three alarm levels: red, yellow, and INOP.

Red and yellow alarms are patient alarms. A red alarm indicates high priority, such as a potentially life threatening situation (for example, SpO_2 below the desaturation alarm limit). A yellow alarm indicates a lower priority alarm (for example, a fetal heart rate alarm limit violation).

INOPs are technical alarms. They indicate that the monitor cannot measure and therefore not detect critical conditions reliably. If an INOP interrupts monitoring and alarm detection (for example, **MECG LEADS OFF**), the monitor places a question mark in place of the measurement numeric and sounds an audible tone. INOPs without this tone indicate that there may be a problem with the reliability of the data, but that monitoring is not interrupted.

Alarms are indicated after the specified alarm delay time. This is made up of the system delay time plus the trigger delay time for the individual measurement. See the Specifications section for details.

If more than one alarm is active, the alarm messages are shown in the alarm status area in succession. An arrow symbol next to the alarm message informs you that more than one message is active.

The monitor sounds an audible indicator for the highest priority alarm. If more than one alarm condition is active in the same measurement, the monitor announces the most severe.

WARNING

Alarm systems of the monitor and those of the connected OB system are independent and not synchronized.

Alarm Mode

You can configure the alarm mode for your fetal monitor. There are two possible modes:

- **All**: 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 is the default alarm mode.

WARNING

In **INOP Only** mode, no fetal/maternal patient alarms are enabled or indicated.

The alarm status area for yellow and red alarms shows the **INOP only** indication in conjunction with the "Alarms Off" symbol. No alarm limits or alarm off icons are displayed. No fetal/maternal patient alarm settings are available in the setup menus.

Visual Alarm Indicators

Alarm message: An alarm message appears in the alarm status area on the second line at the top of the screen indicating the source of the alarm. If more than one measurement is in an alarm condition, the message changes every two seconds, and has an arrow at the side. The background color of the alarm message matches the alarm priority: red for red alarms, yellow for yellow alarms, and light blue for INOPs. The asterisk symbols (*) beside the alarm message match the alarm priority: *** for red alarms, ** for yellow alarms. INOPs are displayed without asterisks.

Depending on how your monitor is configured, it may display alarm limit violation messages:

- in text form, for example **** FHR1 LOW** or
- in numeric form, for example **FHR1 94<110**, where the second number shows the currently set alarm limit, and the first number shows the value at which that alarm limit was violated by the widest margin.

Flashing numeric: The numeric of the measurement in alarm flashes.

Bright alarm limits: If the alarm was triggered by an alarm limit violation, the corresponding alarm limit on the monitor screen is shown more brightly.

Audible Alarm Indicators

The audible alarm indicators configured for your fetal monitor depend on which alarm standard applies in your hospital. Audible alarm indicator patterns are repeated until you acknowledge the alarm by switching it off or pausing it, or until the alarm condition ceases (if audible alarm indication is set to non-latching).

WARNING

Do not rely exclusively on the audible alarm system for fetal monitoring. Adjustment of alarm volume to a low level or off during monitoring may result in a dangerous situation. Remember that the most reliable method of fetal monitoring combines close personal surveillance with correct operation of monitoring equipment.

Alarm Tone Configuration

The audible alarm indicators of your monitor are configurable. In the monitor's Configuration Mode, you can change the alarm sound to suit the different alarm standards valid in different countries.

Standard Philips Alarms

- Red alarms: A high pitched sound is repeated once a second.

- Yellow alarms: A lower pitched sound is repeated every two seconds.
- INOPs: an INOP tone is repeated every two seconds.

ISO/IEC Standard 9703-2 Audible Alarms

- Red alarms: A high pitched tone is repeated five times, followed by a pause.
- Yellow alarms: A lower pitched tone is repeated three times, followed by a pause.
- INOPs: a lower pitched tone is repeated twice, followed by a pause.

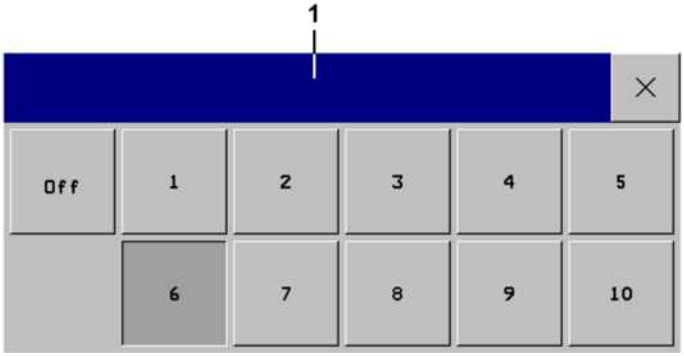
Changing the Alarm Tone Volume

The alarm volume symbol at the top right of the monitor screen gives you an indication of the current volume. To change the volume:

1 Select the volume symbol . The volume scale pops up.

2 Select the required volume from the volume scale.

1 Alarm Volume





When the alarm volume is set to zero (**Off**), the alarm volume symbol shows this. If you switch the alarm volume off, you will not get any audible indication of alarm conditions.

Power Loss Tone

FM40/50 and FM20/30 with Battery Option

When power is lost - no power is available from the AC power source or from the battery - before the monitor is put into Standby, a beeper will sound. The tone can be silenced by pressing the On/Standby switch.

Acknowledging Alarms

To acknowledge all active alarms and INOPs, select the **Silence** key 

. This switches off the audible alarm indicators.

A check mark beside the alarm message indicates that the alarm has been acknowledged.

If the condition that triggered the alarm is still present after the alarm has been acknowledged, the alarm message stays on the screen with a check mark symbol beside it.

If the alarm condition is no longer present, all alarm indicators stop and the alarm is reset.

Switching off the alarms for the measurement in alarm, or switching off the measurement itself, also stops alarm indication.

Acknowledging Disconnect INOPs

Acknowledging an INOP that results from a disconnected transducer switches off the associated measurement.

Pausing or Switching Off Alarms

If you want to temporarily prevent alarms from sounding, for example while you are moving a patient, you can pause alarms. Depending on your fetal monitor configuration, alarms are paused for one, two, or three minutes, or infinitely.

To view the alarm pause setting chosen for your unit:

1 Select **Main Setup** -> **Alarms** -> **Alarm Settings.**

2 Check the **Alarms Off** setting.

This setting can be changed in Configuration Mode.

To Pause All Alarms

If you have configured alarms to be paused for one, two or three minutes, the SmartKey is labeled **Pause Alarms**.



Select the **Pause Alarms** SmartKey to pause all alarms.

Or

1 Select **Main Setup**.

2 Select**Alarms**.

3 Select **Pause Alarms**.

To Switch All Alarms Off

You can switch alarms off permanently if your monitor is configured to allow infinite alarms pause and the SmartKey is labeled **Alarms Off**.



Select the **Alarms Off** SmartKey.

Or

1 Select **Main Setup**.

2 Select **Alarms**.

3 Select **Alarms Off**.

To Switch Individual Measurement Alarms On or Off



This applies to alarm mode **All**.

1 Select the measurement numeric to enter its setup menu.

2 Select **Alarms** to toggle between **On** and **Off**.

The alarms off symbol is shown beside the measurement numeric.

While Alarms are Paused or Off

- In the alarm field, the monitor displays the message **Alarms Paused** or **Alarms Off**, together with the alarms paused symbol  and the remaining pause time in minutes and seconds, or alarms off symbol  .
- No alarms are sounded and no alarm messages are shown.
- INOP messages are shown but no INOP tones are sounded.

The following INOPs are the only exceptions:

NBP CUFF OVERPRESS, **Batt EMPTY** and **Batt MALFUNCTION** (these INOPs are issued even if alarms are paused or off).

If a disconnect INOP is present and alarms are paused or switched off, the measurement in question is switched off.

Restarting Paused Alarms

To manually switch on alarm indication again after a pause, select the SmartKey **Pause Alarms** (or **Alarms Off**) again.

Alarm indication starts again automatically after the pause period expires. If the monitor is configured to stay paused infinitely, you must select **Alarms Off** again to restart alarm indication.

Alarm Limits

The alarm limits you set determine the conditions that trigger yellow and red limit alarms.

WARNING

Be aware that the monitors in your care area may each have different alarm settings, to suit different scenarios. Always check that the alarm settings are appropriate before you start monitoring.

Viewing Individual Alarm Limits (Alarm Mode "All" Only)



1 Alarm Limits
2 Audio source symbol

You can usually see the alarm limits set for each measurement next to the measurement numeric on the main screen.

If your monitor is not configured to show the alarm limits next to the numeric, you can see them in the appropriate measurement setup menu. Select the measurement numeric to enter the menu and check the limits.

Changing Alarm Limits

To change individual measurement alarm limits using the measurement's Setup Menu:

1 In the measurement's Setup Menu, select the alarm limit you want to change. This calls up a list of available values for the alarm limit.

2 Select a value from the list to adjust the alarm limit.

Reviewing Alarms

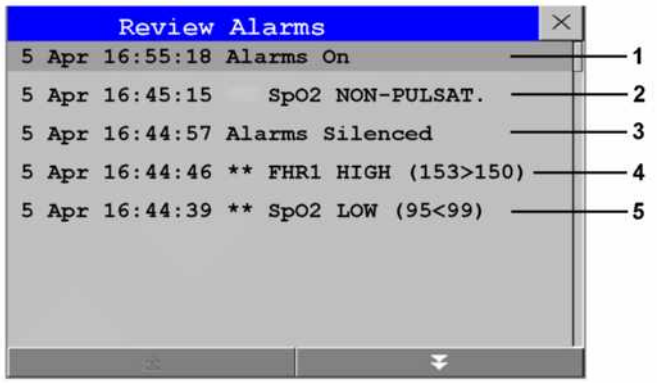
To review the currently active alarms and INOPs, select any of the alarm status areas on the fetal monitor screen. The **Alarm Messages** window pops up . All alarms and INOPs are erased from the monitor's alarm history when you discharge a patient, or if you enter Demonstration Mode.

Alarm Messages Window

The **Alarm Messages** window shows all the currently active alarms and INOPs in chronological order, beginning at the top with the most recent. INOPs are shown on the left hand side and alarms are shown on the right hand side. Any active red alarms are shown first, followed by yellow alarms. Acknowledged alarms or INOPs are shown with the check mark symbol.

The **Alarm Messages** window pop-up keys appear when the window is opened. Selecting the **Review Alarms** pop-up key opens the **Review Alarms** window.

Review Alarms Window



1 Alarms On
2 SpO_2 NON-PULSAT.
3 Alarms Silenced
4 ** FHR1 HIGH
5 ** SpO_2 LOW

The **Review Alarms** window contains a list of up to 300 of the most recent alarms and INOPs with date and time information. If configured to do so, each alarm is shown with the alarm limit active when the alarm was triggered and the maximum value measured beyond this limit. The **Review Alarms** window also shows any changes made to the Alarms On/Off or Silence status. Note that only main alarms On/Off transitions are logged in the alarm history, and On/Off alarm transitions for individual measurements are not logged.

The information in the **Review Alarms** window is deleted when a patient is discharged.

The **Review Alarms** window pop-up keys appear when the window is opened. Selecting the **Active Alarms** pop-up key opens the **Alarm Messages** window.

Latching Alarms

The alarm latching setting for your monitor defines how the alarm indicators behave when you do not acknowledge them. When alarms are set to non-latching, their indicators end when the alarm condition ends. Switching alarm latching on means that visual and/or audible alarm indications are still displayed or announced by the monitor after the alarm condition ends. The indication lasts until you acknowledge the alarm.

Viewing the Alarm Latching Settings

To see the alarm latching setting for your monitor:

1 In the monitor's **Main Setup** menu, select **Alarms**.

2 Select **Alarm Settings**, and see the **Visual Latching** and **Audible Latching** settings.

This setting can be changed in Configuration Mode. You should be aware of the settings chosen for your unit. There are three possible choices each for visual and audible latching: Red, Red and Yellow, and Off. The audible latching configuration can never be configured to a higher level than that configured for the visual latching. In other words, the audible latching setting is always the same level, or lower, than the visual latching setting. For example, if visual latching is configured to **Red Only**,

then audible latching can only be set to **Red** or **Off**. The following table shows the possible combinations for latching settings:

Possible Combinations for Alarm Latching Settings	
Visual Latching Setting	**Audible Latching Setting**
Red and Yellow	Red and Yellow
Red and Yellow	Red
Red and Yellow	Off
Red	Red
Red	Off
Off	Off

Alarm Latching Behavior

Alarm Condition		Red and Yellow Measurement Alarms		
Acknowledgment	**Presence**	**Non-latching alarms**	**Visual and audible latching**	**Visual latching, audible non-latching**
Alarm has not been acknowledged.	Alarm condition still present.	Alarm tone on. Alarm message.	Alarm tone on. Alarm message. Flashing numerics.	Alarm tone on. Alarm message. Flashing numerics.
	Alarm condition no longer present.	All audible and visual alarm indicators automatically stop.	Alarm tone on. Alarm message. Flashing numerics.	Alarm message. Flashing numerics. Audible alarm indicators automatically stop.
Alarm has been acknowledged.	Alarm condition still present.	Alarm tone off. Alarm message.	Alarm tone off. Alarm message. Flashing numerics.	Alarm tone off. Alarm message. Flashing numerics.
	Alarm condition no longer present.	Audible and visual alarm indicators automatically stop.	Audible and visual alarm indicators automatically stop.	Audible and visual alarm indicators automatically stop.

All INOPs except the "unplugged" INOPs are non-latching.

Testing Alarms

In general, to test the functioning of visible and audible alarms, do the following:

1 Enable the alarm.

2 Set the alarm limits.

3 Measure or simulate the parameter that is out of range, or signal loss.

4 Verify that the visible and audible alarms are working.

As an example, to test the FHR alarms:

1 Connect the US transducer to a fetal sensor socket.

2 Enable the FHR alerting (see "Turning Alarms On or Off" on page 127).

3 Set the high alert limit and delay to 150 bpm and 60 seconds respectively, and the low alert limit and delay to 110 bpm and 60 seconds respectively (see "Changing Alarm Limits" on page 127).

4 Generate a fetal heart rate of approximately 180 bpm (3 beats per second) for more that one minute.

5 Verify the functioning of the visible and audible alarm.

Alarm Behavior at Power On

Selecting **AlarmsOffAtStart** will cause alarms to be initially suspended or off the next time the monitor is switched on (depending on the setting for Alarms Off). The Alarms Off as Infinite behaves in the same manner as when Alarm Mode equals INOP Only.

In order for alarms to be suspended or switched off initially, the monitor must be switched off for more than one minute, the last main alarm state was set to off or suspended.

The exception to this condition is when the alarms off state has been set to Infinite, and the new active setting is set to Infinite.

5 Alarms

6

Patient Alarms and INOPs

This chapter lists alarms and technical alarms (INOPs) for the fetal monitors, alphabetically, irrespective of their priority. INOPs start "Technical Alarm Messages (INOPs)" on page 76.

Alarm Messages

Fetal alarms are identified by either "FHR" or "DFHR". All other alarms without these identifiers refer to maternal parameters.

Alarm Message	From	Condition	Indication
***** BRADY (Pulse)** *****BRADY xxx < yyy**	SpO_2	The heart rate from the Pulse signal has fallen below the bradycardia limit. xxx denotes the lowest measured value; yyy is the bradycardia limit.	Numeric flashes and alarm limit is highlighted, red alarm message, alarm tone.
***** DESAT** ***** DESAT xx < yy**	SpO_2	The SpO_2 value has fallen below the desaturation alarm limit. xx denotes the lowest measured value, and yy is the desaturation limit.	Numeric flashes, red alarm message, alarm tone.
**** DFHR1 HIGH** **** DFHR2 HIGH** **** DFHR3 HIGH** ****DFHR1 xxx>yyy** ****DFHR2 xxx>yyy** ****DFHR3 xxx>yyy**	FHR (DECG)	The fetal heart rate obtained from DECG has risen above the high alarm limit. xxx denotes the highest measured value, and yyy is the high alarm limit.	Numeric flashes and high limit is highlighted, yellow alarm message, alarm tone.
**** DFHR1 LOW** **** DFHR2 LOW** **** DFHR3 LOW** ****DFHR1 xxx<yyy** ****DFHR2 xxx<yyy** ****DFHR3 xxx<yyy**	FHR (DECG)	The fetal heart rate obtained from DECG has fallen below the low alarm limit. xxx denotes the lowest measured value, and yyy is the low alarm limit.	Numeric flashes and low limit is highlighted, yellow alarm message, alarm tone.

Alarm Message	From	Condition	Indication
*** EXTREME BRADY ***BRADY xxx < yyy	MECG	The maternal heart rate obtained from the maternal ECG has fallen below the extreme bradycardia limit. xxx denotes the lowest measured value, and yyy is the extreme bradycardia limit.	Numeric flashes, red alarm message, alarm tone.
*** EXTREME TACHY ***TACHY xxx > yy	MECG	The maternal heart rate obtained from the maternal ECG has risen above the extreme tachycardia limit. xxx denotes the highest measured value, and yy is the extreme tachycardia limit.	Numeric flashes, red alarm message, alarm tone.
** FHR1 HIGH ** FHR2 HIGH ** FHR3 HIGH **FHR1 xxx>yyy **FHR2 xxx>yyy **FHR3 xxx>yyy	FHR (ultrasound)	The fetal heart rate obtained from ultrasound has risen above the high alarm limit. xxx denotes the highest measured value, and yyy is the high alarm limit.	Numeric flashes and high limit is highlighted, yellow alarm message, alarm tone.
** FHR1 LOW ** FHR2 LOW ** FHR3 LOW **FHR1 xxx<yyy **FHR2 xxx<yyy **FHR3 xxx<yyy	FHR (ultrasound)	The fetal heart rate obtained from ultrasound has fallen below the low alarm limit. xxx denotes the lowest measured value, and yyy is the low alarm limit.	Numeric flashes and low limit is highlighted, yellow alarm message, alarm tone.
** HR HIGH **HR xxx>yyy	MECG	The maternal heart rate obtained from the maternal ECG has risen above the high alarm limit. xxx denotes the highest measured value, and yyy is the high alarm limit.	Numeric flashes and high limit is highlighted, yellow alarm message, alarm tone.
** HR LOW **HR xxx<yyy	MECG	The maternal heart rate obtained from the maternal ECG has fallen below the low alarm limit. xxx denotes the lowest measured value, and yyy is the low alarm limit.	Numeric flashes and low limit is highlighted, yellow alarm message, alarm tone.
** NBPs HIGH ** NBPd HIGH ** NBPm HIGH	Noninvasive blood pressure	The measured noninvasive blood pressure value is above the high alarm limit. **s**, **d**, or **m** after the label indicates whether the systolic, diastolic or mean pressure has crossed the limit.	Numeric flashes and high limit is highlighted, yellow alarm message, alarm tone.
** NBPs LOW ** NBPd LOW ** NBPm LOW	Noninvasive blood pressure	The measured noninvasive blood pressure value is below the low alarm limit. **s**, **d**, or **m** after the label indicates whether the systolic, diastolic or mean pressure has crossed the limit.	Numeric flashes and low limit is highlighted, yellow alarm message, alarm tone.

Alarm Message	From	Condition	Indication
** Pulse HIGH	SpO_2	The pulse rate has exceeded the high alarm limit.	Numeric flashes and high limit is highlighted, yellow alarm message, alarm tone.
** Pulse LOW	SpO_2	The pulse rate has dropped below the low alarm limit.	Numeric flashes and low limit is highlighted, yellow alarm message, alarm tone.
** SpO_2 HIGH	SpO_2	The arterial oxygen saturation has exceeded the high alarm limit.	Numeric flashes and high limit is highlighted, yellow alarm message, alarm tone.
** SpO_2 LOW	SpO_2	The arterial oxygen saturation has fallen below the low alarm limit.	Numeric flashes and low limit is highlighted, yellow alarm message, alarm tone.
*** TACHY (Pulse) ***TACHY/P xxx>yy	SpO_2	The heart rate from the Pulse signal has exceeded the tachycardia limit. xxx denotes the highest measured value, and yyy is the tachycardia limit.	Numeric flashes, alarm limit is highlighted, red alarm message, alarm tone.

Technical Alarm Messages (INOPs)

INOP Message, Indication	Source	What to do
Batt EMPTY INOP tone, battery LED flashes during this INOP, alarms cannot be paused or switched off.	Battery	The estimated remaining battery-powered operating time is less than 10 minutes. Connect the monitor to AC immediately. If the condition persists and the monitor is not connected to mains power, this INOP is re-issued two minutes after you acknowledge it.
Batt INCOMPAT. INOP tone	Battery	The battery cannot be used with this monitor. Replace with the correct battery.
Batt LOW INOP tone	Battery	The estimated battery-powered operating time remaining is less than 20 minutes.
Batt MALFUNCTION INOP tone, battery LED flashes during this INOP, alarms cannot be paused or switched off unless the monitor is connected to mains power.	Battery	The monitor cannot determine the battery status. If this INOP persists, replace the faulty battery. If the condition persists and the monitor is not connected to mains power, this INOP is reissued two minutes after you acknowledge it.
Batt MISSING	Battery	No battery found in FM20/30. Contact your service personnel.
BUS MASTER MALFUNC	Monitor	There is a problem with the monitor's hardware. Contact your service personnel.
CHARGER MALFUNC. INOP tone, battery LED may flash	Battery	There is a problem with the battery charger in the monitor. Connect the monitor to mains power and contact your service personnel.
CHECK BATT TEMP	Battery	The temperature of the battery is too high. Check that the monitor is not exposed to heat.
Check Flex Texts INOP tone	Monitor	If this INOP appears, check the monitor and patient settings before you resume monitoring. If the settings are unexpected, there may be a problem with the monitor software. Contact your service personnel.
Check Monitor Func INOP tone	Monitor	A potential internal problem with the monitor has been detected. Contact your service personnel.
Check Keyboard INOP tone	Monitor	Perform a visual and functional check of the keyboard. Contact your service personnel.
Check Mouse Device INOP tone	Monitor	Perform a visual and functional check of the mouse input device. Contact your service personnel.
CHECK PAPER INOP tone	Recorder	Check that there is no paper jam, that the print drawer is properly shut, that the paper is loaded with the grid facing upwards, and that the correct Philips paper is being used.
Check Settings INOP tone	Monitor	If this INOP appears, check the monitor and patient settings before you resume monitoring. If the settings are unexpected, there may be a problem with the monitor software. Contact your service personnel.

INOP Message, Indication	Source	What to do
CHECK TI CONFIG	Monitor	If this INOP appears, the monitor can be used normally, except for the Trace Interpretation feature. Contact your service personnel.
Check Touch Input	Monitor	Perform a visual and functional check of the touch input device. Contact your service personnel.
COINCIDENCE	Monitor	One or more fetal/maternal heart rates/pulse rates persistently coincide with each other (see "Cross-Channel Verification" on page 97).
CUFF NOT DEFLATED Numeric is replaced by a -?- INOP tone. During this INOP, alarms cannot be paused or switched off.	Noninvasive blood pressure	Remove the cuff from the patient. Make sure that the tubing is not kinked or twisted. Try restarting the measurement. You can silence the INOP, but the INOP message remains visible until the next measurement is started or the **Stop All** SmartKey is selected.
DFHR1 EQUIP MALF **DFHR2 EQUIP MALF** **DFHR3 EQUIP MALF** INOP tone	DECG	There is a problem with the DECG hardware. Contact your service personnel.
DFHR1 LEADS OFF **DFHR2 LEADS OFF** **DFHR3 LEADS OFF** Numeric is replaced by a -?- INOP tone.	DECG	One or more DECG lead is not attached. Make sure that all required leads are attached, and no electrodes have been displaced. Check all connections are sound, and that the legplate attachment electrode is properly attached. If the INOP persists, try using another adapter cable, or legplate attachment electrode. If the INOP still persists, contact your service personnel.
DFHR1 SIGNAL LOSS **DFHR2 SIGNAL LOSS** **DFHR3 SIGNAL LOSS**	DECG	The input signal quality is not sufficient to process the measurement. Reapply the fetal scalp electrode.
DFHR1 UNPLUGGED **DFHR2 UNPLUGGED** **DFHR3 UNPLUGGED** INOP tone	DECG	Reconnect the DECG transducer to the monitor. Check all connections are sound.
MECG EQUIP MALF INOP tone	MECG	There is a problem with the MECG hardware. Contact your service personnel.
MECG LEADS OFF Numeric is replaced by a -?- INOP tone.	MECG	One or more MECG lead is not attached. Make sure that all required leads are attached, and no electrodes have been displaced. Check all connections are sound. If the INOP persists, try using another adapter cable. If the INOP still persists, contact your service personnel.
MECG UNPLUGGED INOP tone	MECG	Reconnect the MECG transducer to the monitor. Check all connections are sound.
FetRec EQUIP MALF INOP tone	Recorder	There is a problem with the fetal recorder hardware. Contact your service personnel.

INOP Message, Indication	Source	What to do
FetRec CHK CONF. INOP tone	Recorder	**Recorder Speed** and/or **Scale Type** settings are set to "Unknown" and need to be set to the correct values in Configuration Mode before the recorder can be operated.
FHR1 EQUIP MALF **FHR2 EQUIP MALF** **FHR3 EQUIP MALF** INOP tone	FHR (ultrasound)	There is a problem with the FHR hardware. Contact your service personnel.
FHR1 SIGNAL LOSS **FHR2 SIGNAL LOSS** **FHR3 SIGNAL LOSS**	FHR (ultrasound)	The input signal quality is not sufficient to process the measurement. Adjust the position of the transducer to obtain a better signal.
FHR1 UNPLUGGED **FHR2 UNPLUGGED** **FHR3 UNPLUGGED** INOP tone	FHR (ultrasound)	Reconnect the FHR transducer to the monitor. Check all connections are sound.
Internal.Comm.Malf INOP tone	Monitor	There is a problem with I2C Bus communication in the monitor. Contact your service personnel.
IUP EQUIP MALF INOP tone	IUP	There is a problem with the IUP hardware. Contact your service personnel.
IUP UNPLUGGED INOP tone	IUP	Reconnect the IUP transducer to the monitor. Check all connections are sound.
NBP CUFF OVERPRESS Numeric replaced by a -?- INOP tone. During this INOP, alarms cannot be paused or switched off.	Noninvasive blood pressure	The cuff pressure exceeds the overpressure safety limits. Remove the cuff from the patient. Make sure that the tubing is not kinked or twisted and that the correct patient category is selected. Try restarting the measurement. You can silence this INOP, but the INOP message remains visible until the next measurement is started or the **Stop All** SmartKey is selected.
NBP EQUIP MALF Numeric is replaced by a -?- INOP tone.	Noninvasive blood pressure	Remove the cuff from the patient. The noninvasive blood pressure hardware is faulty. Contact your service personnel. You can silence this INOP, but the INOP message remains visible until the next measurement is started or the **Stop All** SmartKey is selected.
NBP INTERRUPTED Numeric is replaced by a -?- INOP tone.	Noninvasive blood pressure	Check the tubing and cuff for leakages or kinks. Check that you are using the correct cuff size and placement, and that the correct patient category is selected. Try restarting the measurement. If the INOP occurs repeatedly, contact your service personnel. You can silence this INOP, but the INOP message remains visible until the next measurement is started or the **Stop All** SmartKey is selected. This INOP arises when the measurement needed longer than the maximum time for inflation, deflation or the total measurement.

INOP Message, Indication	Source	What to do
NBP MEASURE FAILED Numeric is replaced by a -?- INOP tone.	Noninvasive blood pressure	Check that you are using the correct cuff size and placement, and that the correct patient category is selected. Try restarting the measurement. You can silence this INOP, but the INOP message remains visible until the next measurement is started or the **Stop All** SmartKey is selected. Check the condition and suitability of the patient for noninvasive blood pressure monitoring. Use another cuff to continue measuring.
No Central Monit. INOP tone	Monitor	There is a problem with the communication to the network. Central monitoring is currently not possible (no patient alarms or information). Check the connection. Contact your service personnel.
PAPER END	Monitor	The end of the paper pack is detected. Insert a new pack of paper.
PRINTHEAD OVERHEAT INOP tone	Recorder	The printhead is too hot. The recorder stops, the recorder **Start/ Stop** key is disabled, and remains so until the printhead cools down sufficiently. Wait for the printhead to cool down, then press the recorder **Start/ Stop** key or the **Silence** key to clear the INOP.
Pulse(Toco) MALF	Toco MP Maternal Pulse Measurement	There is a problem with the Toco MP transducer hardware. Contact your service personnel.
Settings Malfunc. INOP tone	Monitor	The monitor cannot use the predefined settings for monitoring. Contact your service personnel.
Speaker Malfunct. INOP tone	Monitor	Contact your service personnel to check the speaker and the connection to the speaker.
SpO₂ EQUIP MALF INOP tone	SpO_2	There is a problem with the SpO_2 hardware. Contact your service personnel.
SpO₂ ERRATIC Numeric is replaced by a -?- INOP tone.	SpO_2	Check the sensor placement. Try another adapter cable and sensor. If the INOP persists, contact your service personnel.
SpO₂ EXTD.UPDATE Label is preceded by a ? (questionable numeric)	SpO_2	The update period of displayed values is extended due to a noninvasive blood pressure measurement on the same limb or an excessively noisy signal.
SpO₂ INTERFERNCE Numeric is replaced by a -?- INOP tone.	SpO_2	There is too much interference, caused by a high level of ambient light and/or electrical interference. Cover the sensor to minimize ambient light. If the INOP persists, make sure that the sensor cable is not damaged or positioned too close to power cables.
SpO₂ LOW PERF Label is preceded by a ? (questionable numeric)	SpO_2	Accuracy may be compromised due to very low perfusion. Stimulate circulation at sensor site. If INOP persists, change the measurement site.

INOP Message, Indication	Source	What to do
SpO₂ NOISY SIGN. Numeric is replaced by a -?- INOP tone.	SpO_2	Excessive patient movement or electrical interference is causing irregular pulse patterns. Try to reduce patient movement or to relieve the cable strain on the sensor.
SpO₂ NON–PULSAT. Numeric is replaced by a -?- INOP tone.	SpO_2	Check the perfusion at measurement site. If necessary, stimulate circulation or change measurement site. If the INOP is due to noninvasive blood pressure measurement on the same limb, wait until the measurement is finished.
SpO₂ NO SENSOR Numeric is replaced by a -?- INOP tone.	SpO_2	Make sure the SpO_2 sensor is connected. If the INOP persists, try another adapter cable and sensor. If you silence this INOP, the measurement will be switched off.
SpO₂ POOR SIGNAL Label is preceded by a ? (questionable numeric)	SpO_2	The signal condition of the SpO_2 measurement is poor and measurement accuracy may be compromised.
SpO₂ PULSE? Numeric is replaced by a -?- INOP tone.	SpO_2	The detectable pulsations of the SpO_2 signal are outside the specified pulse rate range.
SpO₂ SEARCHING Numeric unavailable	SpO_2	SpO_2 is analyzing the patient signal to derive Pulse, and SpO_2 values. Please wait until the search analysis is complete.
SpO₂ SENSOR MALF Numeric is replaced by a -?- INOP tone.	SpO_2	The SpO_2 sensor or adapter cable is faulty. Try another adapter cable and sensor. If the INOP persists, contact your service personnel.
SpO₂ SENSOR OFF Numeric is replaced by -?- INOP tone.	SpO_2	The SpO_2 sensor is not properly applied to the patient. Apply the sensor following the instructions supplied by the manufacturer.
SpO₂ UNKN.SENSOR Numeric is replaced by a -?-	SpO_2	The connected sensor or adapter cable is not supported by the SpO_2 measurement. Use only specified sensors and cables.
SpO₂ UPGRADE Label is replaced by a -?-, or numeric is unavailable.	SpO_2	The SpO_2 measurement is currently in UPGRADE mode. Monitoring is not possible in this mode.
TimeExpired:NST	Monitor	The time has expired for the NST timer. Clearing the timer clears the INOP.
Toco EQUIP MALF INOP tone	Toco	There is a problem with the Toco hardware. Contact your service personnel.

INOP Message, Indication	Source	What to do
Toco UNPLUGGED INOP tone	Toco	Reconnect the Toco transducer to the monitor. Check all connections are sound.
Unsupported LAN INOP tone	Monitor	There is a problem with the communication to the network and central monitoring is currently not possible. Check the connection.If the INOP persists, switch off the monitor and contact your service personnel.
User I/F Malfunct. INOP tone	Monitor	Perform a visual and functional check of all the monitor input devices. Contact your service personnel.
WRONG PAPER SCALE INOP tone	Recorder	The grid scale of the paper in the monitor does not match the grid scale configured in the monitor. Make sure that you use the correct paper and scale for your institution: pre-printed: 30-240 in US and Canada, 50-210 in other geographies.

6 Patient Alarms and INOPs

7

Admitting and Discharging

The fetal monitor can store basic patient demographic information used to identify patients.

Admit/Discharge on the Monitor

This section describes how you admit and discharge patients when using the monitor as a stand-alone device (that is, when not used with a obstetrical information and surveillance system such as OB TraceVue).

Admitting a Patient

The fetal monitor displays physiological data as soon as a patient is connected. This lets you monitor a patient who is not yet admitted. It is however important to admit patients properly so that you can identify your patient on recordings.

Use the **Patient Demographics** window and its associated pop-up keys to admit and discharge patients.

To admit a patient,

1 Select the patient name field or select the **Admit/ Dischrge** SmartKey to open the **Patient Demographics** window.

2 Clear any previous patient data by selecting **Dischrge Patient** and then **Confirm**.
If you do not discharge the previous patient, you will not be able to distinguish data from the previous and current patients, for example, on the recording.

3 Select **Admit Patient**.

4 Enter the patient information: select each field and use the on-screen keyboard.
If a conventional keyboard is connected to the monitor you can use this to enter patient information:
- **Last Name**: Enter the patient's last name (family name), for example **Doe**.
- **First Name**: Enter the patient's first name, for example **Jane**.
- **MRN**: Enter the patient's medical record number (MRN), for example **12345678.**

5 Select **Confirm**. The patient status changes to admitted. If the recorder is running, the recorder stops and immediately restarts to annotate the new patient data.

Editing Patient Information

To edit the patient information after a patient has been admitted, select the patient name field on the main screen of the fetal monitor to open the **Patient Demographics** window, and make the required changes.

Discharging a Patient

You should always perform a discharge even if your previous patient was not admitted. A discharge:

- clears the information in the **Patient Demographics** window.
- resets all monitor settings to the settings defined in the User Default.
- advances the paper automatically if the recorder is running.
- stops the fetal recorder.

When a patient is discharged from the monitor, all patient demographic data is deleted (trace data is not affected).

To discharge a patient,

1. Select the patient name field to display the **Patient Demographics** window and associated pop-up keys.
2. Select the pop-up key for **Dischrge Patient**.
3. Select **Confirm** to discharge the patient.

CAUTION

In order to ensure that the settings are reset to user defaults for a new patient, always discharge the previous patient from the fetal monitor.

NOTE

In order to ensure a continuous record, it is recommended to discharge the patient before performing a new patient admission in OB TraceVue.

New Patient Check

The fetal monitor can be configured to ask you in certain situations:

- after a specified power-off period
- after a specified standby period

whether a new patient is now being monitored. The pop-up window is entitled **Is This A New Patient?** The monitor offers a **Yes** key to discharge the previous patient and begin monitoring a new patient and a **No** key to continue monitoring with the current patient data and settings.

The time periods for the two conditions can be configured independently.

OB TraceVue: via LAN

Both the monitor from which you are transferring a patient and the monitor to which you are transferring her must be switched on and connected to the OB TraceVue network during the patient transfer.

When the monitor is connected to an OB TraceVue system over a LAN connection, the OB TraceVue system acts as the "master" over patient demographic data. All patient and location-related data that is visible on the monitor is set, overwritten or updated by the OB TraceVue system. See the OB TraceVue *Instructions for Use* for details.

OB TraceVue: via RS232

In contrast to a LAN connection, when the monitor is connected to an OB TraceVue system over an RS232 connection, the OB TraceVue system has no control over the monitor's patient admission and discharge functions.

Depending on how OB TraceVue is configured, *either* the **Last Name**, **First Name** and the bed label, *or* just the bed label alone, are taken from the OB TraceVue system. See the OB TraceVue *Instructions for Use* for details.

7 Admitting and Discharging

8

Non-Stress Test Timer

The non-stress test (**NST**) timer shows the elapsed time for the non-stress test. The timer counts up to the time you set for the NST.

Setting NST Autostart/Autostop

You can set the recorder so that it starts automatically (**NST Autostart**) when the NST timer is started, and stops automatically (**NST Autostop**) when the NST is complete (when the set run time has elapsed). As default, **NST Autostart** is **On**, and **NST Autostop** is **Off**.

Viewing the NST Timer

You can configure the timer notification symbol (), the NST label, a progress bar and the elapsed time to be displayed in the top left-hand corner of the screen. By default, the NST timer is not displayed on the screen.

Alternatively, you can view the timer in the **Timers** window.

To open the **Timers** window:

Either

a. Press the **Timer** SmartKey .

Or

b. Access the NST pop-up keys (see "Accessing the NST Setup Pop-up Keys" on page 88), and press the **Timers** key.

Timer Expiry Notification

When the timer expires, the color changes from blue to green, you hear a single tone, and a message appears in the status line on the Main Screen.

The volume of the tone can be set in Configuration Mode.

Accessing the NST Setup Pop-up Keys

You control and set up the NST timer (for example, start, stop, or clear the timer, and set the run time) using a selection of pop-up keys that you access via any one of three possible routes:

- Via the **Timer** SmartKey (Route 1).
- Via the **Main Setup** SmartKey (Route 2).
- Via the NST menu entry in the menu that pops-up when you touch the top left-hand corner of the screen (Route 3).

Via the Timer SmartKey (Route 1)

Press the **Timer** SmartKey . The **Timers** window opens, and the pop-up keys for controlling/setting up the NST timer appear (see "Pop-up Keys for NST Timer Setup" on page 88).

Via the Main Setup SmartKey (Route 2)

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

2 Select **NST** to enter the **Setup NST** menu. At the same time, the pop-up keys for controlling/setting up the NST timer appear (see "Pop-up Keys for NST Timer Setup" on page 88).

Via the NST Field (Route 3)

Select the NST field displayed in the top left-hand corner of the screen (when so configured). The pop-up keys for controlling/setting up the NST timer appear (see "Pop-up Keys for NST Timer Setup" on page 88).

Pop-up Keys for NST Timer Setup

Pop-Up Keys	Selecting this pop-up key lets you....	Comments
Start	start the timer	
Stop	stop the timer, allowing either restarting after a pause (**Start**) or clearing (**Clear** key).	
Setup NST	enter the **Setup NST** menu. From here you can set the run time.	This pop-up key is not available with Route 2, as the **Setup NST** menu is already open.
Timer	return to the **Timers** window.	This pop-up key is not available with Route 1, as the **Timers** window is already open.

Run Time

The run time can be set from 10 to 60 minutes. To set the run time, you first need to enter the **Setup NST** menu:

1 To enter the **Setup NST** menu:

Either

a. Enter the **Main Setup** menu using the SmartKey . Then select **NST**.

Or

b. Access the NST pop-up keys (see "Accessing the NST Setup Pop-up Keys" on page 88), and press the **Setup NST** key.

2 Select **Run Time**.

8 Non-Stress Test Timer

9

Non-Stress Test Report

It is generally accepted that a non stress test (**NST**) allows you to assess fetal well-being. The monitor's NST report process uses fetal ultrasound (but not DECG) heart rate traces and the Maternal Toco Trace, generating a printed report when criteria are met and the test can be considered reassuring. The American term Non Stress Test (NST) is used for antepartum testing. The interpretation algorithm and ruleset are equivalent to those implemented in OB TraceVue Revision F.xx, and are based on the 2008 NICHD guidelines.

An NST report is a diagnostic aid, but it does not replace the clinician's judgment. The interpretation and the appropriate clinical response remain with the clinician.

A fetus normally produces characteristic heart rate patterns. Average baseline variability and acceleration of the FHR in response to fetal movement are considered reassuring signs. This test does not take into account any form of external fetal stimulation.

For every active ultrasound fetal heart rate measurement, one NST report can reside in the monitor's memory. The reports are cleared when you discharge a patient and when you start a new NST report.

When the NST Report option is available and the "NST Report" feature is "on", the NST status for all available ultrasound fetal heart rate measurements is displayed as a permanent element within the application area on the resting display.

The minimum displayed information is:

- NST identification (by FHR number: 1, 2, 3)
- Current NST status (by color: inverse for "not started yet", white for "running", yellow for "stopped", green for "finished")

Setting Up an NST Report

To setup NST Report functionality:

1 Enter the **Main Setup** menu and select the **NST Report** or

2 Select the **NST Report** SmartKey.

3 Press the "Setup" pop-up key.

4 Set your configuration options.

Select from:

- **NST Analysis**. Choose from **On** or **Off**.
  This switches the report feature on or off. This is linked to the NST timer. Both must be set to **On** for the NST report to function.

- **Report Recording**. Choose from:
  - **Manual** - press the **Record Report** pop up key to trigger a manual request.
  - **After Recorder Stop** - report is recorded as soon as recorder becomes idle
  - **Immediately** - If a realtime recording is running, the monitor pauses it. The recording is continued after the report has been recorded.

Average short term variability (STV) value is documented in [bpm] and [ms] if STV is configured as part of the NST Report. This parameter is not considered as reassuring criteria.

NST Report Status Window

The NST Report window displays a detailed overview of the current NST status for any available ultrasound fetal heart rate measurement. You can see:

- NST Status - whether it is ready, ongoing, or the time and date at which it was stopped, or at which it finished.
- Runtime - the time that has elapsed since the NST began.
- Accelerations - the number of FHR accelerations detected so far.
- Baseline - the average baseline value.
- Variability - the average variability value.
- Short Term Variability - the current short term variability (STV) value.
- Decelerations - the number of FHR decelerations detected so far.
- FHR Availability - current statistical FHR availability value.
- Sinusoidal - the current status of sinusoidal rhythm detection.

For criteria not yet met, a white arrow symbol marks the overall status on the top line, and also appear against every criterion not yet met. A yellow symbol indicates detection of severe or prolonged decelerations.

The pop-up keys let you perform the following actions:

- **FHR1**, **FHR2**, **FHR3** - switch to the window showing the current NST status for the fetal heart rate.
- **Record Report** - prints the NST Report on paper.
- **Record Trace** - records the trace episode that belongs to the current report. Depending on device usage, the trace recording might be incomplete.
- **Setup** - opens the **Setup NST Report** window.

Example NST Report

Field	Field Content
Report Title, with FHR label and date	NST Report for FHR1 on 12 Oct 2009
Product Information	Product DE53102345 G.01.70, OB A.04.24, Toco DE52401090, FHR1 DE00002345 A.05.26
Patient Information	Rogers, Alice Age: 27 Gestational Age: Week 34, Day 5
Start time, end time, NST duration, Reporting Period	Time: 11:34 - 12:06 Runtime: 32 minutes Reporting Period: 20 minutes
Overall one-line NST result summary	NST Criteria*: not met
Title	Trace Interpretation Summary
Result Accelerations	Accelerations: 2 at: 11:59 12:02
Result: Contractions	Contractions: 3 at: 11:57 12:00 12:04
Result: Baseline and Variability	Baseline: 125 bpm (Range: 118 bpm - 129 bpm) Variability: 23 bpm (Range: 20 bpm - 24 bpm) Short Term Var.: 0.9 bpm (3.8 msec)
Statistics: FHR availability	FHR available: 95%
Result: Decelerations	Decelerations: 1 at: 11:58   severe  prolonged
Result: Sinusoidal Rhythm detected	Sinusoidal: No

NST Reassurance Criteria

The patient is monitored for a user-definable period of time (10 - 60 minutes in steps of 5 minutes). The test is considered reassuring when the following criteria are met:

- The fetal heart rate is valid at least 90% (this is configurable) of the specified time span.
- The FHR features a user-defined minimum number of accelerations.
- The FHR features a user-defined maximum number of tolerated decelerations, and does not include severe or prolonged decelerations, which are never tolerated.
- The average baseline fetal heart rate lies within the user-defined limits for low heart rate and high heart rate over the whole time span.
- The FHR exhibits a moderate variability (user-defined) for the specified time span.

An NST Report is generated when the reassuring criteria are met the first time in the current monitoring phase. When performing NST with twins or triplets, a separate NST Report is generated for each fetus.

In the printed report, the average short term variability (STV) value is shown in bpm and ms. This is not part of the reassurance criteria.

After the reassurance criteria have been met, the clinician can print the NST Report and then turn the fetal monitor off, or may continue fetal monitoring and print the report at any time.

Non-Reassuring Report

When the reassurance criteria are NOT met if the test has run for 90 minutes, or if you stop anytime during the 90 minute period, then the test is stopped and a report is generated, stating the reassurance criteria have not been met.

Non-Reactive NST Test

If a non-reactive test occurs and you then use acoustic stimulation, you must exercise caution in interpreting the resulting traces, as artificial stimulation is not taken into account when calculating test results.

10

Monitoring FHR and FMP Using Ultrasound

To monitor a single FHR externally, you use an ultrasound transducer attached to a belt around the mother's abdomen.The ultrasound transducer directs a low-energy ultrasound beam towards the fetal heart and detects the reflected signal. Your monitor can also detect fetal movements and print the fetal movement profile (**FMP**) on the trace. Monitoring using ultrasound is recommended from the 25th week of gestation for non-stress testing or routine fetal monitoring.

WARNING

Performing ultrasound imaging or Doppler flow measurements together with ultrasound fetal monitoring may cause false FHR readings, and the trace recording may deteriorate.

Technical Description

Fetal monitors use the ultrasound Doppler method for externally monitoring the fetal heart rate. Using the Doppler method, the transducer (in transmitter mode) sends sound waves into the body which are then reflected by different tissues. These reflections (Doppler echoes) are picked up by the transducer (in listening mode). These Doppler echoes are amplified and sent to the monitor's speaker through which the fetal heart signal can be heard. In parallel the Doppler echoes are processed through an autocorrelation algorithm to determine the fetal heart rate (FHR). The FHR is displayed on the monitor's numeric display and on the recorded trace.

Properly representing the fetal heart rate using a device that derives heartbeats from motion is a formidable task and the limitations of the technology will be discussed shortly. Basic fetal cardiac physiology may contribute to difficulties in obtaining a reliable ultrasound signal. A heart rate pattern of a fetus is capable of extraordinary variation, ranging from a quiet stable pattern with minimal variation while the fetus is "asleep" to robust accelerations of 40-60 bpm above baseline rate over a few seconds or exaggerated variability when the fetus is active. Decelerations of the rate 60-80 bpm below baseline may develop even more abruptly than the accelerations. Beat-to-beat arrhythmias may further exaggerate the amount of "variability" and be seen at the bottom of variable decelerations, or in the presence of fetal breathing movements which also tend to lower the fetal heart rate. The recognition of these normal variations in fetal heart rate patterns will greatly assist in the separation of genuine fetal information from the artifact.

Limitations of the Technology

All tissues moving towards or away from the transducer generate Doppler echoes. Therefore, the resulting signal that is provided to the monitor's speaker, and for further fetal heart signal processing, can contain components of the beating fetal heart wall or valves, fetal movements, fetal breathing or hiccup, maternal movements such as breathing or position changes, and pulsating maternal arteries. The fetal heart signal processing uses an autocorrelation algorithm to obtain periodic events such as heart beats. If the signal is erratic such as from a fetal arrhythmia, the ultrasound device may have trouble tracking the abrupt changes and may misrepresent the true FHR pattern. Signals such as those from moving fetal limbs are usually very strong, thereby masking the fetal heart signal. During prolonged movements where the fetal heart signal is masked, the FHR appears blank on the numeric display and as a gap on the recorded trace. Fetal position changes, maternal position changes, or uterine contractions can move the fetal heart partly or fully out of the ultrasound beam resulting in signal loss or even picking up Doppler echoes from pulsating maternal arteries. In these cases a maternal heart rate or sometimes even a rate resulting from the mixture of fetal and maternal signals may be displayed on the monitor's numeric display and on the recorded trace.

In contrast to the timely well-defined R-peak of an ECG signal obtained with a fetal scalp electrode, the ultrasound Doppler signal from a fetal heart consists of multiple components from atria (diastole), ventricles (systole), valves, and pulsating arteries. These components vary depending on fetal and transducer position and angle, and are further modulated by factors such as fetal or maternal breathing. These effects may produce what is called "artifact". Optimal transducer positioning therefore is key to minimizing these effects and thereby minimizing artifact.

Misidentification of MHR as FHR

FHR detection by the monitor may not always indicate that the fetus is alive. Confirm fetal life before monitoring, and continue to confirm that the fetus is the signal source for the recorded heart rate (see "Confirm Fetal Life Before Using the Monitor" on page 10).

Here are some examples where the MHR can be misidentified as the FHR.

- **When using an ultrasound transducer:**
  - It is possible to pick up maternal signal sources, such as the maternal heart, aorta, or other large vessels.
  - Misidentification may occur when the maternal heart rate (MHR) is higher than normal (especially when it is over 100 bpm).

NOTE

When an ultrasound transducer is connected to the monitor but not applied to the patient, the measurement may generate unexpected intermittent FHR readings.

- **When Fetal Movement Profile (FMP) is enabled:**

  The FMP annotations on a fetal trace **alone** may not always indicate that the fetus is alive. For example, FMP annotations in the absence of fetal life may be a result of:
  - Movement of the deceased fetus during or following maternal movement.
  - Movement of the deceased fetus during or following manual palpation of fetal position (especially if the pressure applied is too forceful).
  - Movement of the ultrasound transducer.

Cross-Channel Verification

To reduce the possibility of mistaking the MHR for FHR, it is recommended that you monitor both maternal and fetal heart rates (see "Monitoring Maternal Heart / Pulse Rate" on page 155). The monitor's cross-channel verification (CCV) facility can help by automatically detecting when the same heart rate is being recorded by different transducers.

When the MHR and FHR are being monitored, CCV will alert you when the values are very similar or the same. This may indicate fetal demise, and the transducer may be picking up a signal from a maternal source. CCV can compare all monitored heart rates and indicate when any two channels are picking up the same signal.

When CCV detects two heart rates that coincide, you are alerted within approximately one minute to check the tracings and potentially to reposition the transducers.

In case of difficulties deriving a stable maternal pulse reading using the Toco MP transducer, it is recommended to use SpO_2 instead. In case of similar problems with the pulse measurement from SpO_2, use MECG instead. Reasons to switch the method for deriving a maternal pulse or heart rate include: motion artifacts, arrhythmia, and individual differences in pulse signal quality on the abdominal skin (via Toco MP).

What You Need

- Ultrasound transducer.
- Ultrasound gel.
- Transducer belt (and optional butterfly belt clip, if applicable).

Cordless Monitoring - Important Considerations

When using an Avalon CTS Cordless Fetal Transducer System (M2720A) with your monitor, please note the following:

- Refer to "Cordless Monitoring" on page 22 for general rules regarding the use of cordless transducers from an Avalon CTS Cordless Fetal Transducer System.
- When using a cordless ultrasound transducer from an Avalon CTS system to measure the fetal heart rate, note that you cannot use any other ultrasound transducer (whether cordless or wired) at the same time.

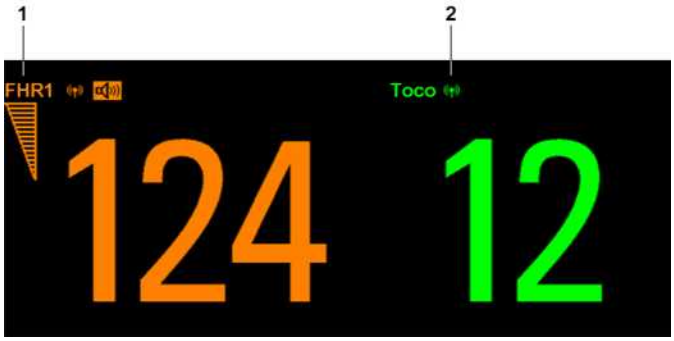
WARNING

To avoid interference on ultrasound channels: When changing from using cordless to wired ultrasound transducers to measure the fetal heart rate, REMOVE the cordless ultrasound transducer from the patient and dock it in the Avalon CTS basestation. Never use ultrasound transducers connected to more than one fetal monitor on the same patient.

- When using an Avalon CTS Cordless fetal Transducer System (M2720A), the monitor automatically sets the Fetal Movement Profile (FMP) to Off, due to the likelihood of generating artifacts when the mother is mobile. You can enable FMP again manually should you wish, but you should be aware that FMP is not recommended when the mother is likely to move, and you should

disable Fetal Movement Profile (FMP) on the fetal monitor (**Fetal Movement Off**) if the mother is walking. See also "Fetal Movement Profile" on page 100.

- The  symbol appears next to the measurement label, indicating that the measurement is being made by a cordless transducer.



1 FHR1
2 Toco parameter

Preparing to Monitor

Prepare for ultrasound monitoring using the list below. The standard procedures in use in your facility determine the sequence of actions.

- Determine fetal position.
- Fasten the belt around the patient.
- Switch on the monitor and the recorder.
- Connect the transducer to a free socket. Note that the signal quality indicator for the heart rate initially displays an invalid signal.
- Apply a thin layer of ultrasound gel to the underside of the transducer.

CAUTION

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

- Place the transducer on the abdomen, if possible over the fetal back or below the level of the umbilicus in a full-term pregnancy of cephalic presentation, or above the level of the umbilicus in a full-term pregnancy of breech presentation. Work the transducer in a circular motion to ensure the gel layer makes good contact.

  When the sensor is connected correctly and a good signal is being received, the signal quality indicator should be full. If an inadequate signal is being produced, the signal quality indicator will indicate a poor signal, and no numeric will appear on the screen.
- Adjust the audio volume of the monitor's loudspeaker to a clearly audible level, while moving the transducer over the abdomen. When you have a good signal, secure the transducer in position below the belt.

WARNING

Periodically compare the mother's pulse with the signal coming from the monitor's loudspeaker to ensure that you are monitoring fetal heart rate. Do not mistake a doubled or elevated MHR for FHR.

Note that when applied to the patient, the ultrasound transducer may warm slightly (less than 1°C/ 1.8°F above ambient temperature). When NOT applied, the transducer can reach a maximum temperature of 44°C/112.2°F at an air temperature of 40°C/104°F.

Selecting Fetal Heart Sound

You can listen to the fetal heart sound from **one** ultrasound transducer at a time. When the fetal heart sound is selected for a FHR channel, you see the audio source symbol  next to the FHR numeric label for that channel.



1 FHR1
2 Audio source symbol

To select the audio source for a FHR channel:

Enter the **Setup FHR1** menu for the channel you want to hear (FHR1 used as an example).

Press **Select Audio**. It may take a few seconds for the audio source symbol  to appear.

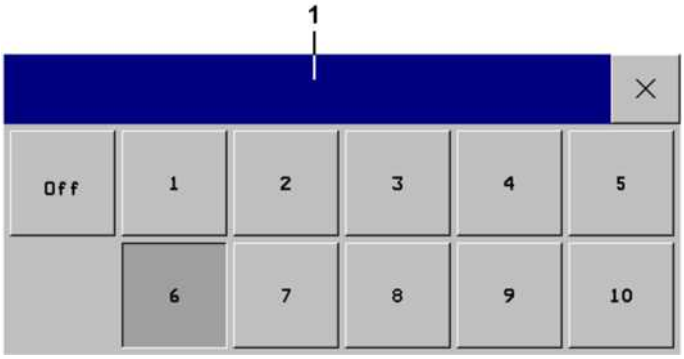
Changing the Fetal Heart Sound Volume

The FHR volume symbol at the top right of the **Fetal Heart Sound Volume** window gives you an indication of the current volume. To change the volume:

1 Select the volume symbol . The volume scale pops up.

2 Select the required volume from the volume scale.

1 Alarm Volume



Fetal Movement Profile

The Fetal Movement Profile (FMP) parameter detects fetal movements via an ultrasound transducer connected to the monitor. Only the fetus monitored on the FHR1 channel is monitored for FMP.

Once you have enabled FMP (see "Switching FMP On and Off" on page 101), it is triggered automatically whenever:

- You connect an ultrasound transducer.
- A patient is discharged.

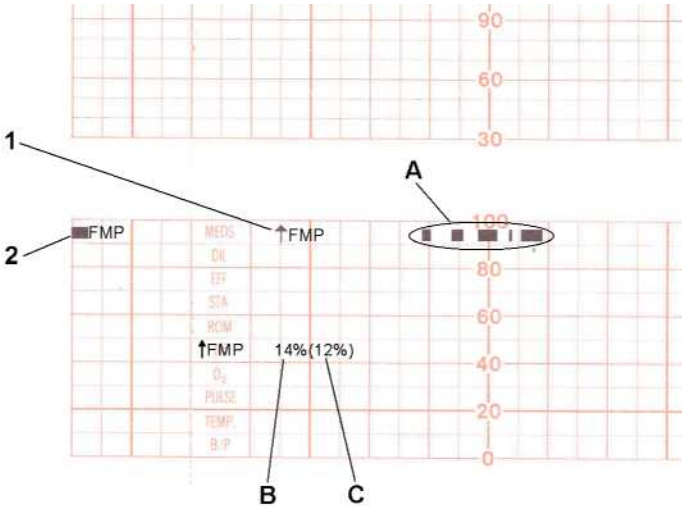
Be aware that when using an Avalon CTS Cordless fetal Transducer System (M2720A), the monitor automatically sets the FMP to **Off** (see "Cordless Monitoring - Important Considerations" on page 97).

When FMP is enabled, the ultrasound transducer detects gross fetal body movements. Eye movements are not detected and movement of the feet and hands may not be detected. Positioning or repositioning of the transducer is recorded as fetal movement. Maternal movement, excessive fetal breathing or fetal hiccups may also be recorded as fetal movement. You can mark these artifacts on the trace paper using either the remote event marker or the event marker key as described in "Marking an Event" on page 51. Ignore these movements when you interpret the FMP. When monitoring twins or triplets, only the fetus monitored on the FHR1 channel is monitored for movement, but be aware that movements recorded for FHR1 may also be caused by movement of the second or third fetus.

The fetal movement profile (FMP) appears as "activity blocks" (see **A** below) along the top of the Toco Scale, the length of each block showing the duration of the activity.

FMP Statistics

FMP statistics are printed every ten minutes.



1 FMP started here
2 FMP enabled

The FMP statistics are presented as two percentage figures:

- The first figure shows the percentage of detected fetal movements in the previous ten minutes (see **B** above).
- The second figure shows the percentage of detected fetal movements since the start of recording (see **C** above).

To mark the start of the FMP statistic,  FMP is printed on the paper.

The FMP detection activates after about half a minute of steady heart rate signals (signal indicator half-full, or full) to minimize transducer positioning artifact. You will notice this deliberate delay:

- When a new patient is admitted. A patient discharge restarts the FMP statistics from zero.
- When you connect an ultrasound transducer.

Switching FMP On and Off

You can switch FMP on and off from any FHR channel. For example, to set it from the FHR1 channel:

1 Enter the **Setup FHR1** Menu.

2 Select **Fetal Movement** to toggle between **On** and **Off**.

3 Return to the main screen.

Troubleshooting

Problem	Possible Causes	Solutions
Erratic trace. Erratic display.	Fetal arrhythmia.	Consider monitoring FHR using DECG after the rupture of membranes.
	Obese patient.	
	Transducer position not optimal.	Reposition transducer until signal quality indicator shows a good signal (at least half-full).
	Belt loose.	Tighten belt.
	Too much gel.	Remove excess.
	Very active fetus.	-
	Insufficient gel.	Use enough gel to ensure the transducer makes good contact with the mother's skin.
Signal quality indicator is continuously poor.	Transducer position not optimal.	Reposition transducer until signal quality indicator shows a good signal (at least half-full).
	FHR less than 50 bpm (and the FHR is audible).	If membranes are ruptured, using a fetal scalp electrode (FM30 and FM50 only) allows measurement of FHR down to 30 bpm.
Questionable FHR.	Recording MHR by mistake.	Reposition transducer. Confirm fetal life.
	Recording periodic signals when the transducer is not applied to the patient.	Disconnect all NON-USED ultrasound transducers, as continuous, regular mechanical or electromagnetic influences can result in an artificial trace.
	Recorded FHR appears to be suspiciously higher, or suspiciously lower, than real FHR. In very rare cases, half- or double-counting of the FHR can occur.	If you have reason to question the validity of the recorded FHR, always verify FHR by independent means (by auscultation, for example). Measure maternal pulse by independent means.
FHR not recorded.	FHR is less than 50 bpm or over 240 bpm.	If membranes are ruptured, using a fetal scalp electrode (FM30 and FM50 only) allows measurement of FHR down to 30 bpm.
		If FHR is outside of the specified range, verify FHR by independent means.

Problem	Possible Causes	Solutions
FHR1 EQUIP MALF or **FHR2 EQUIP MALF** or **FHR3 EQUIP MALF** INOP displayed.		(see "Patient Alarms and INOPs" on page 73).
FHR1 SIGNAL LOSS or **FHR2 SIGNAL LOSS** or **FHR3 SIGNAL LOSS** INOP displayed.		
FHR1 UNPLUGGED or **FHR2 UNPLUGGED** or **FHR3 UNPLUGGED** INOP displayed.		
If you suspect the transducer is malfunctioning.		Test the transducer. See below.

Additional Information

Artifact in Fetal Heart Rate Measurement

How to detect it and reduce its occurrence using the Avalon Fetal Monitor

The ultrasound derived FHR measurement technique in Avalon fetal monitors, like all other ultrasound fetal monitors' FHR measurement techniques, has limitations that can lead to misrepresentation of the fetal heart rate pattern and potential misinterpretation of the fetal condition.

An incorrect interpretation of the trace may lead to either unnecessary interventions or to failure to detect fetal distress and the need for intervention. Therefore, the on-going evaluation of the recorded trace requires regular confirmation that the trace represents true FHR. Specific situations requiring such confirmation include the following:

- After starting a measurement or changing a transducer
- After maternal position changes, for example during pushing with contractions
- When the tracing shows abrupt changes in baseline rate, variability, or pattern (decelerations to accelerations) especially in the second stage of labor
- When the baseline maternal heart rate is within about 15 bpm of the FHR
- When the user is unable to determine a baseline rate and variability occurs between consecutive contractions

There are several ways to verify the source and/or accuracy of the recorded fetal heart rate pattern. These include:

Verification of the FHR with:

- An obstetric stethoscope,
- Ultrasound imaging, or
- A fetal scalp electrode

Verification of the maternal heart rate:

- Using pulse oximetry - for a maternal heart rate pattern displayed simultaneously with the FHR (Cross-Channel Verification (CCV) feature),
- Using Maternal ECG - for a maternal heart rate pattern displayed simultaneously with the FHR (CCV feature), or
- Manual determination of the maternal pulse

It is strongly recommended that the maternal pulse oximeter or maternal ECG be employed to make use of the monitor's Cross-Channel Verification (CCV) feature, especially during the second stage of labor or when the maternal pulse is elevated over 100 bpm. The Philips Avalon fetal monitor offers maternal pulse oximetry (SpO_2) and maternal ECG for maternal pulse detection and the creation of a maternal heart rate pattern plotted on the same recorder as the FHR pattern. When either of these parameters is utilized, the monitor will automatically and continuously perform a CCV of the maternal heart rate pattern against the FHR pattern displayed on the monitor. If the patterns and rates are similar, the CCV provides an alert that both rates are likely to be from the same source (i.e., they both represent the maternal heart rate pattern and the fetus is not being monitored). Repositioning the ultrasound transducer will usually correct this, but it may be necessary to apply a fetal scalp electrode. Advising the mother to temporarily cease pushing during contractions may help to more rapidly resolve any uncertainty in this situation.

Doubling: The autocorrelation algorithm can display a doubled fetal or maternal heart rate if the duration of diastole and of systole are similar to each other and if the heart rate is below 120 bpm. Doubling, usually brief, is accompanied by an abrupt switch of the trace to double the baseline value.

Halving: With fetal tachycardia (above 180 bpm) and some interference from breathing or maternal arteries the autocorrelation algorithm may only recognize every second beat resulting in a halved rate for a limited time. If the actual FHR is above the maximum limit of the monitor (240 bpm), the algorithm will also half-count. Halving is accompanied by an abrupt switch of the trace to exactly half the prior baseline value. This switch may simulate a FHR deceleration and be referred to by clinicians as a "false deceleration."

Switching to maternal heart rate (also referred to as "Maternal Insertion"): The fetal heart can move partly or fully out of the ultrasound beam and the autocorrelation algorithm may then pick up and display the maternal heart rate. Depending on the signal mix in the ultrasound signal, switching to the maternal heart rate may mimic several conditions with the potential for erroneous interpretation and response as follows:

- **The switch to the maternal heart rate may simulate a FHR deceleration** (i.e., a decrease of the fetal heart rate, and be referred to by clinicians as a "false deceleration").
- **The maternal heart rate may simulate a normal fetal heart rate pattern** (i.e., it may mask a FHR deceleration or fetal demise).

Especially during pushing with contractions in the second stage of labor, the maternal heart rate may increase to the point where it may equal or exceed the fetal rate. Here the maternal trace may mimic a normal fetal trace while the fetus may be having decelerations or fetal demise has occurred. This change from fetal to maternal heart rate pattern may not be at all obvious unless CCV is used and represents the most dangerous pitfall of all the artifacts because fetal distress may go unrecognized.

- **The maternal heart rate may simulate a FHR acceleration**, which is an increase of the fetal heart rate.

During expulsive efforts, the maternal heart rate normally accelerates and may be at or above the normal FHR range.

- **The FHR may display gradual appearing decelerations**. Generally, the "false decelerations" described above are abrupt. Rarely, combinations of "noisy/erratic signal" associated with changes in maternal and/or fetal rate or movement will produce more gradual appearing "false decelerations" but these are usually short-lived with an **abrupt** return to an obviously stable FHR baseline.

"Noisy/Erratic" signals: With mixed or weak signals the tracing may reveal very brief episodes of erratic recorded traces. These represent the autocorrelation algorithm finding brief sequences of apparent and persistent heartbeats amidst a mixed or weak signal. These erratic recorded traces are commonplace, especially in association with fetal or maternal movement. **During prolonged periods of such noisy/erratic signals, the fetus is not being adequately monitored.**

Drop out: With mixed or weak signals there may be no heart rate tracing at all. These episodes reflect that if the algorithm does not find an apparent and persistent heartbeat amidst a mixed or weak signal, it will not print a heart rate on the tracing. Brief episodes of drop out are commonplace, especially in association with fetal or maternal movement. **During prolonged periods of drop out, the fetus is not being adequately monitored.**

Multiple Fetuses

With multiple fetuses, the potential to experience these artifacts is increased. Positioning of the transducer is even more critical. Ultrasound scanning should be used to help with positioning of individual transducers.

Obtaining a Good Heart Signal

To successfully position the ultrasound transducer, first determine the fetal position using palpation. Position the transducer over the strongest audible fetal heart sound from the monitor's speaker and **wait at least six seconds after each transducer adjustment** to verify a good signal quality displayed on the Signal Quality Indicator and a consistent FHR numeric display. Having determined the position that provides a strong fetal signal, fix the transducer on the abdomen with the belt.

If the quality of the signal or the appearance of the heart rate trace from the ultrasound transducer is questionable, the transducer should be repositioned as described above. Alternatively, the use of an ultrasound scanner will greatly facilitate the determination of the optimal site for the ultrasound heart rate transducer. Factors during the second stage of labor that may influence the quality of the FHR tracing obtained with ultrasound include:

- Uterine contractions
- Changing contour of the maternal abdomen
- Maternal body movement - positioning
- Maternal expulsive efforts - pushing
- Maternal tachycardia/accelerations with contractions
- Fetal decelerations, Fetal tachycardia
- Delayed return of the fetal heart rate from a deceleration
- Descent of the fetus in the birth canal
- Rotation of the fetus in the birth canal

In some cases during the second stage of labor, a good and reliable ultrasound FHR signal may not be obtainable, and the use of a fetal scalp electrode must be considered (fetal ECG).

Audio Output

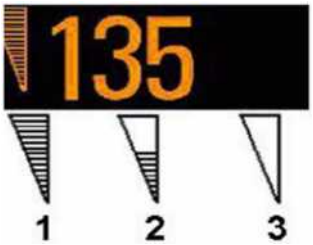
The audio output from the device is an aural representation of movement that, in most cases, permits accurate auscultation of the FHR corresponding to the FHR displayed on the monitor and rate pattern depicted on the trace recording. On occasion, the user may hear a FHR in the audio output that differs from the FHR display and the recorded trace. This may occur in situations where the fetal heart moves partly out of the transducer ultrasound beam. In these cases, the user may still audibly recognize the FHR in the audio output of the monitor's speaker, even though another periodic signal (usually the maternal heart rate) has become stronger. The autocorrelation algorithm will display the stronger maternal heart rate, despite the persistence of a weaker fetal signal. These occurrences are usually very brief and, if persistent, can be addressed by repositioning the transducer.

User Interface

Avalon compared with its predecessor, the Series 50

Signal quality indicator on Avalon fetal monitors:

Instead of a traffic light-like design (red – yellow – green) used on the Series 50, the signal quality on the Avalon fetal monitor is indicated by a triangle on the touch screen that is displayed in one of three ways:



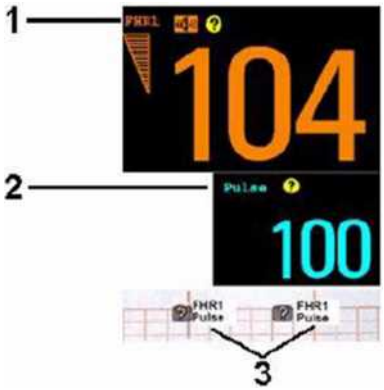
Avalon Fetal Monitor signal quality indicator display

1 Completely filled triangle, indicating good signal quality (good/full).
2 Half-filled triangle, indicating limited signal quality. This condition may indicate a weak or ambiguous signal. If this status persists, reposition the transducer (acceptable/medium).
3 Empty triangle, indicating insufficient signal quality. No FHR is displayed on the monitor's numeric display or the recorded trace. If this status persists, reposition the transducer (poor/no signal).

Cross-Channel Verification (CCV) indication on Avalon fetal monitors

If the Cross-Channel Verification detects a probable duplication of information from both the MHR channel input device (maternal ECG or pulse oximeter) and the fetal transducer, the corresponding recorded trace segment is annotated with question marks at the upper edge of the heart rate grid. This is the same for the Avalon fetal monitor and the Series 50. In addition, the Avalon fetal monitor provides an annotation on the recorded trace to indicate which heart rates coincide. The Avalon fetal monitor also identifies coincidence with a question mark on the FHR numeric display, indicating that the FHR being displayed may actually be the maternal heart rate (see image below). When multiple

fetuses are monitored, the Avalon will identify and label apparent CCV between either two fetuses or a fetus and the mother.



1 FHR1
2 Pulse
3 FHR1 Pulse

Avalon CCV numeric display and recorded trace showing coincident alerts

When monitoring the maternal ECG, a beat-to-beat maternal heart rate trace is printed alongside the FHR recorded trace. When monitoring the maternal SpO_2 derived pulse rate, a filtered and averaged heart rate trace is printed.

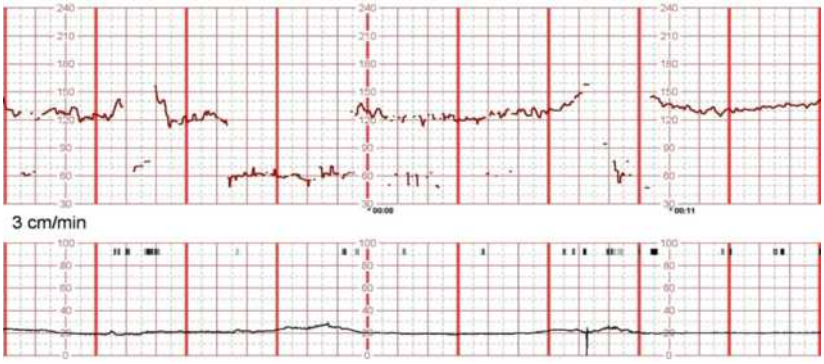
Examples of Artifacts

Following are recorded trace examples of complaints received regarding inaccurate output from the Avalon monitors. Scaling is 3 cm/min and 30 bpm/cm.

Double-Counting	
Baseline Rate	120
Baseline Variability	Moderate
Accelerations	Present
Decelerations	Not apparent
Contractions	Excessive, coupling, hypertonus
Artifact	Double-Counting
Comment	Reassuring tracing. The excessive uterine activity should prompt discontinuation of any oxytocic agent.
Remediation	The true fetal rate can be confirmed by auscultation or by fetal scalp electrode.



Half-Counting	
Baseline Rate	120
Baseline Variability	Moderate
Accelerations	Present
Decelerations	Not apparent
Contractions	Minimal
Artifact	Half-counting, noise, drop out
Comment	Reassuring tracing. The half-count at 4-5 minutes into the tracing may simulate a fetal deceleration, but the abruptness and the lack of any compensatory changes when the normal rate returns suggests that this is half-counting. Insertion of the maternal heart rate (see below) may produce a similar pattern. Note also very brief episodes of half-counting, maternal insertion, and signal drop out.
Remediation	Auscultation or the application of a direct scalp electrode, if feasible, will reveal the true fetal heart rate.

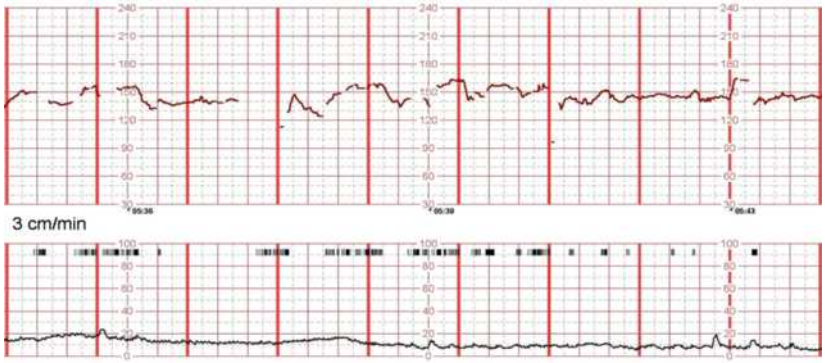


Maternal-Switching (Maternal Insertion)	
Baseline Rate	170 - Tachycardia
Baseline Variability	Moderate
Accelerations	Unable to determine
Decelerations	Absent
Contractions	Absent
Artifact	Maternal insertion, noise
Comment	The fetus has an elevated baseline rate of about 170 bpm with minimal to moderate variability. The ability to assess fetal status is limited because about half of the tracing displays the maternal heart rate.
Remediation	The application of a maternal transducer (ECG or pulse oximeter) will likely resolve any possible confusion with the tracing. Repositioning the transducer may produce a more reliable tracing. Consideration must also be given to applying a fetal scalp electrode.



Noisy/Erratic Signal and Dropout	
Baseline Rate	140
Baseline Variability	Moderate
Accelerations	Present
Decelerations	Absent

Noisy/Erratic Signal and Dropout	
Contractions	Minimal
Artifact	Noisy signal, drop-out
Comment	Reassuring tracing. Note that there is episodic drop out of the signal with discontinuity of the fetal tracing.
Remediation	Either improving the position of the transducer or the application of a fetal scalp electrode will reduce the amount of artifact in the tracing.



Selection of Literature References on Artifacts

Fetal Monitoring, A Multidisciplinary Approach, Sixth edition
Susan M. Tucker, Lisa A. Miller, David A. Miller
Mosby Inc. 2009, ISBN 978-0-323-05670-0

Signal ambiguity resulting in unexpected outcome with external fetal heart rate monitoring
By Duncan R. Neilson Jr, MD; Roger K. Freeman, MD; Shelora Mangan, RNC, MSN, CNS
American Journal of Obstetrics & Gynecology, June 2008:

Antepartal and Intrapartal Fetal Monitoring, 3rd Edition (2007)
By Michelle L. Murray, PhD, RNC
Springer Publishing Company, ISBN 0-8261-3262-6
Page 2, Table 2: **Limitations of Continuous EFM**
Item 15: "The US may detect maternal aortic wall movement and the MHR will be printed. A failure to recognize the lack of a FHR may delay appropriate management."
Page 38, "Solving Equipment Problems", Table 3: **The Ultrasound Transducer**

JOGC (Journal of Obstetrics and Gynaecology Canada)
Volume 29, Number 9, September 2007
Chapter 2: **Intrapartum Surveillance**
Page S35: **"Methods of Electronic Fetal Monitoring"**
"… Among its disadvantages are the need for readjustment with maternal or fetal movements and the following: the transducer may record the maternal pulse, it may be difficult to obtain a clear tracing in obese women or those with polyhydramnios, artifact may be recorded, and there may be doubling or halving of the fetal heart rate when it is outside of the normal range."

Maternal of Fetal Heart Rate? Avoiding Intrapartum Misidentification
by Michelle L. Murray
JOGNN Clinical Issues, April 2003, 33, 93-104; 2004. DOI: 10.1177/0884217503261161

Figure 9 "The recording is of the MHR with occasional doubling."

Maternal Heart Rate Pattern – A Confounding Factor In Intrapartum Fetal Surveillance
Schifrin BS, Harwell R, Hamilton-Rubinstein T, Visser G:
Prenat Neonat Med 2001; 6:75-82.

Fetal Monitoring in Practice, 2nd Edition 1998

By Donald Gibb, S. Arulkumaran

Butterworth-Heinemann, ISBN 0-7506-3432-2

Page 65, "False or erroneous baseline because of double counting of low baseline FHR"

Page 66, "Bradycardia: fetal or maternal"

Role of Maternal Artifact in Fetal Heart Rate Pattern Interpretation

Klapholz, Henry M, MD; Schifrin, Barry S. MD; Myrick, Richard RS

Obstetrics & Gynecology, September 1974, Volume 44, Issue 3

Testing Ultrasound Transducers

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.

To test an ultrasound transducer:

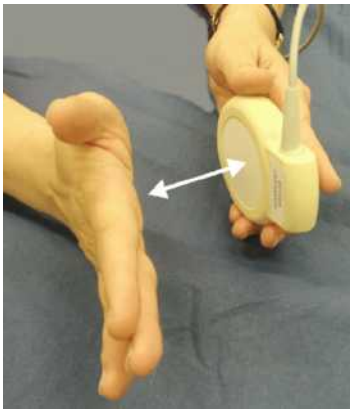
1 Switch on the monitor and the recorder.

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 Holding the transducer in one hand, move your other hand repeatedly towards and then away from the surface.



6 Check that a noise is heard from the loudspeaker.

11

Monitoring Twin FHRs

You can monitor twin FHRs externally using two ultrasound transducers. It is not possible to monitor twins externally using cordless ultrasound transducers.

FM30/50 Additionally, you can monitor twin FHRs throughout labor and delivery after rupture of the membranes by monitoring one twin externally using ultrasound and the other internally using DECG.

Refer to the appropriate preceding chapters for contra-indications and other information about the measurement methods you have chosen.

FHR detection by the monitor may not always indicate that the fetuses are alive. Confirm fetal life before monitoring, and continue to confirm that the fetuses are the signal source for the recorded heart rate.

Important Considerations

When monitoring:

- Make sure that you are recording two different heart rates. The cross-channel verification feature alerts you if the two heart rates coincide (that is, if both transducers are recording the same FHR). If this happens, check the trace and if necessary, reposition an ultrasound transducer to detect the second FHR correctly.
- Fetal heart rate measurements are labeled in the **order** in which you plug in the transducers for those measurements. It does not matter which fetal sensor socket you use, as the monitor allocates a channel automatically. For instance, the first transducer you connect is automatically allocated a channel, and the measurement is labeled **FHR1**, the second is labeled **FHR2**, and so on.
  If you need to disconnect the transducers measuring the FHR temporarily, with the intention to continue monitoring after the temporary break (for example, if the mother needs to go to the bathroom), it is important that you reconnect the transducers in the same order as you originally connected them to make sure the measurement labels remain consistent.
- The blue transducer Finder LED lets you identify at a glance which transducer is monitoring which heart rate channel.
- The fetal sensor socket to which a transducer is connected is identified by the transducer position indicator in the blue setup menu header:

  for FM20/30;

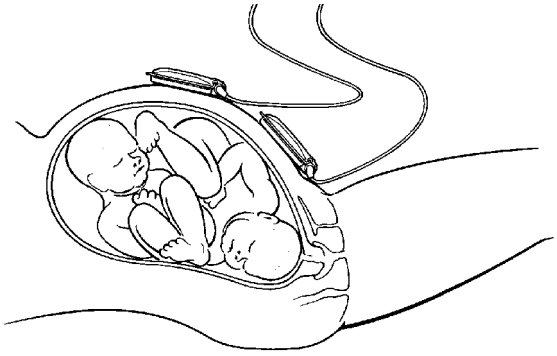


for FM40/50.

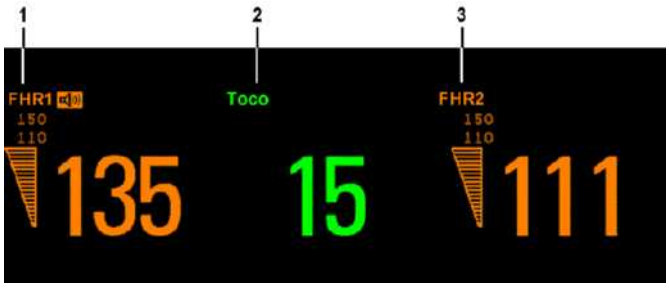
- The trace recorded for FHR1 is thicker (darker) than that recorded for FHR2. This ensures that the two heart rates are easily distinguishable. The thickness of the recorded trace can be changed in Configuration Mode.
- Remember that only one fetal heartbeat can be heard from the loudspeaker at any time. The audio source symbol  shows you which fetus you are listening to. To hear the other fetal heartbeat, select the fetal heart rate sound for this channel (see "Selecting Fetal Heart Sound" on page 99).
- Monitor maternal pulse, especially during later stages of labor, to avoid mistaking maternal heart rate for FHR.
- Make sure you are recording the best possible signals by referring to the signal quality indicators and repositioning the transducers if necessary.

Monitoring Twins Externally

To monitor twin FHRs externally you need two ultrasound transducers. Follow the procedures described in the Chapter "Monitoring FHR and FMP Using Ultrasound" on page 95. The blue transducer Finder LED lets you identify at a glance which transducer is monitoring which FHR channel, and lights when you select the FHR numeric field on the screen.



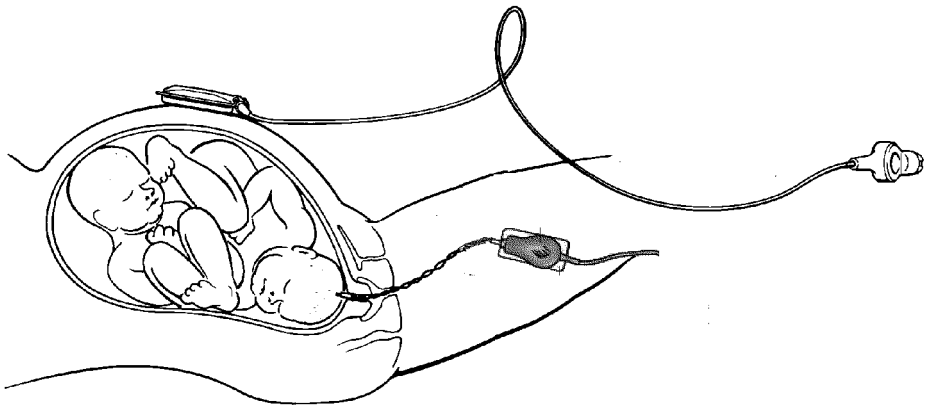
Example of the screen showing ultrasound monitoring of twin FHRs:



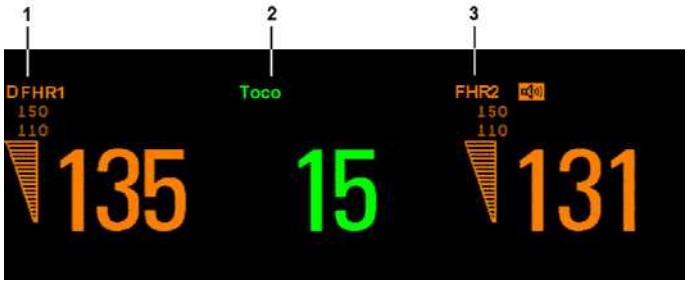
1 FHR 1
2 Toco parameter
3 FHR 2

Monitoring Twins Internally

FM30/50 Monitor one twin using the procedures described in the Chapter "Monitoring FHR and FMP Using Ultrasound" on page 95. Monitor the second twin using the procedures described in the Chapter "Monitoring FHR Using DECG" on page 137.



Example of a screen showing twin monitoring using a combination of US and DECG (The fetal heart rate monitored via DECG is labeled "DFHR1"/"DFHR2"/"DFHR3" on the screen):

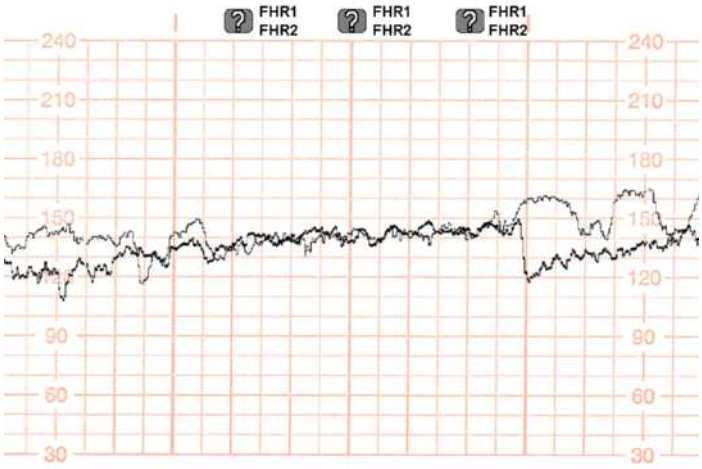


1 DFHR 1
2 Toco parameter
3 FHR 2

Cross-Channel Verification

If the monitored heart rates (from a fetal or maternal source) coincide at any time (that is, if the same heart rate is being monitored by more than one transducer), this is detected via the monitor's cross-channel verification feature, and  appears on the screen and is repeatedly printed on the trace paper after about 30 seconds. If the suspended coincidence persists for more than one minute without interruption, then the INOP **COINCIDENCE** will additionally appear on the screen. If you are monitoring externally, check the trace and reposition one of the transducers, if necessary, to detect the second FHR correctly.

FM30/50 If you are monitoring internally, check the trace and, if necessary, reposition the ultrasound transducer to detect the second FHR correctly.



Separating FHR Traces

To help you to interpret traces with similar baselines, you can separate the baselines by an offset of 20 bpm by switching trace separation on. For details of the offset, see "Determining the Separation Order" on page 116.

Switching Trace Separation On and Off

- Connect transducers to the monitor to measure FHR. Depending on the measurement method, you need *either* two ultrasound transducers *or*

FM30/50 One ultrasound and one Toco^{+} transducer (to monitor DECG)

- Enter the **Main Setup** menu by pressing the **Main Setup**.
- Select **Fetal Recorder**.
- Select **Trace Separation** to toggle between **On** and **Off**.
- Exit the **Main Setup** menu.

Determining the Separation Order

In Configuration Mode, you can choose between two different ways for dealing with the trace offsets on the recording (the order in which they are separated) when **Trace Separation** is **On**.

1. Enter the **Main Setup** menu by pressing the **Main Setup** SmartKey.
2. Select **Fetal Recorder**.
3. Select **Separation Order** to toggle between **Standard** and **Classic**.
   - **Standard**: the FHR2 trace is shifted up by 20 bpm (it is recorded 20 bpm higher than it really is). No offset is ever applied to the FHR1 trace - it stays where it is. (In case of a third FHR, this is shifted down by 20 bpm.)
   - **Classic**: the FHR1 trace is shifted up by 20 bpm when there is more than one FHR measurement. No offset is ever applied to the FHR2 trace - it stays where it is. (In case of a third FHR, this is shifted down by 20 bpm.)
4. Exit the **Main Setup** menu.

When Trace Separation is On

When trace separation is turned on, the recorder prints a dotted line labeled with the two FHRs at the top, and +20 at the bottom.

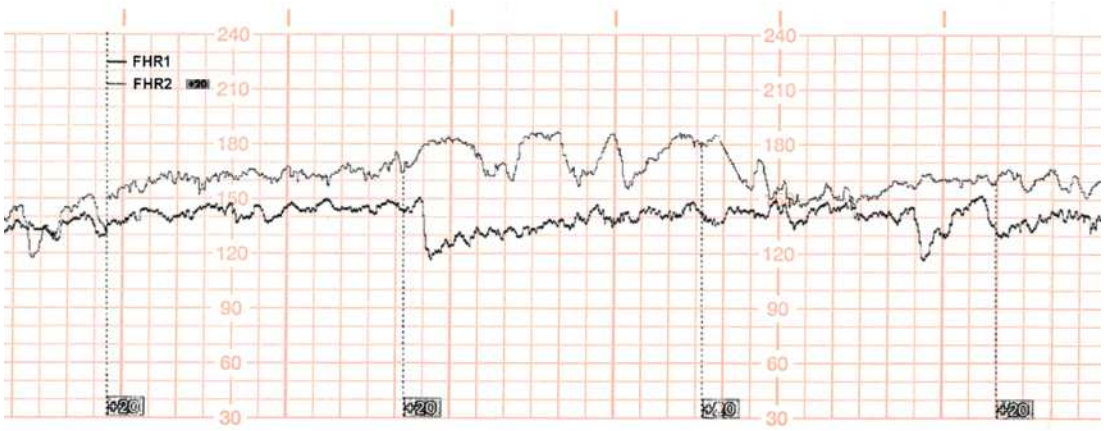
Examples of the two methods (Standard, Classic) for determining the trace separation order are provided here.

"Standard" Separation Order

To make differentiating the traces easier, the trace from the ultrasound transducer connected to the FHR2 channel is separated from that of FHR1 by 20 bpm. In other words, the trace for FHR2 is recorded 20 bpm higher than it really is. The trace for FHR1 is never shifted.

- The recorder prints a dotted line labeled +20 across the FHR scale, to identify the trace for FHR2.
- The FHR trace is labeled +20 every 5cm.
- The label for FHR2 is annotated with +20 .

The following trace shows trace separation switched on.



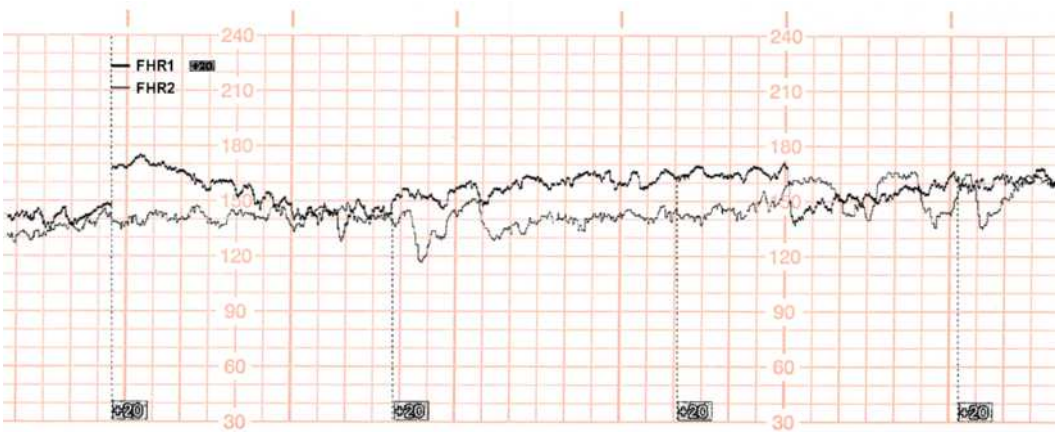
Only the FHR2 trace is offset. The numerical FHR value displayed on the monitor remains unchanged. Subtract 20 from the recorded trace for FHR2 to obtain the true FHR2 value. For example, if the recorded trace shows 160, then the true FHR is 140.

"Classic" Separation Order

To make differentiating the traces easier, the trace from the ultrasound transducer connected to the FHR1 channel is separated from that of FHR2 by 20 bpm. In other words, the trace for FHR1 is recorded 20 bpm higher than it really is. The trace for FHR2 is never shifted.

- The recorder prints a dotted line labeled +20 across the FHR scale, to identify the trace for FHR1.
- The FHR trace is labeled +20 every 5cm.
- The label for FHR1 is annotated with +20 .

The following trace shows trace separation switched on.



Only the FHR1 trace is offset. The numerical FHR value displayed on the monitor remains unchanged. Subtract 20 from the recorded trace for FHR1 to obtain the true FHR1 value. For example, if the recorded trace shows 160, then the true FHR is 140.

Switching Trace Separation On and Off

1 Connect three ultrasound transducers to the monitor to measure FHR.

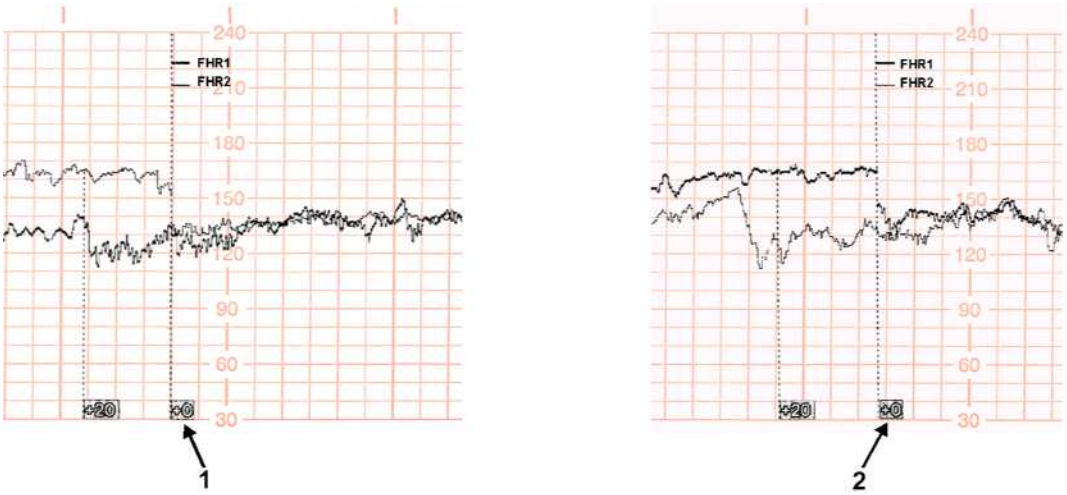
2 See "Switching Trace Separation On and Off" on page 116 for details of how to switch trace separation on or off.

When Trace Separation is On

When trace separation is turned on, the recorder prints a dotted line labeled with the three FHRs at the top, and ±20 at the bottom. Examples of the two methods (**Standard**, **Classic**) for determining the trace separation order are provided here.

When Trace Separation is Off

To indicate that trace separation is switched off, a dotted line labeled ±0 prints across the FHR scale.



1 "Standard" trace separation switched off here

2 "Classic" trace separation switched off here

Troubleshooting

Common problems that may occur when monitoring FHR using ultrasound are listed in "Monitoring FHR and FMP Using Ultrasound" on page 95. See also "Monitoring FHR Using DECG" on page 137 for common problems you might encounter when monitoring FHR directly.

The following problem may occur when monitoring twins.

Problem	Possible Cause	Solution
 is printed repeatedly, and appears on the screen.	Both transducers are recording the same FHR, or one fetal transducer is recording the MHR.	Reposition an ultrasound transducer.

For more information, see "Additional Information" on page 103.

11 Monitoring Twin FHRs

12

Monitoring Triple FHRs

If your monitor is equipped with the triplets option, it carries the  label.

You can monitor triple FHRs externally using three ultrasound transducers. Triplets monitoring is not possible using the Avalon CTS Cordless Fetal Transducer System.

Refer to the appropriate preceding chapters for contra-indications and other information about the measurement methods you have chosen.

FHR detection by the monitor may not always indicate that the fetuses are alive. Confirm fetal life before monitoring, and continue to confirm that the fetuses are the signal source for the recorded heart rate.

Important Considerations

The procedures and any contra-indications that apply for twins monitoring also apply for monitoring triplets. In addition, when monitoring triplets:

- Be aware that monitoring three FHRs is inherently more difficult than monitoring single or twin FHRs. The nature of the application increases the likelihood that a fetal heart rate is monitored by more than one transducer.

  Make sure that you are recording three different fetal heart rates. Pay particular attention to any coincidence of heart rates detected by the monitor's cross-channel verification feature. The cross-channel verification feature alerts you (by showing a ) if two or more heart rates coincide (that is, if two or more transducers are recording the same FHR, or if a fetal transducer is recording the MHR). If this happens, check the trace, and if necessary, reposition the ultrasound transducers as appropriate to detect all the FHRs correctly. If necessary, identify the FHRs using independent means, such as a fetoscope, stethoscope, or Pinard stethoscope.
- The blue transducer Finder LED lets you identify at a glance which transducer is monitoring which heart rate channel.

The fetal sensor socket to which a transducer is connected is identified by the transducer position indicator in the blue setup menu header:



for FM20/30;



for FM40/50.

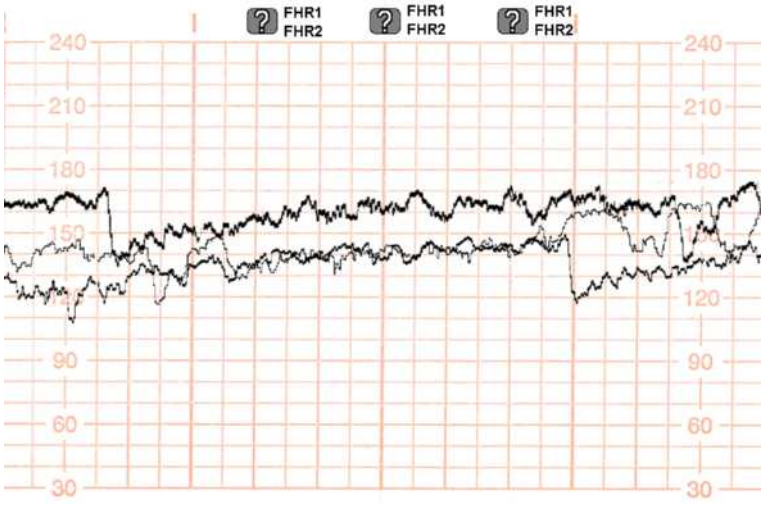
- The trace recorded for the FHR3 is thicker (darker) than that recorded for FHR1, which is thicker than that for FHR2. This ensures that the three heart rates are easily distinguishable. The thickness of the recorded trace can be changed in Configuration Mode.
- Remember that only one fetal heartbeat can be heard from the loudspeaker at any time. The audio source symbol  shows you which fetus you are listening to. To hear the another fetal heartbeat, select the fetal heart rate sound for this channel (see "Selecting Fetal Heart Sound" on page 99).
- Monitor maternal pulse to avoid mistaking maternal heart rate for FHR.
- Make sure you are recording the best possible signals by referring to the signal quality indicators and repositioning the transducers if necessary.

Monitoring Triplets

To monitor triple FHRs you need three ultrasound transducers. Follow the procedures described in "Monitoring FHR and FMP Using Ultrasound" on page 95 and in "Monitoring Twin FHRs" on page 113. The blue transducer Finder LED lets you identify at a glance which transducer is monitoring which heart rate channel.

Cross-Channel Verification

If the monitored heart rates (from a fetal or maternal source) coincide at any time (that is, if the same heart rate is being monitored by more than one transducer), this is detected via the monitor's cross-channel verification feature, and  is repeatedly printed on the trace paper after about 30 seconds. If the suspended coincidence persists for more than one minute without interruption, then the INOP **COINCIDENCE** will additionally appear on the screen. Check the trace and reposition one or more of the transducers, if necessary, to detect all FHRs correctly.



Separating FHR Traces

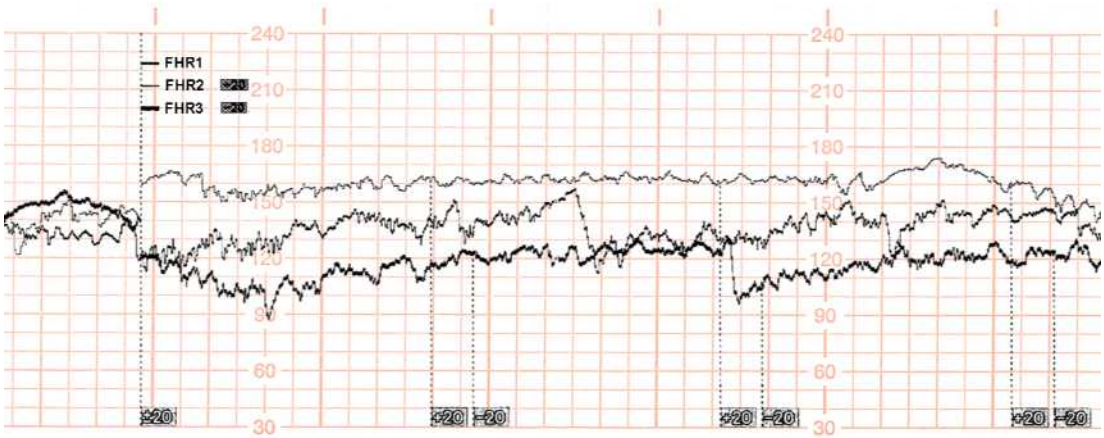
To help you to interpret traces with similar baselines, you can separate the baselines by an offset of 20 bpm by switching trace separation on. For details of the offset, see "Determining the Separation Order" on page 116.

"Standard" Separation Order

To make differentiating the traces easier, the trace for FHR2 is offset by +20 bpm, and the trace for FHR3 is offset by -20 bpm. In other words, the trace for FHR2 is recorded 20 bpm higher than it really is, while the trace for FHR3 is recorded 20 bpm lower than it really is. The trace for FHR1 is never shifted.

- The recorder prints a dotted line labeled +20 across the FHR scale, to identify the trace for FHR2.
- The recorder prints a dotted line labeled -20 across the FHR scale, to identify the trace for FHR3.
- The FHR trace is labeled +20 and -20 every 5cm.
- The label for FHR2 is annotated with +20 and the FHR3 label is annotated with -20 .

The following trace shows triplets with **Trace Separation** on, and using **Standard** separation order.



The traces for FHR2 and FHR3 are offset. The numerical FHR values displayed on the monitor remain unchanged. Subtract 20 from the recorded trace for FHR2 to obtain the true FHR2. For example, if the recorded trace shows 160, then the true FHR is 140. Similarly, add 20 to the recorded trace for FHR3 to obtain the true FHR3.

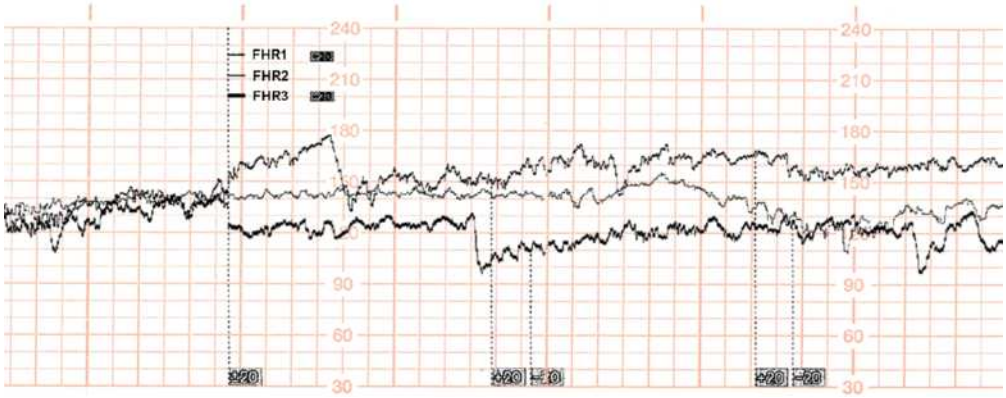
"Classic" Separation Order

To make differentiating the traces easier, the trace for FHR1 is offset by +20 bpm, and the trace for FHR3 is offset by -20 bpm. In other words, the trace for FHR1 is recorded 20 bpm higher than it really is, while the trace for FHR3 is recorded 20 bpm lower than it really is. The trace for FHR2 is never shifted.

- The recorder prints a dotted line labeled +20 across the FHR scale, to identify the trace for FHR1.
- The recorder prints a dotted line labeled -20 across the FHR scale, to identify the trace for FHR3.
- The FHR trace is labeled +20 and -20 every 5cm.

- The label for FHR1 is annotated with +20 and the FHR3 label is annotated with −20 .

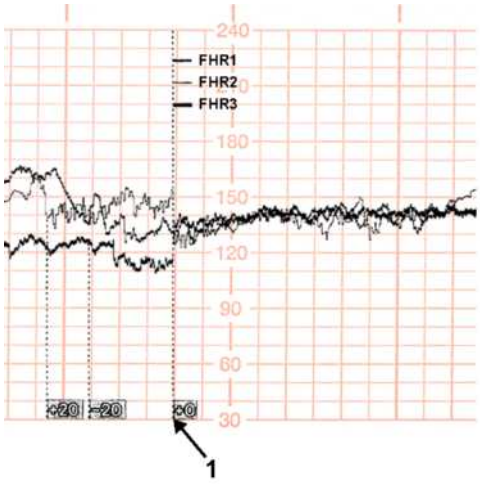
The following trace shows triplets with **Trace Separation** on, and using **Classic** separation order.

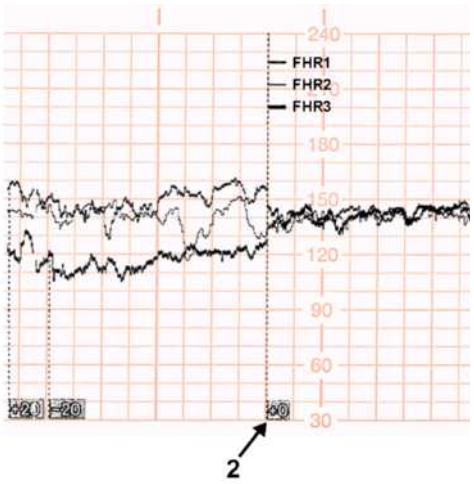


The traces for FHR1 and FHR3 are offset. The numerical FHR values displayed on the monitor remain unchanged. Subtract 20 from the recorded trace for FHR1 to obtain the true FHR1. For example, if the recorded trace shows 160, then the true FHR is 140. Similarly, add 20 to the recorded trace for FHR3 to obtain the true FHR3.

When Trace Separation is Off

To indicate that trace separation is switched off, a dotted line labeled +0 prints across the FHR scale.





1 "Standard" trace separation switched off here

2 "Classic" trace separation switched off here

Troubleshooting

Common problems that may occur when monitoring FHR using ultrasound are listed in “Monitoring FHR and FMP Using Ultrasound” on page 95.

The following problem may occur when monitoring triplets.

Problem	Possible Cause	Solution
 is printed repeatedly.	More than one transducer is recording the same FHR, or a fetal transducer records the same heart rate as the MHR.	Reposition one or more ultrasound transducer, as appropriate.

For more information, see “Additional Information” on page 103.

13

Fetal Heart Rate Alarms

Fetal heart rate (FHR) alerting can give both audible and visual warning of a non-reassuring fetal condition. **Your monitor must be configured to alarm mode All to enable the FHR alerting** (see "Alarms" on page 63).

Changing Alarm Settings

When you do any of the following actions for any FHR measurement channel, this applies for all active FHR measurements, both ultrasound and DECG:

- Turning FHR alarms on or off.
- Changing alarm limits.
- Changing alarm delays.
- Changing signal loss delay.

The monitor retains these settings, even when switched off. The alarm limits are printed on the trace every few pages if alarms are on.

Turning Alarms On or Off

1. Connect either an ultrasound or a DECG transducer to a free socket on the monitor.
2. Enter the Setup Menu for a connected FHR measurement.
3. Select **Alarms** to toggle between **On** and **Off**.

Changing Alarm Limits

1. Connect either an ultrasound or a DECG transducer to a free socket on the monitor.
2. Enter the Setup Menu for a connected FHR measurement.
3. To change the high alarm limit, select **High Limit** and select the alarm limit from the pop-up list.
4. To change the low alarm limit, select **Low Limit** and select the alarm limit from the pop-up list.

Changing Alarm Delays

You can change the alarm delays in Configuration Mode.

1 Connect either an ultrasound or a DECG transducer to a free socket on the monitor.

2 Enter the Setup Menu for a connected FHR measurement.

3 To change the high alarm limit delay time, select **High Delay** and select the delay time (in seconds) from the pop-up list.

4 To change the low alarm limit delay time in seconds, select **Low Delay** and select the delay time (in seconds) from the pop-up list.

Changing Signal Loss Delay

The signal loss delay is the configurable delay before an INOP. You can change the delay in Configuration mode:

1 Connect either an ultrasound or a DECG transducer to a free socket on the monitor.

2 Enter the Setup Menu for a connected FHR measurement.

3 Select **SignalLoss Delay** and select the signal loss INOP delay time (in seconds) from the pop-up list.

14

Monitoring Uterine Activity Externally

You can measure uterine activity externally using a Toco transducer. You can also use a Toco+ or Toco MP transducer for the same purpose, although they also have wider (ECG/IUP and Pulse) capabilities.

The external Toco transducer measures the frequency, duration and relative strength of contractions, but not their absolute intensity. Amplitude and sensitivity depend on various factors such as the position of the transducer, the belt tension and the size of the patient.

What You Need



Toco, Toco MP or Toco+ Transducer



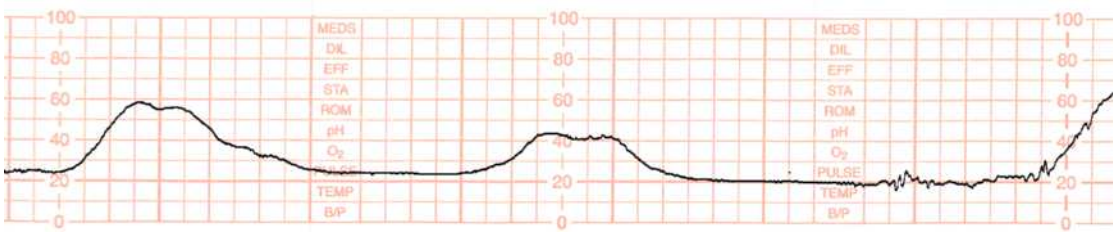
Abdominal Belt (disposable shown)

External Toco Monitoring

Prepare for Toco monitoring using the list below. The standard procedures in use in your facility determine the sequence of actions.

- Fasten the abdominal transducer belt around the patient.
- Connect the Toco transducer to a free socket on the monitor. The Toco baseline is automatically reset. The Toco display shows 20. "Toco", indicating external uterine measurement, is printed on the trace at intervals.
- Place the transducer on the patient's fundus to ensure the optimum recording of uterine activity.
- Reset the Toco baseline as necessary (see “Resetting the Toco Baseline” on page 130), but not during a contraction.

The following example trace shows two contractions.



Resetting the Toco Baseline

Press the **Toco Baseline** SmartKey. This resets the Toco baseline to 20 on the display and trace.

Automatic Baseline Adjustment

If the Toco value is negative for more that five seconds, the Toco baseline is automatically reset to 0 units.

Toco Sensitivity

If the Toco sensitivity is too high, and the Toco trace exceeds the paper scale, you can reduce the Toco sensitivity to 50%. The default setting is 100%.

To change the Toco sensitivity:

1 Enter the **Setup Toco** menu.

2 Select **Gain** to toggle between **100%** and **50%**.

Troubleshooting

External Toco Monitoring		
Problem	**Possible Causes**	**Solutions**
Quality of the trace deteriorates or the Toco baseline varies.	The belt is incorrectly fastened and is too slack or too tight or the belt has lost its elasticity.	The belt must be tight enough to ensure good contact between the patient's skin and the entire surface of the transducer without causing discomfort. Ensure you are using the correct belt. Adjust it as necessary.
	Fetal movement.	Check the belt is correctly fastened (see above) and adjust as necessary. Reposition the transducer and reset the Toco baseline if necessary.
	Maternal respiration superimposed on trace.	Check belt is not too loose.
	Maternal movement/change of position.	Following maternal movement, reset Toco baseline.
Toco sensitivity is too high (above 100 units). Toco trace is exceeding the paper scale.	Physical transmission of pressure from the uterus to the sensor is much higher than the average value.	The belt must be tight enough to ensure good contact between the patient's skin and the entire surface of the transducer without causing discomfort. Ensure you are using the correct belt. Adjust it as necessary.Ensure a good contact between the patient's skin and the entire surface of the transducer. Reposition transducer if necessary.
		Ensure the belt is not too loose. The belt must be tight enough to ensure good contact between the patient's skin and the entire surface of the transducer without causing discomfort. Ensure you are using the correct belt. Adjust it as necessary.
		Select 50% Toco sensitivity.
Toco EQUIP MALF is displayed.		See the chapter "Patient Alarms and INOPs" on page 73.
Toco UNPLUGGED is displayed.		See the chapter "Patient Alarms and INOPs" on page 73.
If you suspect the signal from the transducer.		Test the Transducer (see "Testing Toco Transducers" on page 132 below).

Testing Toco Transducers

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.

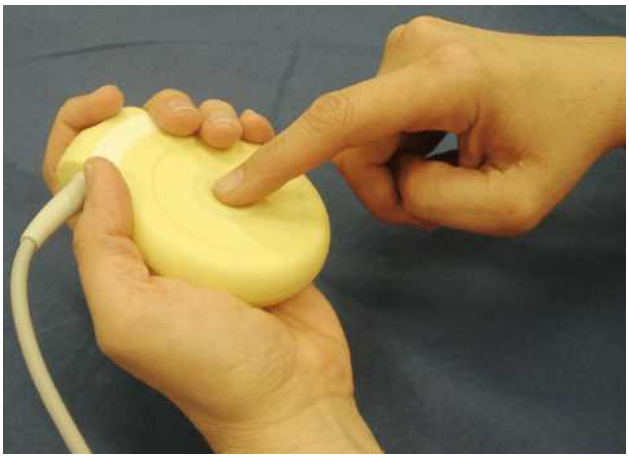
If the second transducer also fails the tests, contact your Philips Service Engineer or Response Center.

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 pick-up button.



4 Check that, after a few seconds, the value on the display and paper shows this change in pressure.

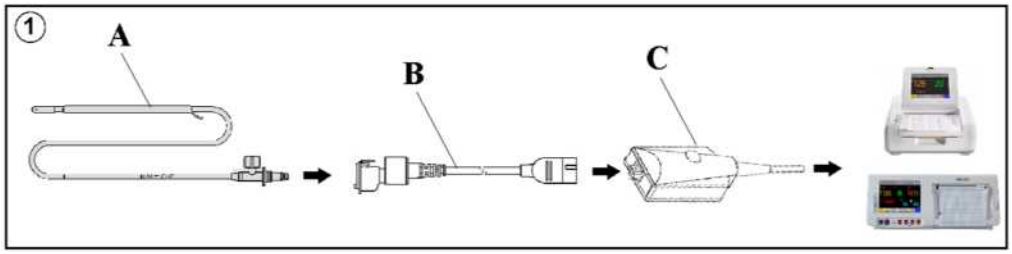
15

Monitoring Uterine Activity Internally

FM30/50 You can monitor intrauterine pressure (IUP) using an intrauterine catheter together with a patient module or a Toco$^+$ transducer, after rupture of the membranes and the cervix is sufficiently dilated.

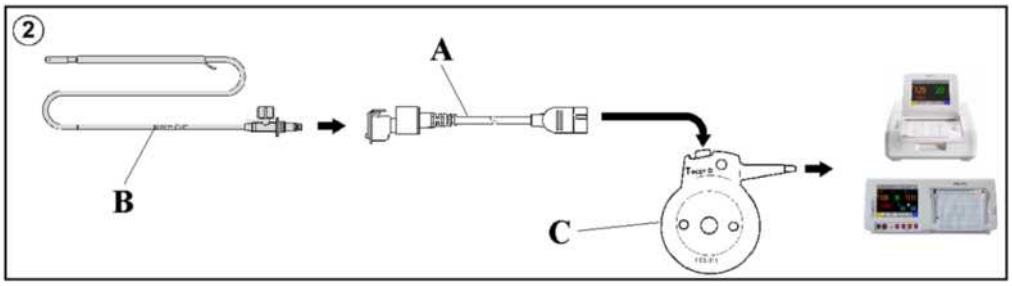
What You Need

Illustration 1 shows the complete connection chain from the IUP catheter to the fetal monitor using the patient module:



A Disposable Koala IUP Catheter
B Reusable Koala IUP Adapter Cable (9898 031 43931)
C Patient Module (M2738A)

Illustration 2 shows the complete connection chain from the IUP catheter to the fetal monitor using the Toco$^+$ transducer:



A Reusable Koala IUP Adapter Cable (9898 031 43931)
B Disposable Koala IUP Catheter

C Toco+ Transducer (M2735A)

Internal (IUP) Monitoring

Read the instructions that accompany the intrauterine catheter and the adapter cable before you start monitoring. Zero the monitor when instructed.

WARNING

Do not catheterize if placenta previa is diagnosed or if uterine bleeding from an undetermined source is present.

Prepare for IUP monitoring using the list below. The standard procedures in use in your facility determine the sequence of actions.

- Perform a complete clinical evaluation.
- Catheterize after membrane rupture. Insert the catheter according to its accompanying instructions.
- Connect the catheter to the socket on the patient module.
- Connect the patient module to a free socket on the monitor. The monitor is automatically zeroed. The IUP display shows 0. "IUP", indicating internal measurement, is printed at intervals on the trace.
- Zero the monitor (see “Zeroing the Monitor” on page 134).
- If you suspect the catheter is not responding appropriately, flush as directed in the catheter's instructions for use. A pressure spike appears on the trace if you flush after connecting the transducer to the monitor.

Zeroing the Monitor

Zero the monitor by selecting the **Zero IUP** SmartKey  or selecting **Zero IUP** in the **Setup IUP** menu. This resets the display and trace to 0. If you do not zero the monitor properly, the pressure trace may exceed the paper scaling. While zeroing the IUP measurement, ensure that the transducer is at the same level as the maternal xiphoid (lower end of the sternum).

Selecting the IUP Unit

You can select between mmHg (default) and kPa for the IUP unit.

1 Enter the **Setup IUP** menu.

2 Press **Unit** to toggle between mmHg and kPa.

Troubleshooting

Internal (IUP) Monitoring		
Problem	**Possible Causes**	**Solutions**
No change in pressure during contraction.	Dry environment or possible extra-ovular placement of sensor tip.	Please refer to catheter Instructions for Use.
Only pressure peaks can be seen (baseline not visible).	Zero adjustment is incorrect.	Zero the system.
Trace is a straight line.	Transducer is defective.	Remove and touch the catheter. If the trace does not show up and down movements, use a new transducer.
	Catheter blocked.	Please refer to catheter Instructions for Use.
Trace is superimposed with noise.	End of catheter is in the uterine wall.	Please refer to catheter Instructions for Use.
IUP EQUIP MALF INOP is displayed.		See "Patient Alarms and INOPs" on page 73.
IUP UNPLUGGED INOP is displayed.		

16

Monitoring FHR Using DECG

FM30/50 This chapter describes how to monitor a single fetal heart rate via direct ECG (DECG), using a spiral fetal scalp electrode in the intrapartum period.

Read and adhere to the instructions that accompany the fetal scalp electrode, the DECG adapter cable, and the attachment electrode. Pay attention to all the contraindications, warnings, and for the DECG adapter cable, the cleaning and disinfection procedures.

Before starting to monitor, first define the fetal position, and ensure that it is suitable for DECG monitoring.

Misidentification of MHR as FHR

Confirm fetal life before monitoring, and continue to confirm that the fetus is the signal source for the FHR during monitoring. Here are two examples where the MHR can be misidentified as the FHR when using a fetal scalp electrode:

- Electrical impulses from the maternal heart can sometimes be transmitted to the fetal monitor through a recently deceased fetus via the spiral scalp electrode, appearing to be a fetal signal source.
- The recorded MHR, and any artifact, can be misinterpreted as a FHR especially when it is over 100 bpm.

To reduce the possibility of mistaking the MHR for FHR, it is recommended that you monitor both maternal and fetal heart rates (see “Monitoring Maternal Heart / Pulse Rate” on page 155). The monitor's cross-channel verification (CCV) facility can help by automatically detecting when the same heart rate is being recorded by different transducers.

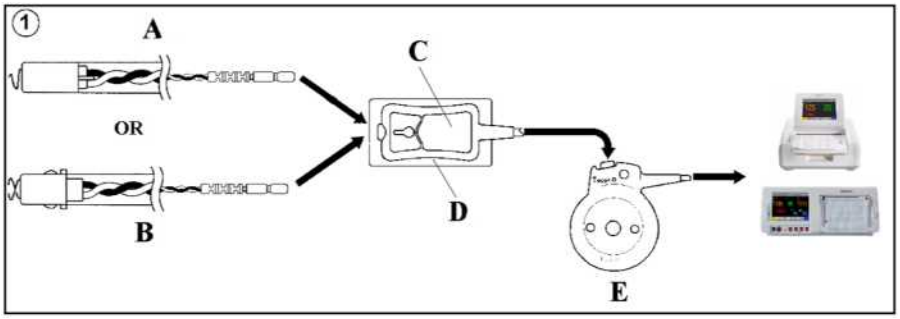
What You Need

You can measure fetal DECG using the equipment combinations shown in the following illustrations.

WARNING

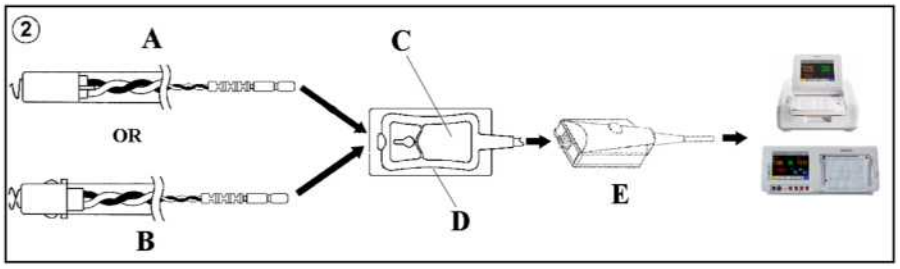
NEVER attempt to connect the fetal scalp electrode to anything other than the correct DECG adapter cable.

Illustration 1 shows the complete connection chain from the fetal scalp electrode to the fetal monitor using the Toco+ transducer.



A Fetal Scalp Electrode, single spiral (9898 031 37631)
B Fetal Scalp Electrode, double spiral, Europe only, not for USA (9898 031 37641)
C DECG Adapter Cable (9898 031 37651)
D Pre-gelled Attachment Electrode (9898 031 39771)
E Toco+ Transducer (M2735A)

Illustration 2 shows the equivalent chain using the patient module.



A Fetal Scalp Electrode, single spiral, (9898 031 37631)
B Fetal Scalp Electrode, double spiral, Europe only, not for USA (9898 031 37641)
C DECG Adapter Cable (9898 031 37651)
D Pre-gelled Attachment Electrode (9898 031 39771)
E Patient Module (M2738A)

Making Connections

WARNING

Follow the instructions supplied with each of the monitoring accessories you are using.

Prepare for DECG monitoring using the list below. The standard procedures in use in your facility determine the sequence of actions.

- If changing monitoring mode from US to DECG, first disconnect the US transducer.
- Depending on the equipment you are using, ensure that *either* the Toco$^+$ transducer *or* the patient module is connected to the fetal monitor.
- Attach the fetal scalp electrode to the fetus, following the instructions supplied with the fetal scalp electrode.
- Attach a pre-gelled attachment electrode to the DECG adapter cable, following the instructions supplied with the DECG adapter cable.
- Fix the attachment electrode to the mother's thigh, following the instructions supplied with the attachment electrode.
- Depending on the equipment you are using, connect the red connector plug on the DECG adapter cable to the red connector on either the Toco+ transducer or the patient module.
- Connect the fetal scalp electrode to the DECG adapter cable.

You are now ready to begin monitoring DECG.

WARNING

The fetal/maternal monitor is not a diagnostic ECG device. In particular, the display of fetal/maternal ECG is intended only for evaluating signal quality for fetal/maternal heart rate as derived from the ECG waveform.

When in doubt, it can be used to identify sources of compromised signal quality, such as noise or muscle artifacts. It can subsequently be used to verify the result of measures taken to resolve them (e.g., checking ECG cable connections or adapting the fetal **ArtifactSuppress** configuration).

The safety and effectiveness of the displayed fetal/maternal ECG waveform (i.e., P, QRS and T segments) for evaluation of fetal/maternal cardiac status during labor have not been evaluated.

Monitoring DECG

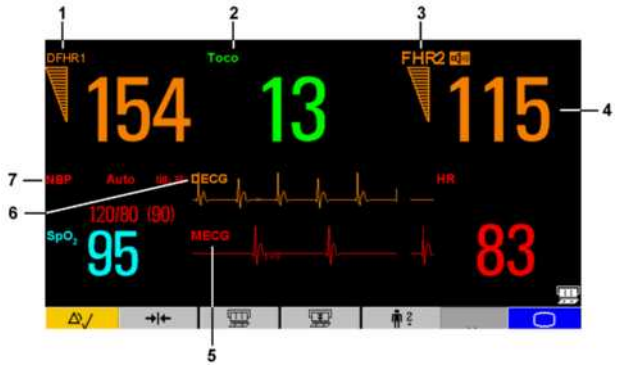
To simultaneously measure DECG and MECG, you need, for instance, a Toco$^+$ transducer for DECG, and a patient module for MECG (see “Monitoring Maternal Heart / Pulse Rate” on page 155). Alternatively, you can monitor the maternal pulse rate via pulse oximetry (see “Pulse Rate from SpO2” on page 159). You can also monitor maternal pulse with the Toco Pulse transducer.

1 Switch on the recorder.

2 The heart rate monitored via DECG is labeled **DFHR1** / **DFHR2** / **DFHR3** on the screen. If configured, the DECG wave is displayed automatically on the screen, labeled **DECG**. If MECG is

being monitored, both waves are displayed, with the DECG wave above the MECG wave. The MECG wave is labeled **MECG**.

3 Check the artifact suppression setting and change it if necessary (see "Suppressing Artifacts" on page 140).



1 Measurement label (DFHR1)
2 Measurement label (Toco)
3 Additional measurement label (FHR2)
4 Numeric/measurement values
5 MECG wave
6 DECG wave
7 Noninvasive blood pressure

WARNING

Periodically compare the mother's pulse with the signal coming from the monitor's loudspeaker to ensure that you are monitoring fetal heart rate. If the MHR coincides with the FHR, do not misinterpret the MHR as the FHR (see also "Confirm Fetal Life Before Using the Monitor" on page 10). When you monitor MHR simultaneously with FHR, cross-channel verification (CCV) warns you of this possibility.

Suppressing Artifacts

When the monitor's artifact suppression is on, instantaneous heart rate changes of 28 bpm or more, however caused, are not recorded. Fetal arrhythmia will also be suppressed. **If you suspect fetal arrhythmia, switch artifact suppression off.** When artifact suppression is off, all recorded fetal heartbeats within the specified range are shown. The default setting is **On** (artifacts are suppressed).

To change the setting:

1 Enter the **Setup DFHR1** menu.

2 Select **ArtifactSuppress** to toggle between artifact suppression **On** (artifacts are suppressed) and **Off** (no artifact suppression, use this setting if you suspect fetal arrhythmia).

When artifact suppression is off, **Artifact Suppression Off** is annotated on the trace recording.

Printing the Waveform

You can print the DECG wave onto the trace paper. Please refer to "Printing the ECG Waveform" on page 161.

Troubleshooting

Problem	Possible Cause	Solutions
DFHR1 EQUIP MALF **DFHR2 EQUIP MALF** **DFHR3 EQUIP MALF**		See "Patient Alarms and INOPs" on page 73.
DFHR1 LEADS OFF **DFHR2 LEADS OFF** **DFHR3 LEADS OFF** Numeric is displayed with a - ? -; INOP tone. See also "Patient Alarms and INOPs" on page 73.	Spiral electrode detached at connector. Poor or no contact between leg attachment electrode and mother. No contact between the DECG adapter cable and the leg attachment electrode. No contact between the fetal scalp electrode connector and the DECG adapter cable.	Reconnect the fetal scalp electrode. Check all connections. Disconnect and reconnect the connector several times. Check all connections. Disconnect and reconnect the connector several times. If problem persists, use a new fetal scalp electrode.
Erratic trace Erratic display	No ECG signal. Poor contact between the reference electrode and the mother.	Check for fetal demise. Use a new fetal scalp electrode if necessary. Use a new fetal scalp electrode if necessary.
Signal quality indicator continuously shows a poor signal.	Fetal arrhythmia.	Use a new fetal scalp electrode if necessary.
DFHR1 SIGNAL LOSS **DFHR2 SIGNAL LOSS** **DFHR3 SIGNAL LOSS**		See "Patient Alarms and INOPs" on page 73.
DFHR1 UNPLUGGED **DFHR2 UNPLUGGED** **DFHR3 UNPLUGGED**		See "Patient Alarms and INOPs" on page 73.

Testing DECG Mode

Refer to the monitor's *Service Guide*.

17

Monitoring Noninvasive Blood Pressure

This fetal monitor uses the oscillometric method for the noninvasive blood pressure measurement. In adult mode, the blood pressure measurements determined with this device comply with the American National Standard for Electronic or Automated Sphygmomanometers (ANSI/AAMI SP10-1992) in relation to mean error and standard deviation, when compared to intra-arterial or auscultatory measurements (depending on the configuration) in a representative sample population. For the auscultatory reference, the fifth Korotkoff sound was used to determine the diastolic pressure.

A physician must determine the clinical significance of the measurement information.

Introducing the Oscillometric Noninvasive Blood Pressure Measurement

Oscillometric devices measure the amplitude of pressure changes in the occluding cuff as the cuff deflates from above systolic pressure. The amplitude suddenly increases as the pulse breaks through the occlusion in the artery. As the cuff pressure decreases further, the pulsations increase in amplitude, reach a maximum (which approximates to the mean pressure), and then diminish.

Studies show that, especially in critical cases (arrhythmia, vasoconstriction, hypertension, shock), oscillometric devices are more accurate and consistent than devices using other noninvasive measuring techniques.

WARNING

Intravenous infusion: Do not use the NBP cuff on a limb with an intravenous infusion or arterial catheter in place. This could cause tissue damage around the catheter when the infusion is slowed or blocked during cuff inflation.

Skin Damage: Do not measure NBP in cases of sickle-cell disease or any condition where skin damage has occurred or is expected.

Unattended measurement: Use clinical judgement to decide whether to perform frequent unattended blood pressure measurements in cases of severe blood clotting disorders because of the risk of hematoma in the limb fitted with the cuff.

CAUTION

If you spill liquid onto the equipment or accessories, particularly if there is a chance that it can get inside the tubing or the measurement device, contact your service personnel.

Measurement Limitations

Measurements are impossible with heart rate extremes of less than 40 bpm or greater than 300 bpm, or if the patient is on a heart-lung machine.

The measurement may be inaccurate or impossible:

- with excessive and continuous patient movement such as during contractions
- if a regular arterial pressure pulse is hard to detect
- with cardiac arrhythmias
- with rapid blood pressure changes
- with severe shock or hypothermia that reduces blood flow to the peripheries
- with obesity, where a thick layer of fat surrounding a limb dampens the oscillations coming from the artery
- on an edematous extremity.

Measurement Methods

There are two measurement methods:

- **Manual** - measurement on demand. Results are displayed for up to one hour.
- **Auto** - continually repeated measurements (between one and 120 minute adjustable interval). You can make a manual measurement between two measurements in Auto mode.

Reference Method

The measurement reference method can be Auscultatory (manual cuff) or Invasive (intra-arterial). For further information, see the Application Note supplied on the monitor documentation DVD.

To check the current setting, select **Main Setup** -> **Measurements** ->**NBP**, and check whether the **Reference** setting is set to **Auscultatory** or **Invasive**. This setting can be changed in Configuration Mode.

Preparing to Measure Noninvasive Blood Pressure

If possible, avoid taking measurements during contractions because the measurement may be unreliable and may cause additional stress for the patient.

1. Connect the cuff to the air tubing.
2. Plug the air tubing into the red NBP connector. Avoid compression or restriction of pressure tubes. Air must pass unrestricted through the tubing.
3. Make sure that you are using a Philips-approved correct sized cuff and that the bladder inside the cover is not folded or twisted.

A wrong cuff size, and a folded or twisted bladder, can cause inaccurate measurements. The width of the cuff should be in the range from 37% to 47% of the limb circumference. The inflatable part of the cuff should be long enough to encircle at least 80% of the limb.

4 Apply the cuff to a limb at the same level as the heart. If it is not, you must use the measurement correction formula to correct the measurement.

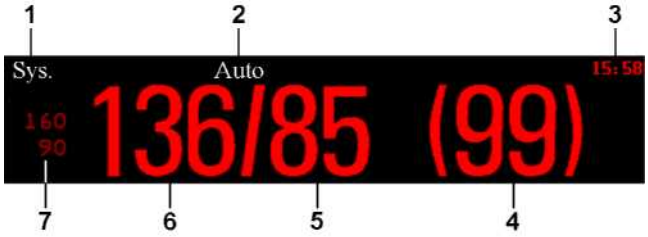
The marking on the cuff must match the artery location. Do not wrap the cuff too tightly around the limb. It may cause discoloration, and ischemia of the extremities. Inspect the application site regularly to ensure skin quality and inspect the extremity of the cuffed limb for normal color, warmth and sensitivity. If the skin quality changes, or if the extremity circulation is being affected, move the cuff to another site or stop the blood pressure measurements immediately. Check more frequently when making automatic or stat measurements.

Correcting the Measurement if Limb is not at Heart Level

To correct the measurement if the limb is not at heart level, to the displayed value

add 0.75 mmHg (0.10 kPa) for each **centimeter** higher or	deduct 0.75 mmHg (0.10 kPa) for each **centimeter** lower or
add 1.9 mmHg (0.25 kPa) for each **inch** higher.	deduct 1.9 mmHg (0.25 kPa) for each **inch** lower.

Understanding the Numerics



1 Alarm source
2 Measurement Mode
3 Timestamp/Timer
4 Mean pressure
5 Diastolic
6 Systolic
7 Alarm limits

Depending on the numeric size, not all elements may be visible. Your monitor may be configured to display only the systolic and diastolic values.

Alarm Sources

If you have parallel alarm sources, the sources are displayed instead of the alarm limits.

NBP Timestamp

Depending on your configuration, the time shown beside the NBP numeric can be:

- the time of the most recent NBP measurement, also known as the "timestamp", or
- the time until the next measurement in an automatic series, displayed with a graphic representation of the remaining time, as shown here.



The NBP timestamp will normally show the **completion** time of the NBP measurement. Only under the following conditions the timestamp shows the **beginning** of the measurement:

- when in **Auto** or **Sequence** mode, **and**
- the monitor is configured to synchronize the measurements in a measurement series to an "easy-to-document" time. For example, if you start the first measurement at 08:23, and the **Repeat Time** is set to 10 minutes, the monitor automatically performs the next measurement at 8:30, then 8:40 and so on.

During Measurements

The cuff pressure is displayed instead of the units and the repeat time. An early systolic value gives you a preliminary indication of the systolic blood pressure during measurement.

Starting and Stopping Measurements

Use the Setup menu or the SmartKeys to start and stop measurements.

Action to be performed	Setup menu	SmartKeys
Start/Stop manual measurement Start Auto series Stop current automatic measurement	**Start/Stop**	 **Start/ Stop**
Start manual measurement Start Auto series	-	 **Start**
Stop manual measurement Stop current automatic measurement	-	 **Stop**
Stop automatic, or manual measurement AND series	**Stop All NBP**	 **Stop All**

Enabling Automatic Mode and Setting Repetition Time

1 In the **Setup NBP** menu, select **Mode**.

2 Toggle between **Auto** and **Manual**, if necessary, to pick the measurement method.

3 If making an automatic measurement, select **Repeat Time** or press the **Repeat Time** SmartKey  and set the time interval between two measurements.

NOTE

Be aware that a combination of a recorder speed of less than 3 cm/min and a repetition time of less than five minutes can result in not all noninvasive blood pressure measurements being recorded on the fetal trace. For example, if the recorder speed is set to 1 cm/min and the repetition time is set to 2 minutes, due to the low speed setting, the recorder will only be able to record every other noninvasive blood pressure measurement. This affects only the local fetal trace recording, and all measurements are displayed as normal on the monitor's screen.

Choosing the Alarm Source

You can monitor for alarm conditions in systolic, diastolic and mean pressure, either singly or in parallel. Only one alarm is given, with the priority of mean, systolic, diastolic.

Menu option	Pressure value monitored
Sys.	systolic
Dia.	diastolic
Mean	mean
Sys & Dia	systolic and diastolic in parallel
Dia & Mean	diastolic and mean in parallel
Sys & Mean	systolic and mean in parallel
Sys&Dia&Mean	all three pressures in parallel

If mean is not selected as alarm source (**Sys.**, **Dia.**, or **Sys & Dia** selected), but the fetal monitor can only derive a mean value, mean alarms will nevertheless be announced using the most recent mean alarm limits. Check that the mean alarm limits are appropriate for the patient, even when not using mean as the alarm source. When no value can be derived an **NBP MEASURE FAILED** INOP will be displayed.

Assisting Venous Puncture

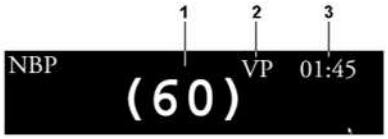
You can use the cuff to cause sub-diastolic pressure. The cuff deflates automatically after a set time if you do not deflate it.

1 In the **Setup NBP** menu select **VeniPuncture**.

2 Puncture vein and draw blood sample.

3 Reselect **VeniPuncture** to deflate the cuff.

During measurement, the display shows the inflation pressure of the cuff and the remaining time in venous puncture mode.



1 Cuff pressure
2 Venous puncture measurement mode
3 Time left in venous puncture mode

Calibration

NBP is not user-calibrated. Cuff-pressure transducers must be verified at least once every two years by a qualified service professional, and calibrated, if necessary. See the Service Guide for details.

Troubleshooting

Problem	Possible Causes	Solutions
Cuff will not inflate.	Monitor is in Service or Configuration Mode.	
	Technical defect.	Call service.
	Cuff tubing not connected.	Connect cuff tubing.
High or low values measured (against clinical expectations).	Contraction occurring.	Wait until contraction has finished.
	Patient talking before or during measurement.	Allow patient to rest quietly, then try again after three to five minutes.
	Incorrect cuff size or cuff not at heart level.	Check cuff size, level, and position.
	Noninvasive blood pressure reference method set incorrectly.	Check the reference method configured (auscultatory or intra-arterial) and correct if necessary in Configuration Mode.
Displays zeros for systolic and diastolic values. Measurement automatically repeats.	Severe vasoconstriction at cuff site.	Move cuff to another limb, check for shock, or verify blood pressure using another method.
	Erratic blood pressure fluctuations due to arrhythmias or rapid-acting drugs or contractions.	Try again, if unsuccessful, verify blood pressure using another method. Wait until contraction has finished.
	Excessive patient movement or convulsions.	Restrain movement or verify blood pressure using another method.
NBP CUFF OVERPRESS INOP is displayed.		See "Patient Alarms and INOPs" on page 73.
NBP EQUIP MALF INOP is displayed.		
NBP INTERRUPTED INOP is displayed		
NBP MEASURE FAILED		

18

Monitoring SpO2

FM30/40/50 The pulse oximetry measurement (SpO_2) is intended for use with maternal patients.

Philips pulse oximetry uses a motion-tolerant signal processing algorithm, based on Fourier Artifact Suppression Technology (FAST). It provides two measurements:

- Oxygen saturation of arterial blood (SpO_2) - percentage of oxygenated hemoglobin in relation to the sum of oxyhemoglobin and deoxyhemoglobin (functional arterial oxygen saturation).
- Pulse rate - detected arterial pulsations per minute. This is derived from the SpO_2 value, and is one of three sources of the maternal heart/pulse rate used for cross-channel verification (see "Monitoring Maternal Heart / Pulse Rate" on page 155).

Selecting an SpO2 Sensor

See "Accessories and Supplies" on page 179 for a list of sensors, and the patient population and application sites for which they are appropriate.

Familiarize yourself with the instructions for use supplied with your sensor before using it.

CAUTION

Do not use OxiCliq disposable sensors in a high humidity environment, such as in neonatal incubators or in the presence of fluids, which may contaminate sensor and electrical connections causing unreliable or intermittent measurements. **Do not use** disposable sensors when there is a known allergic reaction to the adhesive.

Applying the Sensor

1. Follow the SpO_2 sensor's instructions for use, adhering to all warnings and cautions.
2. Remove colored nail polish from the application site.
3. Apply the sensor to the patient. The application site should match the sensor size so that the sensor can neither fall off, nor apply excessive pressure.
4. Check that the light emitter and the photodetector are directly opposite each other. All light from the emitter must pass through the patient's tissue.

WARNING

Proper Sensor Fit: If a sensor is too loose, it might compromise the optical alignment or fall off. If it is too tight, for example because the application site is too large or becomes too large due to edema, excessive pressure may be applied. This can result in venous congestion distal from the application site, leading to interstitial edema, hypoxemia and tissue malnutrition. Skin irritations or lacerations may occur as a result of the sensor being attached to one location for too long. To avoid skin irritations and lacerations, periodically inspect the sensor application site and change the application site regularly.

Venous Pulsation: Do not apply sensor too tightly as this results in venous pulsation which may severely obstruct circulation and lead to inaccurate measurements.

Ambient Temperature: At elevated ambient temperatures be careful with measurement sites that are not well perfused, because this can cause severe burns after prolonged application. All listed sensors operate without risk of exceeding 41°C on the skin if the initial skin temperature does not exceed 35°C.

Extremities to Avoid: Avoid placing the sensor on extremities with an arterial catheter, an NBP cuff or an intravascular venous infusion line.

Connecting SpO2 Cables

Connect the sensor cable to the color-coded socket on the monitor. If you are using a disposable sensor, plug the sensor into the adapter cable and connect this to the monitor. Connect reusable sensors directly to the monitor.

CAUTION

Extension cables: Do not use more than one extension cable (M1941A). Do not use an extension cable with Philips reusable sensors or adapter cables with part numbers ending in -L (indicates "long" cable version).

Electrical Interference: Position the sensor cable and connector away from power cables, to avoid electrical interference.

Measuring SpO2

During measurement, ensure that the application site:

- has a pulsatile flow, ideally with a signal quality indicator of at least medium.
- has not changed in its thickness (for example, due to edema), causing an improper fit of the sensor.

WARNING

- For fully conscious pediatric or adult patients, who have a normal function of perfusion and sensory perception at the measurement site:

  To ensure skin quality and correct optical alignment of the sensor, inspect the application site when the measurement results are suspicious or when the patient complains about pressure at the application site, but at least every 24 hours. Correct the sensor alignment if necessary. Move the sensor to another site, if the skin quality changes.

- For all other patients:

  Inspect the application site every two to three hours to ensure skin quality and correct optical alignment. Correct the sensor alignment if necessary. If the skin quality changes, move the sensor to another site.
  Change the application site at least every four hours.

- Injected dyes such as methylene blue, or intravascular dyshemoglobins such as methemoglobin and carboxyhemoglobin may lead to inaccurate measurements.
- Inaccurate measurements may result when the application site for the sensor is deeply pigmented or deeply colored, for example, with nail polish, artificial nails, dye or pigmented cream.
- Interference can be caused by:
  - High levels of ambient light (including IR warmers) or strobe lights or flashing lights (such as fire alarm lamps). (Hint: cover application site with opaque material.)
  - Another SpO_2 sensor in close proximity (e.g. when more than one SpO_2 measurement is performed on the same patient). Always cover both sensors with opaque material to reduce cross-interference.
  - Electromagnetic interference, especially at perfusion indicator values below 1.0 or signal quality indicator below medium.
  - Excessive patient movement and vibration.

SpO2 Signal Quality Indicator

The SpO_2 numeric is displayed together with a signal quality indicator (if configured and enough space is available) which gives an indication of the reliability of the displayed values.

The level to which the triangle is filled shows the quality of the signal; the indicator below shows a medium signal quality, the signal quality is at a maximum when the triangle is completely filled.



Assessing a Suspicious SpO2 Reading

Traditionally, pulse rate from SpO_2 was compared with heart rate from ECG to confirm the validity of the SpO_2 reading. With newer algorithms, such as FAST-SpO_2, this is no longer a valid criteria because the correct calculation of SpO_2 is not directly linked to the correct detection of each pulse.

When pulse rate is very low, or strong arrhythmia is present, the SpO_2 pulse rate may differ from the heart rate calculated from ECG but this does not indicate an inaccurate SpO_2 value.

WARNING

With pulse oximetry, sensor movement, ambient light (especially strobe lights or flashing lights) or electromagnetic interference can give unexpected intermittent readings when the sensor is not attached. Especially bandage-type sensor designs are sensitive to minimal sensor movement that might occur when the sensor is dangling.

Understanding SpO2 Alarms

This refers to SpO_2 specific alarms. See the Alarms chapter for general alarm information. SpO_2 offers high and low limit alarms, and a high priority desat alarm. You cannot set the low alarm limit below the desat alarm limit.

CAUTION

If you measure SpO_2 on a limb that has an inflated noninvasive blood pressure cuff, a non-pulsatile SpO_2 INOP can occur. If the fetal monitor is configured to suppress this alarm there may be a delay of up to 60 seconds in indicating a critical status, such as sudden pulse loss or hypoxia.

Alarm Delays

There is a delay between a physiological event at the measurement site and the corresponding alarm at the monitor. This delay has two components:

- The general system delay time is the time between the occurrence of the physiological event and when this event is represented by the displayed numerical values. This delay depends on the algorithmic processing and the configured averaging time. The longer the averaging time configured, the longer the time needed until the numerical values reflect the physiological event.
- The time between the displayed numerical values crossing an alarm limit and the alarm indication on the monitor. This delay is the combination of the configured alarm delay time plus the general system alarm signal delay time.

Adjusting the SpO2 Alarm Limits

In the **Setup SpO2** menu:

- Select **High Limit** then choose the upper alarm limit.
- Select **Low Limit** then choose the lower alarm limit.

Adjusting the Desat Limit Alarm

The Desat alarm is a high priority (red) alarm notifying you of potentially life threatening drops in oxygen saturation.

1 In the **Setup SpO2** menu, select **Desat Limit**.

2 Adjust the limit.

Adjusting the Pulse Alarm Limits

See “Adjusting the Heart Rate / Pulse Alarm Limits” on page 160.

Setting Up Tone Modulation

If tone modulation is on, the QRS tone pitch lowers when the SpO_2 level drops. Remember, the QRS tone is derived from either heart rate (from MECG) or pulse (from SpO_2) depending on which is currently displayed (see “Priority for Maternal Heart / Pulse Rate” on page 155).

NOTE

Pulse from Toco MP does not provide a QRS tone.

Setting the QRS Volume

In the **Setup SpO2** menu, select **QRS Volume** and set the appropriate QRS tone volume.

18 Monitoring SpO2

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Monitoring Maternal Heart / Pulse Rate

You can monitor the maternal heart/pulse rate using one of four sources:

- Maternal heart rate (MHR) via MECG electrodes
- SpO_2 (pulse rate)
- Maternal pulse from Toco MP transducer (pulse rate)
- NBP (pulse rate)

Maternal heart / pulse rates derived from MECG, SpO_2 and Toco MP are **continuous** measurements, and are compared against the FHR for cross-channel verification. Average pulse rate derived from noninvasive blood pressure is an **intermittent** measurement, and is therefore not used for cross-channel verification.

Priority for Maternal Heart / Pulse Rate

Priority	Maternal Heart / Pulse Rate Source	Used for CCV	Provides QRS Tone
1	HR from MECG measurement	Yes	Yes
2	Pulse from SpO_2 measurement	Yes	Yes
3	Pulse from Toco MP transducer	Yes	No
4	Pulse from NBP measurement	No	No

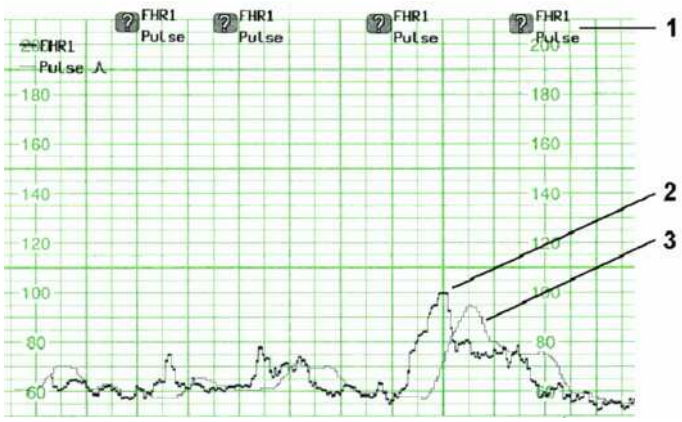
Only one Maternal Heart Rate / Pulse Rate numeric will be displayed and recorded at a time (see priority table). Note that when higher-priority measurements are connected but temporarily not providing valid numerics, lower-priority numerics may be displayed and recorded instead.

Cross-Channel Verification

It is recommended that you monitor both the maternal pulse rate/heart rate and the fetal heart rates to reduce the risk of misinterpreting the maternal heart rate for the fetal heart rate. See "Confirm Fetal Life Before Using the Monitor" on page 10 and "Cross-Channel Verification" on page 97.

SpO_2 pulse rate traces have an averaging calculation of approximately 10 seconds and an overall delay of approximately 12 seconds (depending on printer speed). This differs from a non-averaged beat-to-

beat MECG heart rate trace or an ultrasound heart rate trace calculation, having switched to the maternal rate with no significant delay. Note that Maternal Pulse from Toco has an averaging of 4 seconds and an overall delay of between 6 and 8 seconds.

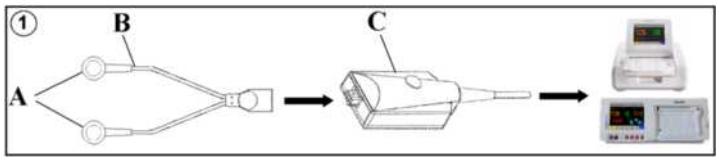


1 Cross-Channel Verification (CCV) has detected a coincidence situation
2 Fetal heart rate trace from Ultrasound
3 Maternal pulse trace from SpO_2

MHR from MECG Electrodes

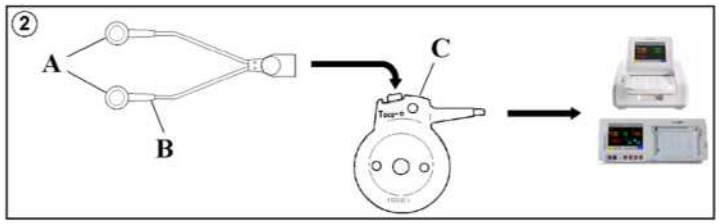
You can measure MHR using the equipment combinations shown in the following illustrations.

Illustration 1 shows the complete connection chain from the foam electrodes applied to the patient to the fetal monitor using the patient module.



A Pre-gelled Foam Electrodes (40493A/B/C/D/E)
B MECG Adapter Cable (M1363A)
C Patient Module (M2738A)

Illustration 2 shows the equivalent chain using the Toco$^+$ transducer.



A Pre-gelled Foam Electrodes (40493A/B/C/D/E)
B MECG Adapter Cable (M1363A)
C Toco+ Transducer (M2735A)

To simultaneously measure DECG and MHR, you use a Toco$^+$ transducer for DECG, and a patient module for MECG (see also "Monitoring FHR Using DECG" on page 137).

Applying Electrodes

To derive the MHR (when you do not want to view the MECG waveform), you can place the electrodes just below the outer end of the clavicle near each shoulder.



1 MECG Electrodes

Making Connections

WARNING

Follow the instructions supplied with each of the monitoring accessories you are using.

Prepare for monitoring MHR using the list below. The standard procedures in use in your facility determine the sequence of actions.

- Depending on the equipment you are using, ensure that *either* the Patient Module *or* the Toco^{+} transducer is connected to the fetal monitor.
- Connect a pre-gelled Foam Electrode to each of the two leads on the MECG Adapter Cable.
- Apply the Foam Electrodes to the patient, following the instructions supplied with the Foam Electrodes.
- Depending on the equipment you are using, connect the pink connector plug on the MECG Adapter Cable to the pink connector on *either* the Patient Module *or* the Toco^{+} transducer.

You are now ready to monitor MHR.

Monitoring MHR

1. Switch on the recorder.
2. The maternal heart rate is labeled **HR** on the screen.

Monitoring MECG Wave

WARNING

The fetal/maternal monitor is not a diagnostic ECG device. In particular, the display of fetal/maternal ECG is intended only for evaluating signal quality for fetal/maternal heart rate as derived from the ECG waveform.

When in doubt, it can be used to identify sources of compromised signal quality, such as noise or muscle artifacts. It can subsequently be used to verify the result of measures taken to resolve them (e.g., checking ECG cable connections).

The safety and effectiveness of the displayed fetal/maternal ECG waveform (i.e., P, QRS and T segments) for evaluation of fetal/maternal cardiac status during labor have not been evaluated.

FM30/50 When measuring MECG with the Avalon FM30 or FM50, the MECG waveform, along with the heart rate numeric, is displayed on the screen when using a Toco^{+} transducer or a patient module.

WARNING

The fetal/maternal monitor is NOT intended for use during defibrillation, electro-surgery, or MRI. Remove all transducers, sensors, and accessories before performing electro-surgery, defibrillation, or MRI, otherwise harm to the patient or the user can result.

Applying Electrodes

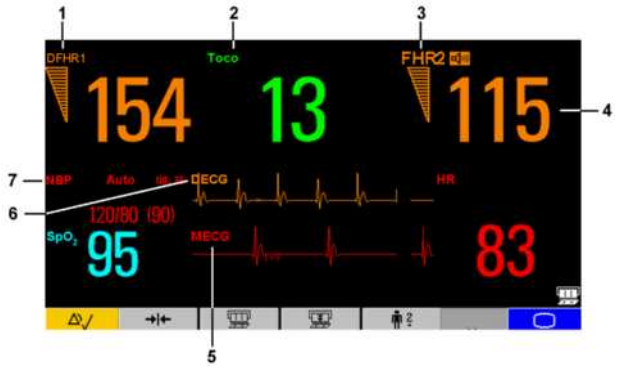
To obtain a satisfactory maternal ECG waveform you must use the RA to LL (lead II) position of the standard 5-lead ECG.



1 Place the RA electrode (**A**) directly below the clavicle and near the right shoulder.

2 Place the LL electrode (**B**) in left lower abdomen.

Viewing the Waveform on the Screen



1 DFHR1 parameter
2 Toco parameter
3 FHR2 parameter
4 Numeric/measurement values
5 For the FM30/50, the MECG wave is displayed automatically on the screen, labeled MECG. If DECG is also being monitored (FM30/50), and the DECG wave is configured to On, both waves are displayed, with the DECG wave above the MECG wave. The DECG wave is labeled DECG.
6 DECG
7 Noninvasive Blood Pressure

Printing the Waveform

You can print the MECG wave onto the trace paper. Please refer to "Printing the ECG Waveform" on page 161.

Pulse Rate from SpO2

If you are not monitoring MHR via MECG electrodes, but you are monitoring SpO_2, the maternal pulse rate is derived from the SpO_2 measurement. The pulse numeric is labeled **Pulse** on the screen.

Pulse Rate from Toco MP

If you are not monitoring MHR via MECG electrodes and you are not monitoring SpO_2, but you are monitoring using Toco MP transducers, then the maternal pulse rate is also derived from this transducer. When pulse rate is very low, or strong arrhythmia is present, the pulse rate measured by the Toco MP transducer may differ from the heart rate calculated from MECG. Due to motion artifacts, arrhythmia, or individual differences in pulse signal quality on the abdominal skin, it may become necessary to choose the MECG measurement to derive a maternal heart rate.

WARNING

- No alarm is possible when Toco MP is the source of the pulse rate.
- No QRS tone is audible when Toco MP is the source of the pulse rate.

NOTE

In rare cases it is possible to pick up a fetal signal source. When a Toco MP transducer is connected to the monitor but not applied to the patient, the measurement may generate unexpected intermittent Pulse readings.

Adjusting the Heart Rate / Pulse Alarm Limits

To adjust the pulse alarm limits:

1 In the **Setup SpO2** menu, select **Pulse (SpO2)**. This opens the **Setup Pulse (SpO2)** menu.

2 Ensure **Pulse (SpO2)** is **On**. Select **Pulse (SpO2)** to toggle between **On** and **Off**.

3 Set the pulse alarm limit:
   – Select **High Limit** then choose the upper alarm limit for tachycardia from the pop-up list.
   – Select **Low Limit** then choose the lower alarm limit for bradycardia from the pop-up list.

Average Pulse Rate from Noninvasive Blood Pressure

WARNING

No alarm is possible when noninvasive blood pressure is the source of the pulse rate.

When you are measuring noninvasive blood pressure, the monitor can also calculate the average pulse rate. This occurs in either manual or automatic mode, when neither MECG, SpO_2 nor pulse from Toco MP is being measured. The value is displayed on the screen, and printed on the trace. It is not the actual pulse value, but an average pulse rate, taken during the most recent noninvasive blood pressure measurement. The value is updated after each successive measurement. If you need a continuous measurement, you should monitor using MECG, SpO_2 or pulse from Toco MP.

Troubleshooting

Problem	Possible Causes	Solutions
MECG LEADS OFF displayed. Numeric is displayed with a - ? - for 10 seconds; INOP tone. See also "Patient Alarms and INOPs" on page 73.	One or more MECG leads is not attached.	Make sure that all required leads are attached.
	Bad electrical contact.	Check positioning of the electrode, ensuring that none are displaced. Check electrodes and replace if necessary.
	Electrodes defective.	
 prints repeatedly	The ultrasound transducer is measuring maternal pulse.	Reposition the ultrasound transducer.
MECG EQUIP MALF displayed.		See "Patient Alarms and INOPs" on page 73.
MECG UNPLUGGED		

Testing MECG Mode

Refer to the monitor's *Service Guide*.

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Printing the ECG Waveform

FM30/50 You can print the ECG wave onto the trace paper. If you are monitoring both DECG and MECG, both waves will be printed. The start of the wave recording is annotated above the wave with **MECG** for Maternal ECG, with **DECG** for Direct fetal ECG, and with **25 mm/sec** below the wave.

WARNING

The fetal/maternal monitor is not a diagnostic ECG device. In particular, the display of fetal/maternal ECG is intended only for evaluating signal quality for fetal/maternal heart rate as derived from the ECG waveform.

When in doubt, it can be used to identify sources of compromised signal quality, such as noise or muscle artifacts. It can subsequently be used to verify the result of measures taken to resolve them (e.g., checking ECG cable connections or adapting the fetal **ArtifactSuppress** configuration).

The safety and effectiveness of the displayed fetal/maternal ECG waveform (i.e., P, QRS and T segments) for evaluation of fetal/maternal cardiac status during labor have not been evaluated.

The ECG waveform is printed along the bottom of the heart rate grid, and the three different possibilities look like this:



1 **DECG**
2 Paper speed

DECG waveform on its own



1 **MECG**
2 Paper speed

MECG waveform on its own



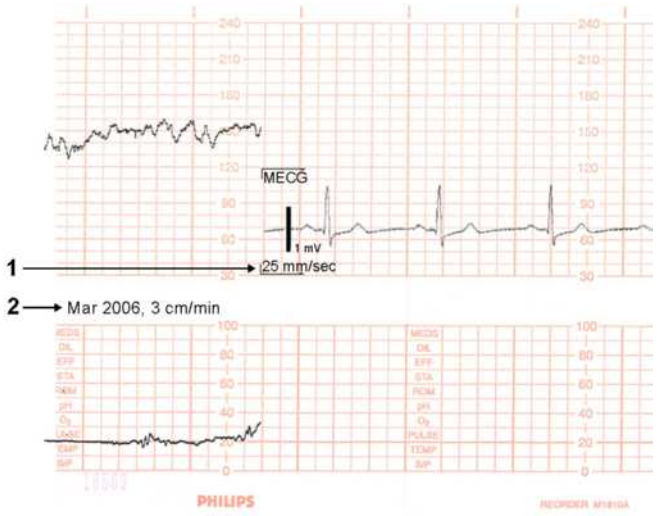
1 **DECG**
2 **MECG**
3 Paper speed

DECG and MECG waveforms

When the recorder is on, there are two choices for printing the ECG wave:

- **Separate**: This recording mode gives you a six-second ECG strip on the fetal trace paper in fast printout mode. As this is a real-time recording, the real-time fetal trace recording is temporarily interrupted while the ECG strip prints. A new trace header is printed out to mark where the real-time fetal trace resumes.

  The following trace shows the MECG waveform:



1 Paper speed
2 Date

- **Overlap**: This recording mode gives you a delayed six-second snapshot of the maternal and/or direct fetal ECG for documentation on the fetal strip, but without interrupting the fetal trace. It takes 5 minutes to print this six-second snapshot at a recorder speed of 3 cm/min. It is documented as if it was recorded at 25 mm/s.

The following trace shows both the DECG and MECG waveforms:



1 Paper speed
2 Date

To make your choice:

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

2 Select **Fetal Recorder** to enter the **Fetal Recorder** menu.

3 Select **ECG Wave** to toggle between **Separate** and **Overlap**.

To print the ECG wave(s):

Either

Select the **Start ECG** SmartKey .

Or

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

2 Select **Fetal Recorder** to enter the **Fetal Recorder** menu.

3 Select **Start ECG Wave**.

Or

1 Select the **ECG Wave**.

2 Select **Start ECG Wave** in the ECG wave menu.

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Paper Save Mode for Maternal Measurements

Your monitor's recorder features a Paper Save Mode, where maternal vital signs are recorded using less paper than during a normal trace recording.

When Paper Save Mode is enabled, and if the recorder is stopped, it will start automatically to print data from maternal measurements as they occur, and then stop again to save paper. You enable Paper Save Mode in Configuration Mode (default is off).

- A header is printed first before the measurements are recorded. A new header is also printed when there is a date change at midnight.
- Each NBP measurement is recorded. The time when the measurement **ended** is recorded.
- Other maternal parameters (SpO_2, maternal heart rate or Pulse) are recorded every five minutes. The rules described in the section “Priority for Maternal Heart / Pulse Rate” on page 155 apply.
- Paper Save Mode recording stops if there are no valid maternal measurements for more than one hour, and a message will notify you that there are no active parameters. Paper Save Mode recording will restart automatically when another valid measurement is made.

21 Paper Save Mode for Maternal Measurements

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Recovering Data

The monitor stores trace data, including annotations, in its internal backup memory. This allows the monitor to recover trace data that would otherwise be lost under certain circumstances. This trace recovery data can be automatically retrieved and printed in the event of the paper running out, or automatically transmitted to an OB TraceVue system (LAN connection only), allowing continuity of data.

The fetal trace printed from the trace recovery data contains all data from the real-time trace, with the exception of the maternal heart rate, the pulse numeric and the MECG wave.

Note that the data in the memory is cleared when a software upgrade is performed.

CAUTION

Only use Philips paper. Using paper other than Philips paper may result in the failure to recover traces.

Recovering Traces on Paper

The monitor is able to recover traces by printing them out at a high speed from the monitor's backup memory. If the monitor runs out of paper, or if the paper drawer is open, the exact time when this happens is annotated in the backup memory. If the **Bridge Paperout** setting is set to **On** (default), when new paper is loaded and the recorder is started, a trace recovery printout of the data recovered from the backup memory is automatically printed out at high speed (up to 20 mm/s), starting from the time noted in the backup memory. This ensures that no data is lost. A minimum of one hour of trace recovery data can be printed out from the backup memory. When the trace recovery printout has finished, the recorder automatically switches back to continue recording the current trace at the normal speed.

Note the following:

- If you press the fetal recorder **Start/ Stop** SmartKey  during a trace recovery printout, the recording stops and the next recording following a recorder restart will be a normal, real-time trace.

  After switching the monitor off and then back on again, or following a power failure, the time of the last **CHECK PAPER** INOP or paper-out detection is lost, and therefore any trace recovery data in the backup memory is no longer available to print. The next recording made following a restart of the recorder is a normal, real-time trace.

- The change back to a real-time recording from a trace recovery printout prompts the recording to restart. A new vertical trace header annotation consisting of the time, date and paper speed is printed, letting you see where the trace recovery printout ends, and where the real-time trace continues.
- There can be a gap of up to 30 seconds between the trace recovery printout and the beginning of the real-time trace.

Recovering Traces on an OB TraceVue System

The trace recovery data stored in the monitor's backup memory can also be uploaded at high speed to an OB TraceVue system connected over the LAN interface (OB TraceVue Revision E.00.00 or later).

When the OB TraceVue system reconnects to the fetal monitor and detects that there is trace recovery data in the monitor's backup memory that has not yet been transmitted to the system, this data is transferred at high speed to the system. No user action is required.

The exact length of the recovered trace will vary depending on the amount of trace information, but will cover **at least one hour** of trace data, regardless of how many parameters are being measured.

To recover traces on an OB TraceVue system, the following applies:

- The trace data in the monitor's internal memory must relate to a specific patient in the OB TraceVue system. In other words, there were no discharge events made on the monitor that would change the patient context.
- The patient must have an open episode. No data will be uploaded if the patient is not admitted to OB TraceVue. For this reason, it is not possible to use the monitor to collect patient data offline for later transmission to OB TraceVue.
- Current online trace data is held back until the fast upload is complete.

Recording Stored Data

When the recorder is not already running, you can choose to print trace data from the monitor's memory at any time. You can see a list of all stored traces, showing patient identification and episode time, in the **Stored Data Recording** window, from which you can choose one entry at a time.

CAUTION

So that you can identify which episode (entry in the patient list) refers to which patient, make sure that you admit each patient by name, including other patient identification information, and discharge the patient when you have finished monitoring.

A new episode can be triggered by:

- Discharging a patient
- Powering on the monitor
- Entering Standby
- Entering Service Mode

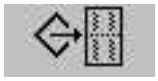
Times when the monitor is switched off, is in Service Mode or in Standby are not included, neither are any episodes lasting less than one minute.

The speed of the printout depends on the configured recorder speed and on the amount of trace data available. The fetal trace printed from the trace data contains all data from the real-time trace, with the exception of the maternal heart rate, the pulse numeric and the ECG wave.

Information for scale type, trace separation and recorder speed are not stored in the trace memory, but is applied when the stored recording starts. While the stored recording is printing, all functions are disabled, except that for stopping the recorder.

To start a stored data recording:

Either

Select the **Stored Data Rec** SmartKey  .

Or

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

2 Select **Fetal Recorder** to open the **Fetal Recorder** menu.

3 Select **Stored Data Rec** to open the **Stored Data Recording** window.

4 Select an entry for a patient.

5 Select **All** to print all stored trace data for the selected entry, or select one of the choices on the other pop-up keys to print only a specified portion of the entry (for example, **Last 15 min** for the last 15 minutes of trace data).

The current patient's entry is at the top of the list. The oldest entry at the bottom of the list has no start time specified, as part of the data originally stored may have been over-written by the current patient's data. The first part of the data, including the information for the start time, is no longer accessible.

It may be that you only see one entry (the current patient's data) in the **Stored Data Recording** window if that patient was monitored for a period long enough to erase any earlier entries.

If you wish to make a stored data recording for an old entry (that is, not for the current patient), the recorder performs a fast trace printout of the stored data, advances the paper to the next paper fold, then stops.

If you wish to make a stored data recording for the current patient, the recorder performs a fast trace printout of the stored data, and then reverts automatically to recording the real-time trace.

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Care and Cleaning

Use only the Philips-approved substances and methods listed in this chapter to clean or disinfect your equipment. Warranty does not cover damage caused by using unapproved substances or methods.

Philips makes no claims regarding the efficacy of the listed chemicals or methods as a means for controlling infection. Consult your hospital's Infection Control Officer or Epidemiologist. For comprehensive details on cleaning agents and their efficacy refer to "Guideline for Disinfection and Sterilization in Healthcare Facilities" issued by the U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, Atlanta, Georgia, 2008. See also any local policies that apply within your hospital, and country.

General Points

The transducers and patient modules are sensitive instruments. Handle them with care.

Keep your monitor, transducers, patient modules, cables and accessories free of dust and dirt. After cleaning and disinfection, check the equipment carefully. Do not use if you see signs of deterioration or damage. If you need to return any equipment to Philips, **always** decontaminate it first before sending it back in appropriate packaging.

Observe the following general precautions:

- Always follow carefully and retain the instructions that accompany the specific cleaning and disinfecting substances you are using.
- Always dilute according to the manufacturer's instructions or use lowest possible concentration.
- Do not allow liquid to enter the case.
- Do not immerse the monitor in liquid. Protect it against water sprays or splashes.
- Do not pour liquid onto the system.
- Never use abrasive material (such as steel wool or silver polish).
- Never use bleach.

WARNING

- Do not operate the monitor if it is wet. If you spill liquid on the monitor, contact your service personnel or Philips service engineer.
- Do not perform underwater monitoring (for example, in a bath or shower) using wired transducers.
- Place the monitor where there is no chance of contact with, or falling into water or other liquid.
- Do not dry equipment using heating devices such as heaters, ovens (including microwave ovens), hair dryers and heating lamps.

Cleaning and Disinfecting

Clean and disinfect the Avalon FM20, FM30, FM40 and FM50 fetal monitors and the transducers M2734A, M2734B, M2735A, M2736A, and M2738A (including ECG adapter cables) after each use. Clean equipment before disinfecting. For other accessories, see "Cleaning and Disinfecting Monitoring Accessories" on page 173.

Clean with a lint-free cloth, moistened with warm water (40°C/104°F maximum) and soap, a diluted non-caustic detergent, tenside, or phosphate based cleaning agent (see "Recommended Cleaning Agents" on page 173). Do not use strong solvents such as acetone or trichloroethylene. After cleaning, disinfect using only the approved disinfecting agents listed.

CAUTION

Solutions: Do not mix disinfecting solutions (such as bleach and ammonia) as hazardous gasses may result.

Skin contact: To reduce the risk of skin irritations, do not allow a cleaning or disinfecting agent to leave residues on any of the equipment surfaces - wipe it off with a cloth dampened with water, after allowing the appropriate time for the agent to work, or before applying to a patient.

Hospital policy: Disinfect the product as determined by your hospital's policy, to avoid long term damage to the product.

Local requirements: Observe local laws governing the use of disinfecting agents.

Touch display: To clean and disinfect the touch-enabled display, disable the touch operation by switching off the monitor during the cleaning procedure, or by selecting and holding the **Main Screen** key until the padlock symbol appears on it, indicating that touch operation is disabled. Select and hold again to re-enable touch operation.

Take extra care when cleaning the screen of the monitor because it is more sensitive to rough cleaning methods than the housing. Do not permit any liquid to enter the monitor case and avoid pouring it on the monitor while cleaning. Do not allow water or cleaning solution to enter the measurement connectors. Wipe around, not over, connector sockets or those of the Toco^{+} transducer, ECG and IUP Patient Modules and adapter cables. Wipe around, not over, connector sockets.

Wash soiled reusable belts with soap and water. Water temperature must not exceed 60°C/140°F.

Recommended Cleaning Agents

We recommend that you use one of the following disinfectants:

Product Name	Product Type	Ingredients
Isopropanol	liquid	Isopropanol 80%
Bacillol® AF	liquid, spray	100 g concentrate contains: Propan-1-ol 45.0 g; Propan-2-ol 25.0 g; Ethanol 4.7 g.
Bacillol®25	liquid	Ethanol 100 mg/g Propan-2-ol (= 2-Propanol) 90 mg/g; Propan-1-ol (= 1-Propanol) 60 mg/g
Meliseptol®	spray	50% 1-Propanol
Accel TB RTU	liquid	0.5% accelerated hydrogen peroxide
Oxivir® Tb Cleaner Disinfectant	spray	0.5% accelerated hydrogen peroxide
Oxivir® Tb Wipes	wipes	0.5% accelerated hydrogen peroxide
Carpe Diem$^{TM/MC}$ Tb Ready-to-Use General Virucide, Bactericide, Tuberculocide, Fungicide, Sanitizer	spray	0.5% accelerated hydrogen peroxide
Carpe Diem$^{TM/MC}$ Tb Wipes	wipes	0.5% accelerated hydrogen peroxide
Super Sani-Cloth Germicidal Disposable Wipes	wipes	isopropanol 55% quaternary ammonium chlorides 0.5%
SANI-CLOTH® PLUS Germicidal Disposable Wipes	wipes	isopropanol 15% quaternary ammonium chlorides 0.25%
SANI-CLOTH® HB Germicidal Germicidal Disposable Wipes	wipes	isopropanol < 0.15% quaternary ammonium chlorides 0.14%

Cleaning and Disinfecting Monitoring Accessories

To clean, disinfect and sterilize reusable transducers, sensors, cables, leads, and so forth, refer to the instructions delivered with the accessory.

Do not allow a cleaning or disinfecting agent to leave residues on any of the equipment surfaces. Wipe residues off, after allowing the appropriate time to for the agent to work, with a cloth.

Sterilizing

Sterilization is not recommended for this monitor, related products, accessories or supplies unless otherwise indicated in the Instructions for Use that accompany the accessories and supplies.

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Maintenance

WARNING

Schedule: Failure on the part of the responsible individual hospital or institution employing the use of this equipment to implement a satisfactory maintenance schedule may cause undue equipment failure and possible health hazards.

In case of problems: If you discover a problem with any of the equipment, contact your service personnel, Philips, or your authorized supplier.

Electric shock hazard: Do not open the monitor housing. Refer all servicing to qualified service personnel.

Inspecting the Equipment and Accessories

You should perform a visual inspection **before each use**, and in accordance with your hospital's policy. With the monitor switched off:

1. Examine unit exteriors for cleanliness and general physical condition. Make sure that the housings are not cracked or broken, that everything is present, that there are no spilled liquids that may have entered the housing, and that there are no signs of abuse.
2. Inspect all accessories (transducers, sensors and cables, and so forth). Do not use a damaged accessory.
3. Switch the monitor on and make sure the display is bright enough. If the brightness is not adequate, contact your service personnel or your supplier.

Inspecting the Cables and Cords

1. Examine all system cables, the power plug and cord for damage. Make sure that the prongs of the plug do not move in the casing. If damaged, replace it with an appropriate power cord.
2. Inspect the cables, leads and their strain reliefs for general condition. Make sure there are no breaks in the insulation. Make sure that the connectors are properly engaged at each end to prevent rotation or other strain.
3. Carry out performance assurance checks as described in the monitor's *Service Guide*.

Maintenance Task and Test Schedule

The following tasks are for Philips-qualified service professionals. All maintenance tasks and performance tests are documented in detail in the service documentation supplied on the monitor's documentation DVD.

Ensure that these tasks are carried out as indicated by the monitor's maintenance schedule, or as specified by local laws, whichever comes sooner. Contact a Philips-qualified service provider if your monitor needs a safety or performance test. Clean and disinfect equipment to decontaminate it before testing or maintaining it.

Maintenance and Test Schedule	Frequency
Visual Inspection	Before each use.
Clean and disinfect the equipment	After each use.
Safety checks according to IEC 60601-1, and where applicable, to national standards	At least once every two years, or as specified by local laws. After any repairs where the power supply has been replaced (by an authorized service agent). If the monitor has been dropped, it must be repaired/ checked by an authorized service agent.
Performance assurance for all measurements	At least once every two years, or if you suspect the measurement values are incorrect.
Noninvasive blood pressure calibration	At least once every two years, or as specified by local laws.
Clean the thermal printhead	At each paper pack change, or every 500 m of paper run.

Storing Recorder Paper

Recorder paper is not intended for long-term archival storage. Another medium should be considered if this is required.

Dyes contained in thermal papers tend to react with solvents and other chemical compounds that are being used in adhesives. If these compounds come into contact with the thermal print, the print may be destroyed over time. You can take the following precautionary measures to help avoid this effect.

- Store the paper in a cool, dry and dark place.
- Do not store the paper at temperatures over 40°C (104°F).
- Do not store the paper where the relative humidity exceeds 60%.
- Avoid intensive light (UV light), as this may cause the paper to turn gray or the thermal print to fade.
- Avoid storing the thermal paper in combination with the following conditions:
  - Papers that contain organic solvents. This includes papers with tributyl and/or dibutyl phosphates, for example recycled paper.
  - Carbon paper and carbonless copy paper.
  - Products containing polyvinyl chlorides or other vinyl chlorides for example (but not exclusively) document holders, envelopes, letter files, divider sheets.
  - Detergents and solvents, such as alcohol, ketone, ester and others, including cleaning and disinfecting agents.

– Products containing solvent-based adhesives such as (but not exclusively) laminating film, transparent film or labels sensitive to pressure.

To ensure long lasting legibility and durability of thermal printouts, store your documents separately in an air-conditioned place and use:

- only plasticizer-free envelopes or divider sheets for protection.
- laminating films and systems with water-based adhesives.

Using such protective envelopes cannot prevent the fading effect caused by other, external agents.

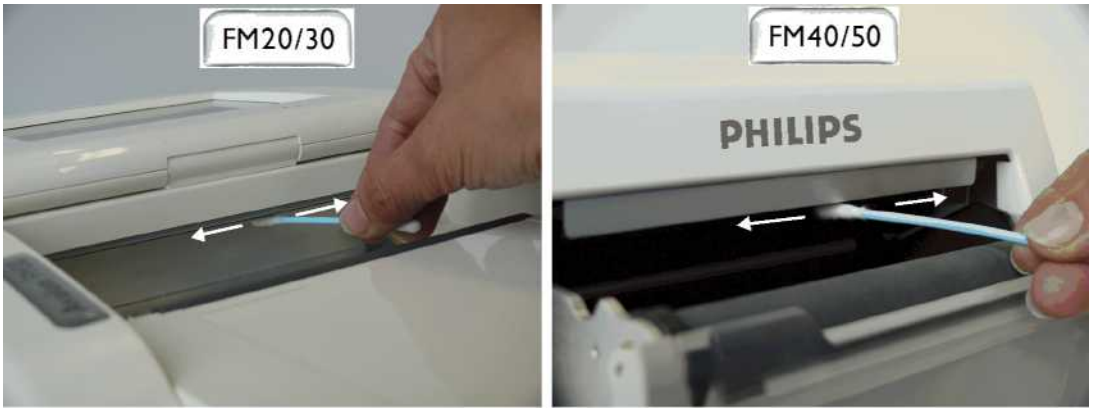
Cleaning the Printhead

To clean the recorder's thermal printhead:

1 Switch off the monitor.

2 Open the paper drawer, and remove the paper if necessary, to gain access to the thermal printhead.

3 Gently clean the thermal printhead with a cotton swab or soft cloth soaked in isopropyl alcohol.



Disposing of the Monitor

WARNING

To avoid contaminating or infecting personnel, the service environment or other equipment, make sure the equipment has been appropriately disinfected and decontaminated before disposal at the end of its useful life, in accordance with your country's laws for equipment containing electrical and electronic parts.



Do not dispose of waste electrical and electronic equipment as unsorted municipal waste. Collect it separately, so that it can be safely and properly reused, treated, recycled, or recovered.

Monitor:

- There is no metal molded into the plastic parts and no metal sprays on the plastic.
- All plastic parts with a weight greater than 10g (0.35 ounces) are marked with the ISO code for identification.
- You can disassemble the monitor as described in the *Service Guide*.
- The display has a touch resistor laminate.
- Recycle PCBs according to local laws.
- Recycle the paper *Instructions for Use*.

FM20/30 with Battery Option #E25 Only

- The Lithium Ion battery should be removed and recycled according to local laws and regulations.

Transducer:

- The transducer housing is a two-component molding of polycarbonate (white) and polyurethane (yellow) and has one brass thread-insert molded in.
- All labeling on the transducer has been done by laser, so no separation is necessary before recycling.
- The housing is held together with screws.
- The transducer PCB is glued to the lower half of the transducer housing.
- Recycle the PCB according to local laws.

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Accessories and Supplies

All accessories listed for the fetal monitor may not be available in all geographies. You can order parts, accessories and supplies from Philips supplies at www.medical.philips.com or consult your local Philips representative for details. All accessories and supplies listed here are reusable, unless indicated otherwise.

WARNING

Reuse: Disposable accessories and supplies intended for single use, or single use only, and are indicated as such on their packaging. Never reuse disposable accessories and supplies, such as transducers, sensors, electrodes and so forth that are intended for single use, or single patient use only.

Approved accessories: Use only Philips-approved accessories.

Packaging: Do not use a sterilized accessory if its packaging is damaged.

Protection against electric shocks: The transducers and accessories listed in this chapter are NOT defibrillator proof.

Electro-Surgery, Defibrillation and MRI: The fetal/maternal monitors are NOT intended for use during defibrillation, electro-surgery, or MRI. Remove all transducers, sensors, and accessories before performing electro-surgery, defibrillation, or MRI, otherwise harm can result.

Information on Latex

All Philips transducers and accessories are latex-free, unless indicated otherwise in the following tables.

Transducers

Transducer	Part Number
Toco transducer	**M2734A**
Toco^{+} transducer for Toco, DECG, MECG or IUP monitoring	**M2735A**
Toco MP transducer for Toco and Maternal Pulse	**M2734B**
Ultrasound transducer	**M2736A**
ECG/IUP Patient Module (for DECG, MECG or IUP)	**M2738A**
External Marker	**989803143411**

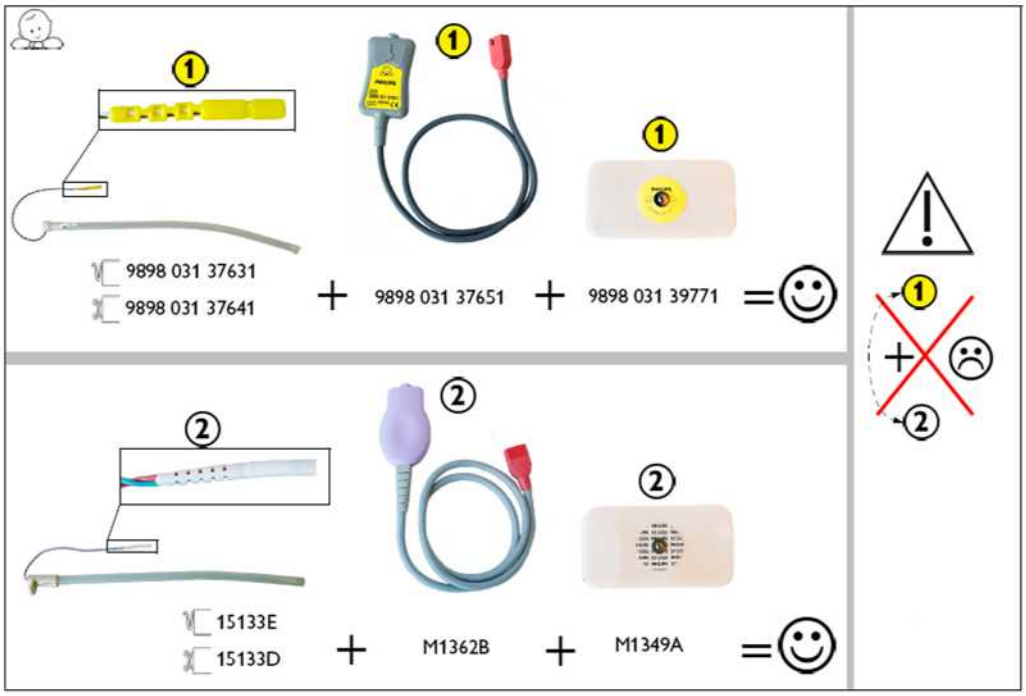
Fetal Accessories

Accessory	Description	Part Number
Belt (reusable, gray, water resistant)	32 mm wide, 15 m roll	**M4601A**[1]
	60 mm wide, 5 belts	**M4602A**
	60 mm wide, 15 m roll	**M4603A**
	50 mm wide, 5 belts	**M1562B**
Belt (reusable, brown, contains latex)	32 mm wide, 15 m roll	**1500-0628**[1]
	50 mm wide, 5 belts	**M1562A**
	60 mm wide, 5 belts	**1500-0642**
	60 mm wide, 15 m roll	**1500-0643**
Belt (disposable, yellow, water resistant)	60 mm wide, pack of 100	**M2208A**
Ultrasound gel	12 Bottles	**40483A**
	5 liter refill (with dispenser) for 40483A Shelf life: 24 months max.	**40483B**
Belt buttons, pack of 10		**M1569A**
Butterfly belt clip (pack of 6)		**989803143401**
DECG Accessories: New Philips DECG Solution *(NOT compatible with QwikConnect Plus Solution accessories)*	DECG reusable legplate adapter cable (with flushing port)	**989803137651**
	DECG leg attachment electrode for DECG legplate adapter cable	**989803139771**
	DECG fetal scalp electrode: single spiral, worldwide availability	**989803137631**
	DECG fetal scalp electrode: double spiral, Europe only. Not for USA	**989803137641**
DECG Accessories: QwikConnect Plus Solution *(NOT compatible with New Philips DECG Solution accessories)*	ECG reusable legplate adapter cable (QwikConnect Plus)	**M1362B**
	ECG leg attachment electrode for DECG legplate adapter cable	**M1349A**
	DECG fetal scalp electrode: single spiral, worldwide availability	**15133E**
	DECG fetal scalp electrode: double spiral, Europe only. Not for USA	**15133D**
Disposable Koala IUP catheter		**M1333A**
Reusable Koala IUP adapter cable		**989803143931**

[1] Note: 32 mm belts for use with M2738A Patient Module only.

DECG Accessories: Component Compatibility

Use the following pictorial guide to check component compatibility for DECG accessories. **Do NOT mix accessories from the New Philips DECG Solution (marked 1)** with those from the QwikConnect Plus Solution (marked 2).



MECG Accessories

Accessory	Part Number
MECG reusable adapter cable	**M1363A**
Foam ECG electrodes, snap-fit, for MECG Adapter Cable (disposable)	**40493D/E**

Noninvasive Blood Pressure Accessories

The following accessories are approved for use with the fetal monitor:

Adult/Pediatric Multi-Patient Comfort Cuffs and Disposable Cuffs

Maternal Patient Category	Limb Circumference	Bladder Width	Disposable cuff Part No.	Reusable cuff Part No.	Tubing
Adult (Thigh)	42.0 - 54.0 cm	20.0 cm	M1879A	M1576A	M1598B (1.5 m) or M1599B (3.0 m)
Large Adult	34.0 - 43.0 cm	16.0 cm	M1878A	M1575A	
Adult	27.0 - 35.0 cm	13.0 cm	M1877A	M1574A	
Small Adult	20.5 - 28.0 cm	10.5 cm	M1876A	M1573A	

Adult Antimicrobial Coated Reusable Cuffs

Maternal Patient Category (color)	Limb Circumference	Bladder Width	Part No.	Tubing
Adult Thigh (grey)	45.0 - 56.5 cm	21.0 cm	**M4559A**	M1598B (1.5 m) or M1599B (3.0 m)
Large Adult X-Long (burgundy)	35.5 - 46.0 cm	17.0 cm	**M4558A**	
Large Adult (burgundy)	35.5 - 46.0 cm	17.0 cm	**M4557A**	
Adult X-Long (navy blue)	27.5 - 36.5 cm	13.5 cm	**M4556A**	
Adult (navy blue)	27.5 - 36.5 cm	13.5 cm	**M4555A**	
Small Adult (royal blue)	20.5 - 28.5 cm	10.6 cm	**M4554A**	

Adult Soft Single Patient Single-Hose Disposable Cuffs

Maternal Patient Category	Limb Circumference	Bladder Width	Part No.	Tubing
Adult (Thigh)	45.0 - 56.5 cm	20.4 cm	**M4579A**	M1598B (1.5 m) or M1599B (3.0 m)
Large Adult X-Long	35.5 - 46.0 cm	16.4 cm	**M4578A**	
Large Adult	35.5 - 46.0 cm	16.4 cm	**M4577A**	
Adult X-Long	27.5 - 36.5 cm	13.1 cm	**M4576A**	
Adult	27.5 - 36.5 cm	13.1 cm	**M4575A**	
Small Adult	20.5 - 28.5 cm	10.4 cm	**M4574A**	

SpO2 Accessories

Some Nellcor sensors contain natural rubber latex which may cause allergic reactions. See the Instructions for Use supplied with the sensors for more information. M1901B, M1903B and M1904B are not available in USA from Philips. Purchase Nellcor OxiCliq sensors and adapter cables directly from Tyco Healthcare. Some sensors may not be available in all countries.

Do not use more than one extension cable with any sensors or adapter cables. Do not use an extension cable with Philips reusable sensors or adapter cables with part numbers ending in -L (indicates "**L**ong" version).

All listed sensors operate without risk of exceeding 41°C on the skin if ambient temperature is below 37°C.

Make sure that you use only the accessories that are specified for use with this device, otherwise patient injury can result.

Philips SpO2 Accessories

Product Number	Description	Comments
Philips reusable sensors		
M1191A/B	Adult sensor (2.0 m cable), for patients over 50 kg. Any finger, except thumb.	No adapter cable required.
M1191AL/BL	M1191A with longer cable (3.0 m)	
M1192A	Small adult, pediatric sensor (1.5 m cable) for patients between 15 kg and 50 kg. Any finger except thumb. Use only on adult patients with FM30/40/50.	
M1194A	Ear sensor (1.5 m cable) for patients more than 40 kg. Use only on adult patients with FM30/40/50.	
M1196A	Adult clip sensor (3 m cable) for patients over 40 kg. Any finger except thumb.	
M1191T	Adult sensor (0.45 m), for patients over 50 kg. Any finger except thumb.	Requires M1943A (1.0 m) or M1943AL (3.0 m) adapter cable.
M1192T	Small adult, pediatric sensor (0.45 m cable) for patients between 15 kg and 50 kg. Any finger except thumb. Use only on adult patients with FM30/40/50.	
M1196T	Adult clip sensor (0.9 m cable) for patients over 40 kg. Any finger except thumb.	
M1191ANL	Special Edition (SE) Adult sensor (3 m cable), for patients over 50 kg. Any finger except thumb.	No adapter cable required. SE sensors work with FM30/40/50, as well as with OxiMax-compatible SpO2 versions of other Philips monitors.
M1192AN	Special Edition (SE) Small adult, pediatric sensor (1.5 m cable) for patients between 15 kg and 50 kg. Any finger except thumb. Use only on adult patients with FM30/40/50.	
M1194AN	Special Edition (SE) Ear sensor (1.5 m cable) for patients more than 40 kg.	
Philips disposable sensors. Not available in the USA.		
M1904B	Identical to OxiMax MAX-A	Requires M1943A (1.0 m) or M1943AL (3.0 m) adapter cable
M1903B	Identical to OxiMax MAX-P	
M1901B	Identical to OxiMax MAX-N	

Product Number	Description	Comments
Philips disposable sensors. Available worldwide.		
M1131A	Adult/Pediatric finger sensor (0.45 m cable) Use only on adult patients with FM30/40/50.	Requires M1943A (1.0 m) or M1943AL (3.0 m) adapter cable
M1133A	Adult/Infant/Neonatal (0.9 m cable) for patients > 40 kg. Any finger except thumb. Use only on adult patients with FM30/40/50.	
M1134A	Adult/Infant/Neonatal (0.9 m cable) for patients > 40 kg. Any finger except thumb. Adhesive-free Use only on adult patients with FM30/40/50.	

Nellcor SpO2 Accessories

Product Number	Description	Comments
NELLCOR disposable sensors (must be ordered from Nellcor)		
OxiMax MAX-A	Adult finger sensor (patient size > 30 kg)	Requires M1943A (1.0 m) or M1943AL (3.0 m) adapter cable.
OxiMax MAX-AL	OxiMax MAX-A with long cable	
OxiMax MAX-P	Pediatric foot/hand sensor (patient size 10-50 kg) Use only on adult patients with FM30/40/50.	
OxiMax MAX-N	Adult finger or neonatal foot/hand sensor (patient size > 40 kg or < 3 kg) Use only on adult patients with FM30/40/50.	
Oxisensor II D-25	Adult sensor (patient size > 30 kg)	Requires M1943A (1.0 m) or M1943AL (3.0 m) adapter cable.
Oxisensor II D-20	Pediatric sensor (patient size 10-50 kg) Use only on adult patients with FM30/40/50.	
Oxisensor II N-25	Neonatal/Adult sensor (patient size < 3 kg or > 40 kg) Use only on adult patients with FM30/40/50.	
OxiCliq A	See OxiMax MAX-A	Requires M1943A (1.0 m) or M1943AL (3.0 m) adapter cable **together with** OC3 adapter cable.
OxiCliq P	See OxiMax MAX-P Use only on adult patients with FM30/40/50.	
OxiCliq N	See OxiMax MAX-N Use only on adult patients with FM30/40/50	

Masimo SpO2 Accessories

Product Number	Description	Philips Part Number
MASIMO LNOP reusable sensors (No adaptor cable required)		
LNOP DC-I	Adult Finger Sensor (> 30 kg)	989803140321
LNOP DC-IP	Pediatric Finger Sensor (10 - 50 kg) Use only on adult patients with FM30/40/50	989803140331
LNOP YI	Multi-Site Sensor (> 1kg) Use only on adult patients with FM30/40/50	n/a
LNOP TC-I	Ear Sensor (> 30 kg) Use only on adult patients with FM30/40/50	989803140341
MASIMO LNCS reusable sensors (No adaptor cable required)		
LNCS DC-I	Adult Finger Sensor (> 30 kg)	989803148281
LNCS DC-IP	Pediatric Finger Sensor (10 - 50 kg) Use only on adult patients with FM30/40/50	989803148291
LNCS TC-I	Ear Sensor (> 30 kg) Use only on adult patients with FM30/40/50	989803148301
MASIMO LNOP disposable adhesive sensors		
LNOP Adt	Adult Sensor (> 30 kg)	989803140231
LNOP Adtx	Adult Sensor (> 30 kg)	n/a
LNOP Pdt	Pediatric Sensor (10 - 50 kg) Use only on adult patients with FM30/40/50	989803140261
LNOP Pdtx	Pediatric Sensor (10 - 50 kg) Use only on adult patients with FM30/40/50	n/a
LNOP Neo-L	Neonatal Sensor (< 3kg) or Adult adhesive Sensor (> 40 kg) Use only on adult patients with FM30/40/50	989803140291
MASIMO LNCS disposable adhesive sensors (No adaptor cable required)		
LNCS Adtx	Adult Sensor (> 30 kg)	989803148231
LNCS Pdtx	Pediatric Finger Sensor (10 - 50 kg) Use only on adult patients with FM30/40/50	989803148241
LNCS Neo-L	Neonatal Foot Sensor (<3 kg) or Adult Finger Sensor (>40 kg) Use only on adult patients with FM30/40/50	989803148271

Extension / Adapter Cables

Product Number	Description	Comments
M1941A	Extension cable (2 m)	For use with Philips reusable sensors and adapter cables.
M1943A	Adapter cable (1.1 m cable)	Adapter cable for Philips/ Nellcor disposable sensors.
M1943AL	Adapter cable (3 m cable)	
OC 3	Adapter Cable for OxiCliq sensors	Available from Nellcor.
LNOP MP12	LNOP MP Series Patient Cable (3.6 m) Adapter Cable for Masimo LNOP sensors	Available from MASIMO.
LNC MP10	LNCS MP Series Patient Cable (3.0 m) Adapter Cable for Masimo LNCS sensors	

Recorder Paper

Supplied in cases of 40 packs. Each pack has 150 numbered pages. Single use. Use the paper specified here.

Product Number	Geography	FHR Scale	Grid Color	Scale Units	Highlighted 3 cm Lines?
M1910A	USA/Canada and Asia	30 - 240	Red/Orange	mmHg	Yes
M1911A	Europe/Japan	50 - 210	Green	mmHg and kPa	No
M1913A	Japan	50 - 210	Green	mmHg	Yes
M1913J	Japan	50 - 210	Green*	mmHg	Yes

* Bradycardia and tachycardia alarm ranges are shaded.

25 Accessories and Supplies

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Specifications and Standards Compliance

The monitors are intended to monitor a mother and her fetus(es), which from an electrical safety point of view, are one person.

Environmental Specifications

The monitor may not meet the given performance specifications if stored and used outside the specified temperature and humidity ranges.

Monitor (M2702A/M2703A); Interface Cable for Avalon CTS (M2731-60001 and M2732-60001)		
Temperature Range	Operating	without battery option: 0°C to 45°C (32°F to 113°F)
		with battery option/charging: 0°C to 35°C (32°F to 95°F)
		with battery option/fully charged: 0°C to 40°C (32°F to 104°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/M2734B/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)
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)

WARNING

Explosion Hazard: Do not use in the presence of flammable anesthetics, such as a flammable anesthetic mixture with air, oxygen or nitrous oxide. Use of the devices in such an environment may present an explosion hazard.

Physical Specifications

Monitor Physical Specifications		M2702A/M2703A	M2704A/M2705A
Power	Supply Voltages	100 VAC to 240 VAC ±10%	
	Supply Frequency Range	50 Hz/60 Hz	
	Power Consumption (current)	0.7 - 0.4 A	1.3 - 0.7 A
Dimensions and Weight	Size (without options) mm/(in): width x height x depth	286 x 133 x 335 ±1% (11.3 x 5.2 x 13.2 in ±1%)	420 x 172 x 370 ±5% (16.5 x 6.8 x 14.6 in ±5%)
	Weight	< 5.1 kg/11.2 lbs	< 9.0 kg/19.8 lbs
Degree of Protection Against Electrical Shock		Type CF	
Electrical Class		Class II equipment	Class I equipment
Mode of Operation		Continuous operation	
Water Ingress Protection Code		-	IP X1 (provided recorder drawer is shut)
Global Speed		6.25 mm/sec, 12.5 mm/sec, 25 mm/sec, 50 mm/sec	
Startup Time	Time taken from switching on the monitor to seeing the first parameter labels	< 30 seconds	

Transducers (M2734A/M2734B/M2735A/M2736A/M2738A)		
Shock Resistance		Withstands a 1 m drop to concrete surface with possible cosmetic damage only
Water Ingress Protection Code	M2734A&B/35/36A	IP 68 (immersion up to 1 m water depth for 5 hours)
	M2738A	IP 67 (immersion up to 0.5 m water depth for 30 minutes)

Transducers (M2734A/M2734B/M2735A/M2736A/M2738A)			
Dimensions and Weight	M2734A&B/35/36A	Size (diameter)	83 mm/3.27 in
		Weight (without cable)	< 220 g/7.8 oz.
	M2738A	Maximum size mm/ (in): width x height x depth	50 x 28 x 135 (2.0 x 1.1 x 5.3 in)
		Cable length	2.5 m
		Weight	< 150 g/5.3 oz.
Degree of Protection Against Electrical Shock		Type CF	
Transducer Identification		Optical Signal Element (Finder LED). Not M2738A	

Interface Cable for Avalon CTS (M2731-60001 and M2732-60001)		
Shock Resistance	Withstands a 1m drop to concrete surface with possible cosmetic damage only	
Water Ingress Protection Code	IP X1	
Dimensions and Weight	Maximum size mm/(in): width x height x depth	55 x 28 x 50 (2.2 x 1.1 x 2.0 in)
	Cable length	2.5 m
	Weight	< 200 g/7.0 oz.

M8023A (Option #E25) External Power Supply Weight and Dimensions	
Maximum Weight	700 g ±10% (1.5 lb ±10%)
Size (W x H x D)	207 x 70 x 113 mm / 8.1 x 2.8 x 4.4 in

Performance Specifications

Note that your monitor's default settings can be permanently changed in Configuration Mode. The default settings specified here refer to the settings initially shipped with the monitor.

Complies with EN/IEC EN 60601-2-37:2001+A1:2004.

ECG measurement follows EN/IEC 60601-2-27:1994.

Battery Specifications

Performance Specifications		
Battery	Operating Time (with new, fully charged battery)	Basic monitoring configuration: >2 hours (Display Brightness: 70%, Recorder: "On" at 3cm/min, NBP: Auto Mode at 15min, 2 US Transducers, 1 Toco+ with MECG, 1 Patient Module with DECG)
	Charge Time	When monitor is off: approx. 6 hours When monitor is in use: more than 10 hours (depending on monitor configuration)

Fetal / Maternal Specifications

Performance Specifications		
Ultrasound		
Measurement Method		Ultrasound Pulse Doppler
Measurement Range	US	50 to 240 bpm
Resolution	Display	1 bpm
	Printer	1/4 bpm
Jitter @ 200 bpm		≤ 3 bpm
Display Update Rate		1 / second
US Intensity	Average output power	P = (7.4 ± 0.4) mW
	Peak-negative acoustic pressure	p_- = (40.4 ± 4.3) kPa
	Output beam intensity (I_{ob}) (= spatial average - temporal average intensity)	I_{sata} = (2.38 ± 0.59) mW/cm^2
	Spatial-peak temporal average intensity	I_{spta} = (15.0 ± 3.2) mW/cm^2
	Effective radiating area @ -12 dB	(3.11 ± 0.74) cm^2
Signal Quality Indication	Poor Quality	Empty
	Acceptable Quality	Half-full
	Good Quality	Full
Beat-to-Beat Change (max.) for Ultrasound		28 bpm
US Frequency		1 MHz ± 100 Hz
US Signal range		3.5 µVpp to 350 µVpp @ 200 Hz
US Burst	Repetition Rate	3.0 kHz
	Duration	≤ 100 µs
US LF Frequency Passband @ -3dB		100 to 500 Hz ± 20%
FMP Signal Range @ 33 Hz		200 µVpp to 40 µVpp
FMP Frequency Passband @ -3dB		10 to 100 Hz
Toco		
Measurement Method		Strain Gauge Sensor Element
Sensitivity		1 unit = 2.5 g
Resolution	Display	1 unit
	Printer	1/4 unit
Measurement Range		400 units
Signal Range		0 to 127 units
Maximum Offset Range		-300 units
Baseline Setting		20 units
Update Rate	Display	1 / second
	Printer	~4 / seconds

Performance Specifications		
Auto Offset Correction		3 seconds after connecting the transducer, the Toco value is set to 20 units
Auto Zero Adjust		Toco value is set to zero following a negative measurement value for 5 seconds
Maternal Pulse from Toco		
Emitted Light Energy		≤ 15 mW
Wavelength Range		780 to 1100 nm
Range		40 to 240 bpm
Resolution		1 bpm
Display Update Rate		1 / s
Accuracy		± 2% or 1 bpm, whichever is greater
Update Rate		every 4 seconds
IUP		
Measurement Method		Passive Resistive Strain Gauge Elements
Measurement Range		-100 to +300 mmHg
Signal Range		-99 to 127 mmHg
Resolution	Display	1 mmHg
	Printer	1/4 mmHg
Sensitivity		5 µV/V/mmHg
Offset Compensation		+100 to -200 mmHg
Accuracy (not including sensor accuracy)		± 0.5% per 100 mmHg
Update Rate	Display	1 / second
	Printer	~4 / seconds
Auto Offset Correction		3 seconds after connecting the transducer, the IUP value is set to 0 mmHg
ECG		
Type	DECG	Single Lead ECG (derived from Fetal Scalp Electrode)
	MECG	Single Lead ECG (derived from RA and LA electrodes)
Measurement Range		30 to 240 bpm
Resolution	Display	1 bpm
	Recorder	1/4 bpm
Accuracy		± 1 bpm or 1%, whichever is greater
Beat-to-Beat Change (max.)		MECG: 28 bpm DECG: 28 bpm (with Artifact Suppression On)
Differential Input Impedance		> 15MΩ
Electrode Offset Potential Tolerance		± 400 mV

Performance Specifications		
Filter Bandwidth		0.8 to 80 Hz
Inop Auxiliary Current (Leads Off Detection)		< 100 µA
Input Signal Range	DECG	20 µVpp to 6 mVpp
	MECG	150 µVpp to 6 mVpp
Dielectric Strength		1500 Vrms
Defibrillator Protection		None
ESU Protection		None

WARNING

The fetal/maternal monitor is not a diagnostic ECG device. In particular, the display of fetal/maternal ECG is intended only for evaluating signal quality for fetal/maternal heart rate as derived from the ECG waveform.

When in doubt, it can be used to identify sources of compromised signal quality, such as noise or muscle artifacts. It can subsequently be used to verify the result of measures taken to resolve them (e.g., checking ECG cable connections or adapting the fetal **ArtifactSuppress** configuration).

The safety and effectiveness of the displayed fetal/maternal ECG waveform (i.e., P, QRS and T segments) for evaluation of fetal/maternal cardiac status during labor have not been evaluated.

Fetal Heart Rate (Ultrasound/DECG) Alarm Specifications			
FHR Alarm Limits	Range	Bradycardia (low limit)	60 to 200 bpm adjustable in 10 bpm steps Default: 110 bpm
		Tachycardia (high limit)	70 to 210 bpm adjustable in 10 bpm steps Default: 170 bpm
FHR Alarm Delay	Range	Bradycardia (low limit) Delay	10 to 300 seconds in steps of 10s Default: 240 s
		Tachycardia (high limit) Delay	10 to 300 seconds in steps of 10s Default: 300s
		Signal Loss Delay	10 to 300 seconds in steps of 10s

MECG Alarm Specifications	Range	Adjustment
MECG Alarm Limits	High Range: 31 to 240 Default: 120 bpm	1 bpm steps (30 to 40 bpm) 5 bpm steps (40 to 240 bpm)
	Low Range: 30 to 235 Default: 50 bpm	
Tachycardia	Difference to high limit: 0 to 50 bpm Default: 20 bpm	5 bpm steps
	Clamping at: 150 to 240 bpm Default: 200 bpm	5 bpm steps
Bradycardia	Difference to low limit: 0 to 50 bpm Default: 20 bpm	5 bpm steps
	Clamping at: 30 to 100 bpm Default: 40 bpm	5 bpm steps

ECG/Arrhythmia/ST Supplemental Information as required by IEC 60601 - 2- 27	
Maximum T-wave amplitude	a = 8.0 mm
Heart Rate Averaging Method	Three different methods are used: Normally, heart rate is computed by averaging the 12 most recent RR intervals. For runs of PVCs, up to 8 RR intervals are averaged to compute the HR. If each of 3 consecutive RR intervals is greater than 1200 ms (that is, rate less than 50 bpm), then the 4 most recent RR intervals are averaged to compute the HR.
Display Update Rate	2 s
Response Time of Heart Rate Meter to Change in Heart Rate	HR change from 80 to 120 bpm: Average: 9 seconds HR change from 80 to 40 bpm: Average: 10.5 seconds
Heart Rate Meter Accuracy and Response to Irregular Rhythm	Ventricular bigeminy: 63 bpm Slow alternating ventricular bigeminy: 46 bpm Rapid alternating ventricular bigeminy: 93 bpm Bidirectional systoles: 125 bpm

Fetal / Maternal Defaults Settings		
FHR (Ultrasound/DECG)	Alarms On/Off Default	On
	Default Color for FHR Numeric	Orange
Toco	Default color for Toco numeric	Green
IUP	Default IUP Scale Unit	mmHg
	Default color for IUP numeric	Green
Maternal Heart Rate (MHR) Measurement	Default Color for MECG Numeric	Red

Noninvasive Blood Pressure

Complies with IEC 60601-2-30:1999/EN60601-2-30:2000.

Performance Specifications		
Measurement Ranges	Systolic	30 to 270 mmHg (4 to 36 kPa)
	Diastolic	10 to 245 mmHg (1.5 to 32 kPa)
	Mean	20 to 255 mmHg (2.5 to 34 kPa)
Accuracy		Max. Std. Deviation:8 mmHg (1.1 kPa) Max. Mean Error: ±5 mmHg (±0.7 kPa)
Pulse Rate	Range	40 to 300 bpm
	Accuracy (average over noninvasive blood pressure measurement cycle)	40 to 100 bpm: ±5 bpm
		101 to 200 bpm: ±5% of reading
		201 to 300 bpm: ±10% of reading
Measurement Time		Typical at HR > 60bpm Auto/manual: 30 seconds (adult) Maximum time: 180 seconds (adult)
Cuff Inflation Time		Typical for normal adult cuff: Less than 10 seconds
Initial Cuff Inflation Pressure		165 ±15 mmHg
Auto Mode Repetition Times		1, 2, 2.5, 3, 5, 10, 15, 20, 30, 45, 60 or 120 minutes
Venipuncture Mode Inflation		
Inflation Pressure		20 to 120 mmHg (3 to 16 kPa)
Automatic deflation after		170 seconds

Measurement Validation: In adult mode, the blood pressure measurements determined with this device comply with the American National Standard for Electronic or Automated Sphygmomanometers (ANSI/AAMI SP10 - 1992) in relation to mean error and standard deviation, when compared to intra-arterial or auscultatory measurements (depending on the configuration) in a representative population. For the auscultatory reference the 5th Korotkoff sound was used to determine the diastolic pressure.

Alarm Specifications	Range	Adjustment
Systolic	Adult: 30 to 270 mmHg (4 to 36 kPa)	10 to 30 mmHg: 2 mmHg (0.5 kPa) > 30 mmHg: 5 mmHg (1 kPa)
Diastolic	Adult: 10 to 245 mmHg (1.5 to 32 kPa)	
Mean	Adult: 20 to 255 mmHg (2.5 to 34 kPa)	

Overpressure Settings	Adjustment
> 300 mmHg (40 kPa) > 2 sec	not user adjustable

Factory Default Settings	
Mode	Manual
Repetition Time	15 min
Alarm Parameter	Systolic
Low Alarm Limit	90 / 50 (60)
High Alarm Limit	160 / 90 (110)
Pressure Units	mmHg
NBP finished tone	off
Venipuncture Pressure	60 mmHg
Start Time	Synchronized
Parameter On/Off	On
Parameter Alarms On/Off	On
Color	red
Reference	Auscultatory

SpO2

Complies with ISO 9919:2005 / EN ISO 9919:2009 (except alarm system; alarm system complies with IEC 60601-2-49:2001).

Measurement Validation: The SpO_2 accuracy has been validated in human studies against arterial blood sample reference measured with a CO-oximeter. Pulse oximeter measurements are statistically distributed, only about two-thirds of the measurements can be expected to fall within the specified accuracy compared to CO-oximeter measurements. Display Update Period: Typical: 2 seconds, Maximum: 30 seconds. Max. with noninvasive blood pressure INOP suppression on: 60 seconds.

SpO_2 Performance Specifications		
SpO_2 The specified accuracy is the root-mean-square (RMS) difference between the measured values and the reference values	Range	0 to 100%
	Accuracy	**Philips Reusable Sensors:** M1191A/B, M1191AL/BL, M1191ANL, M1192A, M1192AN = 2% (70% to 100%) M1191T, M1192T, M1194A, M1194AN, M1196A, M1196T = 3% (70% to 100%) **Philips Disposable Sensors with M1943A(L):** M1131A, M1901B, M1903B, M1904B = 3% (70% to 100%) M1133A, M1134A = ±2% (70% to 100%) **NellcorPB® Sensors with M1943A(L):** MAX-A, MAX-AL, MAX-P, MAX-N, D-25, D-20, N-25, OxiCliq A, P, N = 3% (70% to 100%) **Masimo Reusable Sensors® with LNOP MP12 or LNC MP10:** LNOP DC-I, LNOP DC-IP, LNOP YI, LNCS DC-I, LNCS DC-IP: 2 % (70 % to 100 %) LNOP TC-I, LNCS TC-I: 3.5 % (70 % to 100 %) **Masimo Disposable Sensors® with LNOP MP12 or LNC MP10:** LNOP Adt, LNOP Adtx, LNOP Pdt, LNOP Pdtx, LNCS Adtx, LNCS Pdtx: 2 % (70 % to 100 %) LNOP Neo-L, LNCS Neo-L: 3 % (70 % to 100 %)
	Resolution	1%
Pulse	Range	30 to 300 bpm
	Accuracy	±2% or 1 bpm, whichever is greater
	Resolution	1 bpm
Sensors	Wavelength range	500 to 1000 nm. Information about the wavelength range can be especially useful to clinicians (for instance, when photodynamic therapy is performed).
	Emitted Light Energy	≤ 15mW
Pulse Oximeter Calibration Range		70% - 100%

SpO_2 Alarm Specifications	Range	Adjustment	Delay
SpO_2	50 to 100%	1% steps	(0, 1, 2, 3,... 30) + 4 seconds
Desat	50 to Low alarm limit	1% steps	
Pulse	30 to 300 bpm	1 bpm steps (30 to 40 bpm) 5 bpm steps (40 to 300 bpm)	max. 14 seconds
Tachycardia	Difference to high limit 0 to 50 bpm	5 bpm steps	max. 14 seconds
	Clamping at 150 to 300 bpm	5 bpm steps	
Bradycardia	Difference to low limit 0 to 50 bpm	5 bpm steps	max. 14 seconds
	Clamping at 30 to 100 bpm	5 bpm steps	

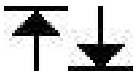
SpO_2 Factory Default Settings	
Desat Alarm Limit	80
Low Alarm Limit	90
High Alarm Limit	100
Desat Alarm Limit Delay	20 seconds
Low Alarm Limit Delay	10 seconds
High Alarm Limit Delay	10 seconds
Averaging Time	10 seconds
NBP Alarm Suppression	On
Parameter Alarms On/Off	On
Color	Cyan
Pulse Settings	
Pulse Alarms On/Off	On
Pulse High Limit	120 bpm
Pulse Low Limit	50 bpm
Bradycardia: Difference to Low Limit	20 bpm
Bradycardia: Clamp	40 bpm
Tachycardia: Difference to High Limit	20 bpm
Tachycardia: Clamp	200 bpm

Recorder Specifications

Built-in Thermal Array Fetal Trace Recorder			
Mechanism	Thermal Array Recorder		
Paper & Printing	Type		Standard Z-fold paper
	Standard Speeds (real-time traces)		3 cm/min, 2 cm/min, 1cm/min
	Fast Print Speed (stored traces)		Max. 20 mm/s Print speed is variable and depends on the print load
	ECG Wave Print Speed (not real-time)		Emulated 25 mm/s Print speed is variable and depends on the print load
	Paper Advance		20 mm/s
	Sensing		Optical Reflex Sensor for black page marks
Accuracy @ 3 cm/min, 2 cm/min, 1 cm/min	±5 mm/page		
Usable Print Width	128 mm		
Resolution	8 dots/mm (200 dpi)		
Time Delay to see trace on paper	<30s @ 1 cm/min		
Trace Separation Offset for FHR (Ultrasound and DECG)	Twin	Standard	FHR2 +20 bpm
		Classic	FHR1 +20 bpm
	Triplet	Standard	FHR2 +20 bpm FHR3 -20 bpm
		Classic	FHR1 +20 bpm FHR3 -20 bpm

Recorder Default Settings		
Setting	**Choice**	**Default**
Recorder Speed	1, 2, or 3 cm/min	3 cm/min
Scale Type	**US, Internat'l**	**US**
Trace Style FHR1	**Thin, Medium, Thick, Extra Thick**	**Thick**
Trace Style FHR2		**Medium**
Trace Style FHR3		**Extra Thick**
Trace Style Toco		**Thick**
Trace Style HR		**Thin**
Wave Style ECG		**Thin**
ECG Wave printing choice	**Separate, Overlap**	**Separate**
Notes Recording	**Along, Across**	**Along**

Recorder Default Settings		
Setting	**Choice**	**Default**
Auto Start	Off, On	Off
Confirmed Stop		Off
Bridge Paperout		On
Paper Save Mode		Off
NST Autostart		On
NST Autostop		Off
Trace Separation		Off
Separation Order	Standard, Classic	Standard
Intensity	1..5	n/a

Recorder Symbols	
Symbol	**Description**
	Alarm is on (printed next to measurement label)
	Upper and lower alarm limit (printed next to measurement label)
	FMP detection is on
	Beginning of the date/time annotation
	Warning (INOP)
	Measurement from a cordless transducer (printed next to measurement label)
	Pulse from SpO_2
	Pulse from Toco MP
	Pulse from NBP
	Trace separation +20 bpm (in label)

Recorder Symbols	
Symbol	**Description**
	Trace separation -20 bpm (in label)
	Trace separation Off (in trace)
	Trace separation +20 bpm (in trace)
	Trace separation -20 bpm (in trace)
	Trace separation +20 bpm and -20 bpm (in trace)
	Coincidence of heart rates is detected
	Marker
	Special wave, with different speed and scale (for example, fast printout of MECG wave on FM30)

Battery Specifications

The battery lifetime is 3 years from manufacturing date or 500 charge/discharge cycles.

M4605A Battery Specifications	
Physical Specifications	
W x D x H	149 mm (5.866 in) x 89 mm (3.504 in) x 19.8 mm (0.78 in)
Weight	490 g (1.08 lb) per battery
Performance Specifications	
Nominal Voltage	10.8 Volt
Rated Capacity at discharge C/5	6000 mAh
Continuous Discharge Capability	6.5 A
Environmental Specifications	
Temperature Range	Discharge 0 to 50°C (32 to 122°F) Charge 0 to 50°C (32 to 122°F) Storage and Transportation: -20 to 65°C (-4 to 140°F)
Humidity Range	Operating: 15% to 95% Relative Humidity (RH) Storage and Transportation: 5 % to 95 % Relative Humidity (RH)

M4605A Battery Specifications	
Battery Type	Smart Battery 10.8 V, 6000 mAh, Lithium Ion
Safety	complies with UL 2054
Electromagnetic Compatibility (EMC)	complies with the requirements for FCC Type B computing Device, and EN 61000-4-2 and EN 61000-3-2
Communication Standard	complies with the SMBus specification v 1.1

Alarm Defaults

Alarm Setting	Choice	Default
Alarm Mode	**INOP only**,**All**	**INOP only**
Alarm Volume	0..10	5
Alarms Off	**1 min**, **2 min**, **3 min**, **Infinite**	**3 min**
Alarm Text	**Standard**/Extended	**Standard**
Visual Latching	**Red&YellowRed**/**Off**	**Off**
Audible Latching	**Red Only**/**Off**	**Off**
Alarm Sounds	**Traditional**/**ISO**	**Traditional**
Alarm Low	0..10	4

Compatible External Displays: FM40/FM50 Only

External displays can be connected with a maximum cable run of 10 m.

Compatible Display Specifications	External XGA Display (M8031B)	External SXGA Display (M8033C)
Resolution*	1024 x 768	1280 x 1024 pixel
Refresh frequency	60 Hz or 75 Hz	60 Hz
Useful screen	depends on size of display	
Pixel size		

** The video output of the Avalon FM40/FM50 has VGA resolution.*

Manufacturer's Information

You can write to Philips at this address:

Philips Medizin Systeme Boeblingen GmbH

Hewlett-Packard-Str. 2

71034 Boeblingen

Germany

Visit our website at: www.philips.com

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Regulatory and Standards Compliance

U.S. Federal Law restricts this device to sale by or on the order of a physician.

The monitor is in conformity with the requirements of the European Medical Devices Directive 93/42/EEC and the following major international standards:

CE 0366

Safety and Performance

The monitor complies with the following major international safety and performance standards:

- EN 60601-1:1990+A1:1993+A2:1995/IEC 60601-1:1988+A1:1991+A2:1995
- EN 60601-1-1:2001/IEC 60601-1-1:2000
- EN 60601-1-6:2004/IEC 60601-1-6:2004
- EN/IEC 60601-2-27:2006
- EN/ISO 9919:2005
- EN 60601-2-30:2000/IEC 60601-2-30:1999
- EN/IEC 60601-2-37:2001+A1:2004
- EN 60601-2-49:2001/IEC 60601-2-49:2001
- UL 60601-1:2003
- CAN/CSA C22.2#601.1-M90
- JIS T 1303
- AS/NZS 3200.1.0-1998

The possibility of hazards arising from hardware and software errors was minimized in compliance with ISO 14971:2000+A1:2003, EN60601-1-4:1996+A1:1999 and IEC 60601-1-4:1996+A1:1999.

Alarm sounds are compliant with the draft ISO/IEC 9703-2 Standard.

Electromagnetic Compatibility (EMC)

The device and its accessories, listed in the accessories section, comply with the following EMC standards:

- EN/IEC 60601-1-2: 2001+A1:2004

Take special precautions regarding electromagnetic compatibility (EMC) when using medical electrical equipment. You must operate your monitoring equipment according to the EMC information provided in this book. Before using the device, assess the electromagnetic compatibility of the device with surrounding equipment.

This ISM device complies with Canadian ICES-001. Cet appareil ISM est conforme à la norme NMB-001 du Canada.

CAUTION

- **FM20/FM30 only:** Although this is an electrical Class II device, it has a protective earth conductor which is needed for EMC purposes.
- Always use the supplied power cord with the three-prong plug to connect the monitor to AC mains. Never adapt the three-prong plug from the power supply to fit a two-slot outlet.

CAUTION

The use of accessories, transducers and cables other than those specified may result in increased electromagnetic emissions or decreased electromagnetic immunity of the device.

WARNING

Do NOT use cordless/mobile phones or any other portable RF communication system within the patient vicinity, or within a 1.0 m radius of any part of the fetal monitoring system.

EMC Testing

CAUTION

Fetal parameters, especially ultrasound and ECG, are sensitive measurements involving small signals, and the monitoring equipment contains very sensitive high gain front-end amplifiers. Immunity levels for radiated RF electromagnetic fields and conducted disturbances induced by RF fields are subject to technological limitations. To ensure that external electromagnetic fields do not cause erroneous measurements, it is recommended to avoid the use of electrically radiating equipment in close proximity to these measurements.

Reducing Electromagnetic Interference

CAUTION

The device should not be used adjacent to, or stacked with, other equipment unless otherwise specified.

The product and associated accessories can be susceptible to interference from continuous, repetitive, power line bursts, and other RF energy sources, even if the other equipment is compliant with EN 60601-1-2 emission requirements. Examples of other sources of RF interference are other medical electrical devices, cellular products, information technology equipment, and radio/television transmissions.

When electromagnetic interference (EMI) is encountered, for example, if you can hear spurious noises on the fetal monitor's loudspeaker, attempt to locate the source. Assess the following:

- Is the interference due to misplaced or poorly applied transducers? If so, re-apply transducers correctly according to directions in this book or in the Instructions for Use accompanying the accessory.
- Is the interference intermittent or constant?
- Does the interference occur only in certain locations?
- Does the interference occur only when in close proximity to certain medical electrical equipment?

Once the source is located, there are a number of things that can be done to mitigate the problem:

1. Eliminating the source. Turn off or move possible sources of EMI to reduce their strength.
2. Attenuating the coupling. If the coupling path is through the patient leads, the interference may be reduced by moving and/or rearranging the leads. If the coupling is through the power cord, connecting the system to a different circuit may help.
3. Adding external attenuators. If EMI becomes an unusually difficult problem, external devices such as an isolation transformer or a transient suppressor may be of help. Your Service Provider can be of help in determining the need for external devices.

Where it has been established that electromagnetic interference is affecting physiological parameter measurement values, a physician, or a suitably qualified person authorized by a physician, should determine if it will negatively impact patient diagnosis or treatment.

System Characteristics

The phenomena discussed above are not unique to this system but are characteristic of fetal patient monitoring equipment in use today. This performance is due to very sensitive high gain front end amplifiers required to process the small physiological signals from the patient. Among the various monitoring systems already in clinical use, interference from electromagnetic sources is rarely a problem.

Electromagnetic Emissions and Immunity

The EMC standards state that manufacturers of patient-coupled equipment must specify immunity levels for their systems. See Tables 1 to 4 for this detailed immunity information. See Table 5 for recommended minimum separation distances between portable and mobile communications equipment and the product.

Immunity is defined in the standard as the ability of a system to perform without degradation in the presence of an electromagnetic disturbance.

Caution should be exercised in comparing immunity levels between different devices. The criteria used for degradation are not always specified by the standard and can therefore vary with the manufacturer.

In the table below, the term "device" refers to the Avalon FM20/30/40/50 fetal monitor together with its accessories. The table gives details of the electromagnetic emissions, and how these are classified, for the device, and the electromagnetic environments in which the device is specified to technically function.

Table 1 - Guidance and Manufacturer's Declaration: Electromagnetic Emissions		
Emissions Test	**Compliance**	**Avoiding Electromagnetic Interference**
Radio Frequency (RF) emissions	Group 1	The device uses RF energy only for its internal function. Therefore, its RF emissions are very low and are not likely to cause any interference in nearby electronic equipment.
Harmonic emissions IEC 61000-3-2	Class A	
Voltage fluctuations and flicker IEC 61000-3-3	complies	
RF emissions CISPR 11 For the Avalon FM20/30 fetal monitor with all accessories except the IUP/ECG patient module M2738A.	Class B	The device is suitable for use in all establishments, including domestic establishments and those directly connected to the public low-voltage supply network that supplies buildings used for domestic purposes [1].
RF emissions CISPR 11 For the Avalon FM40/FM50 with all accessories. For the Avalon FM20/30 fetal monitor whenever used with the IUP/ECG patient module M2738A. For the Avalon CTS Interface Cable (M2731-60001/M2732-60001) whenever used with the Avalon CTS Cordless Fetal Transducer System.	Class A	The device is suitable for use in all establishments other than domestic establishments and those directly connected to the public low-voltage supply network that supplies buildings used for domestic purposes.

[1] Note that the device is not intended for home use.

Electromagnetic Immunity

The monitor is suitable for use in the specified electromagnetic environment. The user must ensure that it is used in the appropriate environment as described below.

Table 2 - Guidance and Manufacturer's Declaration: Electromagnetic Immunity			
Immunity Test	**IEC 60601-1-2 Test Level**	**Compliance Level**	**Electromagnetic Environment Guidance**
Electrostatic discharge (ESD) IEC 61000-4-2	± 6 kV contact ± 8kV air	± 6 kV contact ± 8kV air	Floors should be wood, concrete, or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30%.
Electrical fast transient/burst IEC 61000-4-4	± 2 kV for power supply lines ± 1 kV for input/output lines	± 2 kV for power supply lines ± 1 kV for input/output lines	Mains power quality should be that of a typical commercial and/or hospital environment
Surge IEC 61000-4-5	± 1 kV differential mode ± 2 kV common mode	± 1 kV differential mode ± 2 kV common mode	Mains power quality should be that of a typical commercial and/or hospital environment
Voltage dips, short interruptions and voltage variations on power supply input lines IEC 61000-4-11	<5% U_T (> 95% dip in U_T) for 0.5 cycles	<5% U_T (> 95% dip in U_T) for 0.5 cycles	Mains power quality should be that of a typical commercial and/or hospital environment. If the user of the device requires continued operation during power mains interruptions, it is recommended that the device is powered from an uninterruptible power supply.
	40% U_T (60% dip in U_T) for 5 cycles	40% U_T (60% dip in U_T) for 5 cycles	
	70% U_T (30% dip in U_T) for 25 cycles	70% U_T (30% dip in U_T) for 25 cycles	
	< 5% U_T (> 95% dip in U_T) for 5 sec	< 5%U_T (> 95% dip in U_T) for 5 sec	
Power frequency (50/60 Hz) magnetic field IEC 61000-4-8	3 A/m	3 A/m	Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial and/or hospital environment
Key: U_T is the AC mains voltage prior to application of the test level.			

Finding Recommended Separation Distances

In the following table, *P* is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer, and *d* is the recommended separation distance in meters (m).

Portable and mobile RF communications equipment should be used no closer to any part of the device, including cables, than the recommended separation distance calculated from the equation appropriate for the frequency of the transmitter.

Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey, should be less than the compliance level in each frequency range.

Interference may occur in the vicinity of equipment marked with this symbol:



Table 3 - Guidance and Manufacturer's Declaration: Electromagnetic Immunity		
Conducted RF Immunity Test EN/IEC 61000-4-6		
IEC 60601-1-2 Test Level over 150 kHz to 80 MHz	**Compliance Level**	**Electromagnetic Environment Guidance:** **Recommended Separation Distance (*d*)** **(in Meters, at Frequency Range Tested) for Ultrasound and ECG Measurements**
3.0 V_{RMS}	3.0 V_{RMS}	d = 1, 2√P
Key: *d* = Recommended separation distance in meters (m)		
P = maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer		
V1 = Tested compliance level (in Volts) for the Conducted RF Immunity test IEC 61000-4-6		
Note: The device meets the compliance level of 3.0 V_{RMS} according to IEC 60601-1-2 over the specified test frequency range. Over the frequency range 150 kHz to 80 MHz, the recommended separation distance in meters (d) is found by the following equation:		
$d = \left(\frac{3,5}{V1}\right)\sqrt{P}$	For a compliance level of 3.0 V_{RMS}:	d = 1, 2√P

Table 4 - Guidance and Manufacturer's Declaration: Electromagnetic Immunity		
Radiated RF Immunity Test EN/IEC 61000-4-3		
IEC 60601-1-2 Test Level over 80 MHz to 2.5 GHz	**Compliance Level**	**Electromagnetic Environment Guidance:** **Recommended Separation Distance (*d*)** **(in Meters, at Frequency Range Tested) for Ultrasound and ECG Measurements**
3.0 V/m	3.0 V/m	Over 80 MHz to 800 MHz:d = 1, 2√P
		Over 800 MHz to 2.5 GHz:d = 2, 3√P
Key: *d* = Recommended separation distance in meters (m)		
P = maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer		
E1 = Tested compliance level (in Volts/meter) for the Radiated RF Immunity test IEC 61000-4-3		

Table 4 - Guidance and Manufacturer's Declaration: Electromagnetic Immunity		
Radiated RF Immunity Test EN/IEC 61000-4-3		
IEC 60601-1-2 Test Level over 80 MHz to 2.5 GHz	**Compliance Level**	**Electromagnetic Environment Guidance:** **Recommended Separation Distance (*d*)** **(in Meters, at Frequency Range Tested) for Ultrasound and ECG Measurements**
Note: The device meets the compliance level of 3.0 V_{RMS} according to IEC 60601-1-2 over the specified test frequency range. Over the frequency range 80 kHz to 800 MHz, the recommended separation distance in meters (d) is found by the following equation:		
$d = \left(\frac{3,5}{E1}\right)\sqrt{P}$	For a compliance level of 3.0 V_{RMS}:	$d = 1,2\sqrt{P}$
Over the frequency range 800 kHz to 2.5 GHz, the recommended separation distance in meters (*d*) is found by the following equation:		
$d = \left(\frac{7,0}{E1}\right)\sqrt{P}$	For a compliance level of 3.0 V_{RMS}:	$d = 2,3\sqrt{P}$

Field strengths from fixed transmitters, such as base stations or radio (cellular, cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcast and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the device is used exceeds the applicable RF compliance level above, it should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as reorienting or relocating the device.

These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects, and people.

If you require further information or assistance, please contact Philips Support.

Recommended Separation Distances from Other RF Equipment

The device is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The customer or user of the device can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment and the device as recommended below, according to the maximum output power of the communications equipment.

Table 5 - Separation Distance (*d*) in Meters According to Frequency of Transmitter at IEC 60601-1-2 Test Compliance Level			
Rated Maximum Output Power (*P*) of Transmitter (in Watts)	**150 kHz to 80 MHz** $d = \left(\frac{3,5}{V1}\right)\sqrt{P}$	**80 MHz to 800 MHz** $d = \left(\frac{3,5}{E1}\right)\sqrt{P}$	**800 MHz to 2.5 GHz** $d = \left(\frac{7,0}{E1}\right)\sqrt{P}$
0.01 W	0.1 m	0.1 m	0.23 m
0.1 W	0.4 m	0.4 m	0.7 m
1 W	1.2 m	1.2 m	2.3 m
10 W	3.8 m	3.8 m	7.3 m
100 W	12.0 m	12.0 m	23.0 m

Environment

Before operation, make sure that the fetal monitor is free from condensation. This can form when equipment is moved from one building to another, and is exposed to moisture and differences in temperature.

Use the monitor in an environment which is reasonably free from vibration, dust, corrosive or explosive gasses, extremes of temperature, humidity, and so forth. It operates within specifications at ambient temperatures between 0 and +45°C (32°F to 113°F). Ambient temperatures that exceed these limits can affect the accuracy of the system, and can damage the components and circuits.

Ambient temperature ranges for storage are -20°C to +60°C (-4°F to 140°F) for the monitor, and -40°C to +60°C (-40°F to 140°F) for transducers.

The transducers are watertight to a depth of 1.0 m for at least five hours (rated IP 68).

WARNING

- **Leakage currents:** If several items of equipment used to monitor a patient are interconnected, the resulting leakage current may exceed allowable limits.
- **ECG electrodes:** NEVER allow ECG electrodes to contact other electrical conductive parts, including earth.

Monitoring After a Loss of Power

If the monitor is without power for **less** than one minute, monitoring will resume with all active settings unchanged. If the monitor is without power for **more** than one minute, the behavior depends on your configuration. If **Automat. Default** is set to **Yes**, the User Defaults will be loaded when power is restored. If **Automat. Default** is set to **No**, all active settings are retained, if power is restored within 48 hours. The **Automat. Default** setting is made in Configuration mode.

FM40/50 and FM20/30 with Battery Option

When power is lost - no power is available from the AC power source or from the battery - before the monitor is put into Standby, a beeper will sound. The tone can be silenced by pressing the On/Standby switch.

ESU, MRI and Defibrillation

WARNING

The fetal/maternal monitors are NOT intended for use during defibrillation, electro-surgery, or MRI. Remove all transducers, sensors, and accessories before performing electro-surgery, defibrillation, or MRI, otherwise harm to the patient or the user can result.

Cardiac Pacemakers and Electrical Stimulators

WARNING

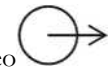
The fetal/maternal monitors are NOT intended for use for ECG measurements on patients connected to electrical stimulators or with cardiac pacemakers.

Fast Transients/Bursts

The equipment will return to the previous operating mode within 10 seconds without loss of any stored data.

Symbols on the System

	This caution/warning symbol indicates that you should consult the Instructions for Use (this document), and particularly any warning messages.
	This symbol indicates that you should consult the Instructions for Use (this document).
	Power-On/Off Switch - FM20/FM30 without Battery Option
	Power-On/StandBy Switch - FM40/FM50 and FM20/30 with Battery Option
	Power-On LED
	Electrical Class II equipment, in which the protection against electric shock relies on double or reinforced insulation (FM20/FM30).
	Fetal Sensor Socket symbol.
	SpO_2 Socket symbol.
	Noninvasive Blood Pressure Socket symbol.
	Symbol indicating the monitor has the triplets option.
	Symbol indicating the monitor is capable of intrapartum monitoring.
	Button to open paper drawer/paper eject. (FM40/FM50).
	Protective earth terminal (FM40/FM50).
	Equipotential grounding point (FM40/FM50).
Tele	Socket for connecting Avalon CTS interface cable M2732-60001 (with black connector, FM40/FM50)

Video 	Analog interface indicator for connection to any analog video display (VGA resolution).
IP 67	Ingress Protection code according to IEC 60529. The IUP/ECG patient module (M2738A) is rated IP 67 (protection against dust, access to hazardous parts, and the effects of continuous immersion in water to a depth of 0.5 meter for 30 minutes).
IP 68	Ingress Protection code according to IEC 60529. All transducers (excluding M2738A) are rated IP 68 (protection against dust, access to hazardous parts, and the effects of continuous immersion in water to a depth of 1.0 meter for five hours).
IP X1	Ingress Protection code according to IEC 60529. The monitors and interface cable for the Avalon CTS (M2731-60001/M2732-60001) are rated IP X1 (protection against water dripping vertically only).
	Type CF equipment, not defibrillation proof.
	Identifies the year and month of manufacture.
	Symbol indicating separate collection for waste electrical and electronic equipment.

26 Specifications and Standards Compliance

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