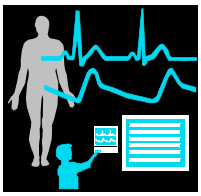
IntelliVue MP40/50 and MP60/70/90



INSTRUCTIONS FOR USE

IntelliVue Patient Monitor

MP40/50 and MP60/70/90

Release B.0 with Software Revision B.0x.xx

Patient Monitoring

PHILIPS

Part Number M8000-9001D
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PHILIPS

Table Of Contents

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Basic Operation

This Instructions for Use is for clinical professionals using the IntelliVue MP40/50 (M8003A/M8004A) and MP60/70/90 (M8005A/M8007A/M8010A) patient monitors. Unless otherwise specified, the information here is valid for all the IntelliVue patient monitors.

The basic operation section 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 and off, setting up and adjusting wave speeds, working with profiles). 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.

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 care and cleaning that is not repeated in this book.

This guide describes all features and options. Your monitor may not have all of them; they are not all available in all geographies. Your monitor is highly configurable. What you see on the screen, how the menus appear and so forth, depends on the way it has been tailored for your hospital may not be exactly as shown here.

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 patient monitor. **Display** refers to the physical display unit. **Display Screen** and **Screen** refer to everything you see on monitor's display, such as measurements, alarms, patient data and so forth.

Introducing the IntelliVue Family

The Philips IntelliVue family of patient monitors offers a monitoring solution optimized for the surgical, cardiac, medical and neonatal care environments. Combining patient surveillance and data management, it allows multi-measurement monitoring by linking separate modules with “plug-and-play” convenience.

Your monitor stores data in trend, event, and calculation databases. You can see tabular trends (vital signs) and document them on a local or remote printer. You can view measurement trend graphs, with up to three measurements combined in each graph, to help you identify changes in the patient’s physiological condition. You can view fast-changing measurement trends with beat to beat resolution and see up to four high resolution trend segments. Event surveillance enhances documentation and review of physiologically significant events by automatically detecting and storing up to 50 user-defined clinical events over a 24 hour period.

There is a choice of monitor configurations, as explained below. All models can also use computer devices such as a mouse, a trackball and a keyboard.

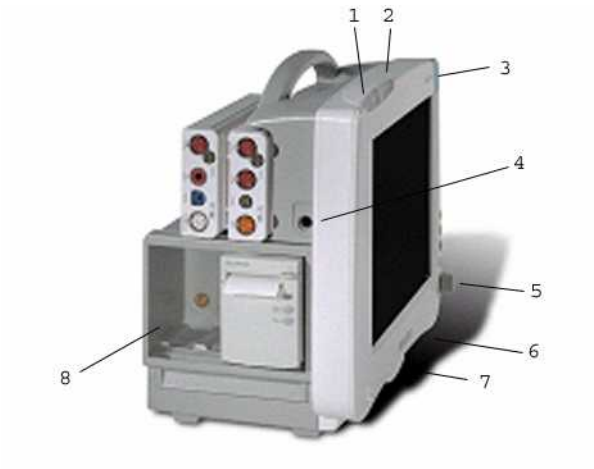
IntelliVue MP40/MP50

The IntelliVue MP40/MP50 (M8003A/M8004A) patient monitor has a 12-inch TFT LCD flat panel SVGA display. The standard input devices for the MP50 are the Touchscreen and integrated navigation point; the MP40 is supplied with an integrated navigation point only. Up to six waves can be shown on MP40/MP50 Screens, as well as the 12-Lead ECG Screen.

The MP40/MP50 can be connected to one Multi-Measurement Server (MMS) and any one of the measurement server extensions. The IntelliVue family plug-in measurement modules can be connected to its four integrated plug-in module slots with plug-and-play convenience (the only exception is the SvO_2 module, M1021A, which cannot be used with the MP40/MP50). The integrated module slots replace the Flexible Module Server (M8048A), which cannot be used with the MP40/MP50.

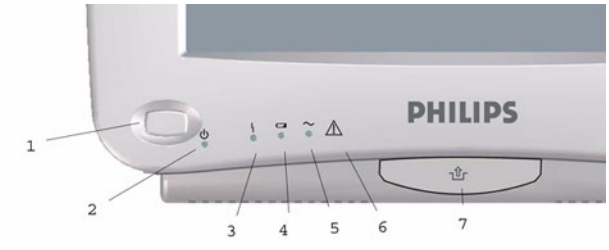
MP40/MP50 Major Parts and Keys

MP40/MP50 left side



1 Color-coded alarm lamps
2 Alarms off lamp
3 Model indicator
4 ECG out
5 Navigation Point
6 Part number and serial number
7 Quick-release mounting release
8 Plug-in module slots

MP40/MP50 front panel



1 On/Standby switch
2 On/Standby LED
3 Error LED
4 Battery status LED
5 AC power operation LED
6 “read the documentation” symbol
7 Mounting quick- release lever

MP40/MP50 LED Colors and their Meanings	
On/Standby LED	Green when monitor is switched on
Error LED	Red if there is a problem with the monitor
Battery LED	Green, yellow, and red. See the “Battery LED” on page 260 for details
AC Power	Green when monitor is connected to mains power

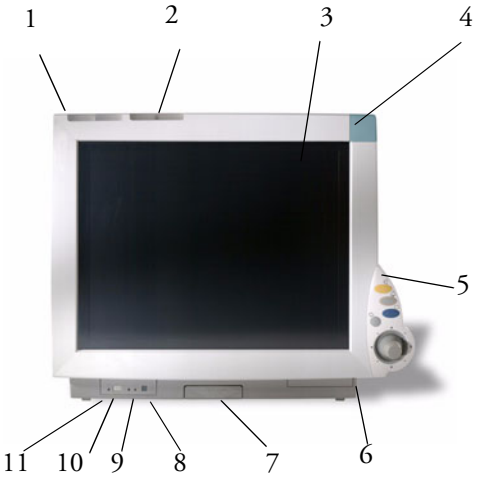
IntelliVue MP60/MP70

The IntelliVue MP60/MP70 (M8005A/M8007A) patient monitors integrate the display unit, with a 15” color LCD display, and the data processing unit into one. Up to eight waves can be shown on the screens, as well as the 12-Lead ECG Screen. The MP60 uses the SpeedPoint as its primary input device while the MP70 uses touch screen operation but may have an optional SpeedPoint.

The monitors can be connected to the Multi-Measurement Server (MMS) and any one of the measurement server extensions, and to the Flexible Module Server (M8048A). The IntelliVue family plug-in measurement modules can be connected to its FMS module slots with plug-and-play convenience.

The MP60/MP70 has two integrated slots for plug-in modules. You can combine one each of the following modules in these slots: Pressure, Temperature, C.O., and VueLink. You can also use the two-slot recorder module in the integrated slots.

MP60/MP70 Major Parts and Keys

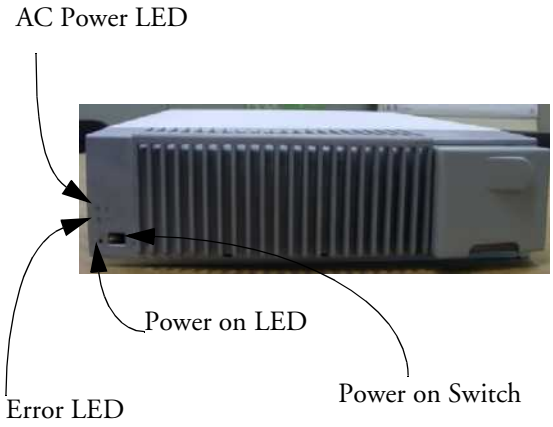


1 Color coded alarm lamps
2 Alarms Off lamp
3 Display
4 Model indicator
5 SpeedPoint (optional for MP70)
6 Part number and serial number
7 Mounting adapter release
8 AC power LED
9 Error LED
10 Power on/standby switch
11 Power on LED

MP90 Major Parts and Keys

In the MP90, the display and the processing unit are separate components. It offers both touchscreen and the Remote SpeedPoint as standard input devices.

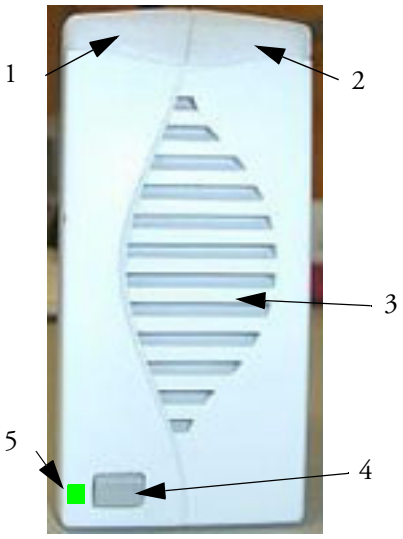
Display Unit



Processing Unit

Remote Alarm Device

The Remote Alarm Device provides audio and visual indicators of alarms, in addition to those shown on the display.



1 Two color coded alarm lamps (right-hand lamp flashes red or yellow for patient alarms, left-hand lamp flashes light blue for INOPs)

2 Alarms off lamp - when illuminated it indicates that all patient alarms are deactivated.

3 Speaker - for alarm prompts, QRS tones and so forth

4 Monitor power on /standby switch. Press to switch monitor on remotely. Press and hold for one second to turn monitor off.

5 Power on LED - green when monitor is on

Related Products

Related products extend the measurement capabilities of your monitor. None of the related devices have their own power on/standby switches. They take their power from the monitor, and switch on automatically when you turn on the monitor. A green power-on LED indicates when they are drawing power from the monitor. A permanently illuminated, or flashing, red LED indicates a problem with the unit that requires the attention of qualified service personnel.

Flexible Module Server (M8048A)

MP60/70/90 only

The flexible module server (FMS) lets you use up to eight plug-in physiological measurement modules.

With the MP90 (M8010A) you can connect two FMSs to use up to 10 measurement modules.

Connect the FMS to the monitor via the measurement server link cable (MSL). Use the MSL connector on the left-hand side to connect additional measurement servers. Use the connector on the right to connect to the monitor.

1	Multi-Measurement Server
2	Measurement server extension
3	Measurement server mount
4	Flexible Module Server
5	BIS engine
6	Power on LED
7	Interruption indicator

Measurement Modules

You can use up to eight measurement modules with the Flexible Module Server (M8048A), two additional modules in the integrated module slots in the MP60/MP70, and up to four in the integrated slots in the MP40/MP50. Available modules are:

- Invasive blood pressure, with up to five pressure modules simultaneously (M1006B)
- Temperature, with up to four temperature modules simultaneously (M1029A)
- Oxygen saturation of arterial blood (SpO_2) (M1020B)
- Cardiac output (M1012A), and Continuous cardiac output with M1012A Option #C10
- Transcutaneous gas (M1018A)
- Mixed venous oxygen saturation - SvO_2 (M1021A) MP60/70/90 monitor only
- Recorder (M1116B)
- VueLink device interface, with up to four VueLink modules simultaneously (M1032A)
- EEG (M1027A)
- Bispectral Index - BIS (M1034A)

You can plug and unplug modules during monitoring. Insert the module until the lever on the module clicks into place. Remove a module by pressing the lever upwards and pulling the module out. Reconnecting a module to the same monitor restores its label and measurement settings, such as alarms limits. If you connect it to a different monitor, the module remembers only its label.

The connector socket on the front of each module is the same color as the corresponding connector plug on the transducer or patient cable.

Press the Setup key on the module's front to display the measurement's setup menu on the monitor screen. When the setup menu is open, a light appears above the key. Some modules have a second key. On the pressure module, for example, it initiates a zeroing procedure.

Example Module (Pressure)

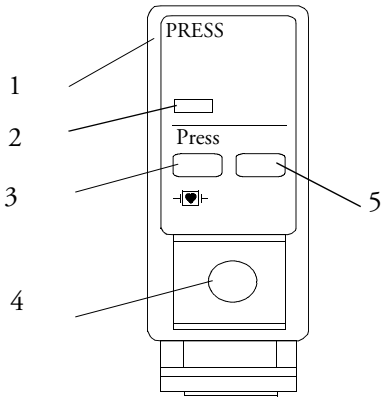
1 Module name

2 Setup key LED

3 Setup key to enter setup menu of measurement modules or VueLink device data window

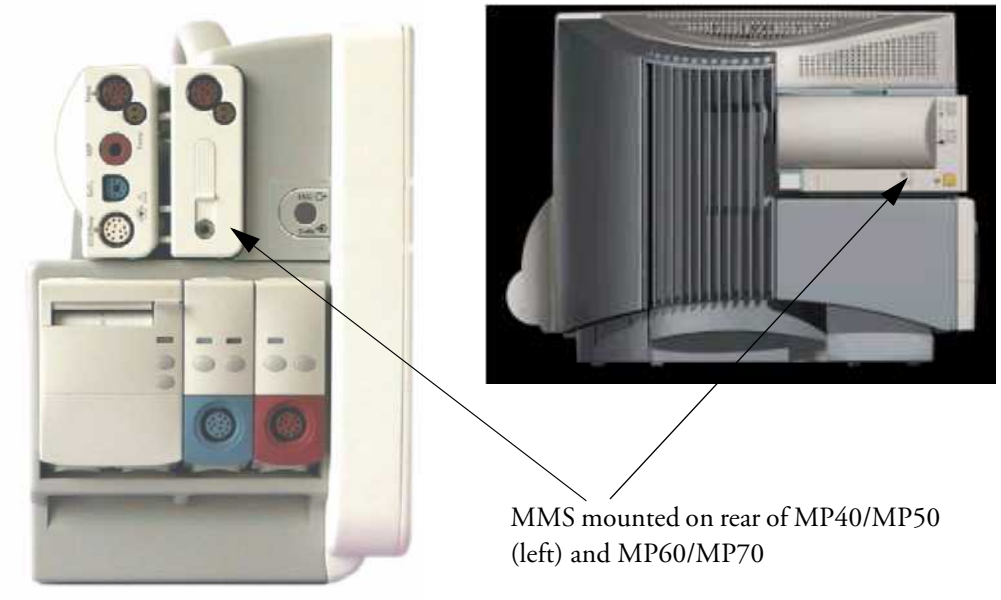
4 Connector socket for patient cable/ transducer

5 Second module-specific key, for example Zero

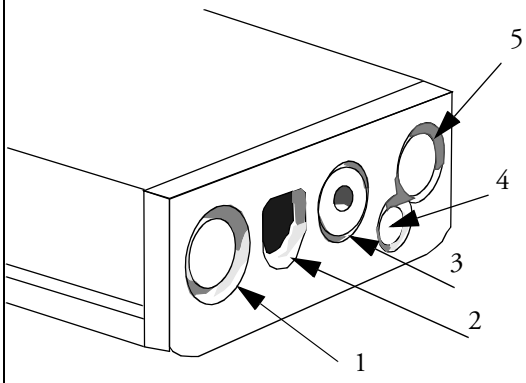
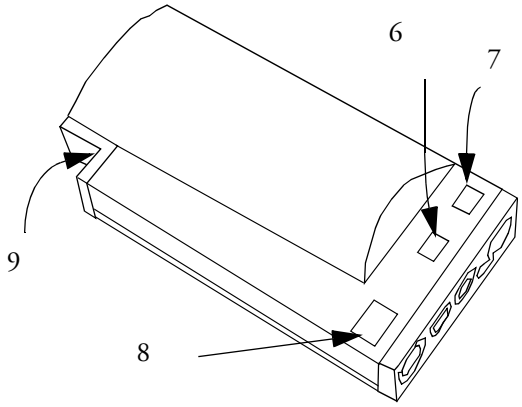


Multi-Measurement Server (M3001A)

The Multi-Measurement Server (MMS) can simultaneously monitor 3-, 5- or 10-lead ECG (including arrhythmia and ST monitoring), respiration, SpO_2, NBP and either invasive pressure or temperature. Depending on the monitor model, you can connect it to the monitor via a cable or mount it either on the left side of the FMS or on the back of the monitor, as shown here.



MMS mounted on rear of MP40/MP50 (left) and MP60/MP70

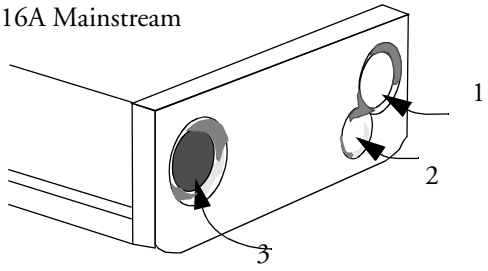
M3001A Connectors and Symbols		
	1	White ECG/Resp connector
	2	Blue SpO_2 connector
	3	Red NBP connector
	4 & 5	Combined pressure (red) and temperature (brown) connector - connect either invasive pressure transducer or temperature probe. You might have a version of the MMS that does not have this connector.
	6	NBP Start/Stop key - starts or stops NBP measurements 
	7	NBP STAT key - starts NBP STAT series of measurements 
		OR  Zero key - initiates a zero procedure for the connected pressure transducer when pressed and held for a second
	8	Silence: acknowledges all active alarms by switching off audible alarm indicators and lamps. Takes behavior from SmartKey configuration 
	9	MSL cable connector to the monitor

M3015A and M3016A Measurement Server Extensions

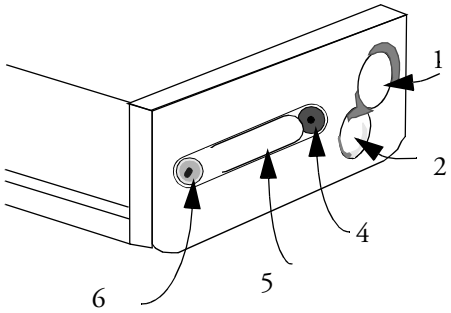
The optional M3015A Microstream CO_2 Extension adds microstream capnography and either pressure or temperature to the MMS. The optional M3016A Mainstream CO_2 Extension adds mainstream capnography and either pressure or temperature to the MMS. The measurement server extensions connect to the MMS and use the MMS settings and power.

The measurement server extensions must not be disconnected during monitoring. When the connection to the measurement server is broken, settings revert to default and any stored trend information is lost.

M3016A Mainstream



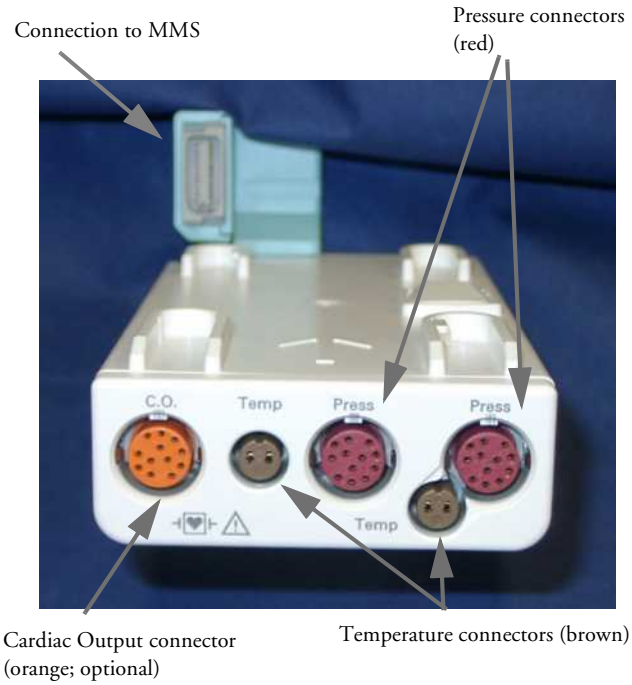
M3015A Microstream



1	Pressure connector (red)	4	Inlet
2	Temperature connector (brown)	5	Microstream connector CO_2
3	Mainstream connector CO_2 (optional)	6	Gas sample outlet

M3012A Hemodynamic Measurement Server Extension

The M3012A Hemodynamic Measurement Server Extension (HMSE) can be connected to the M3001A Multi-Measurement Server to provide the following additional measurements: Temperature, Pressure, an additional Pressure or Temperature, and C.O. and CCO measurements.



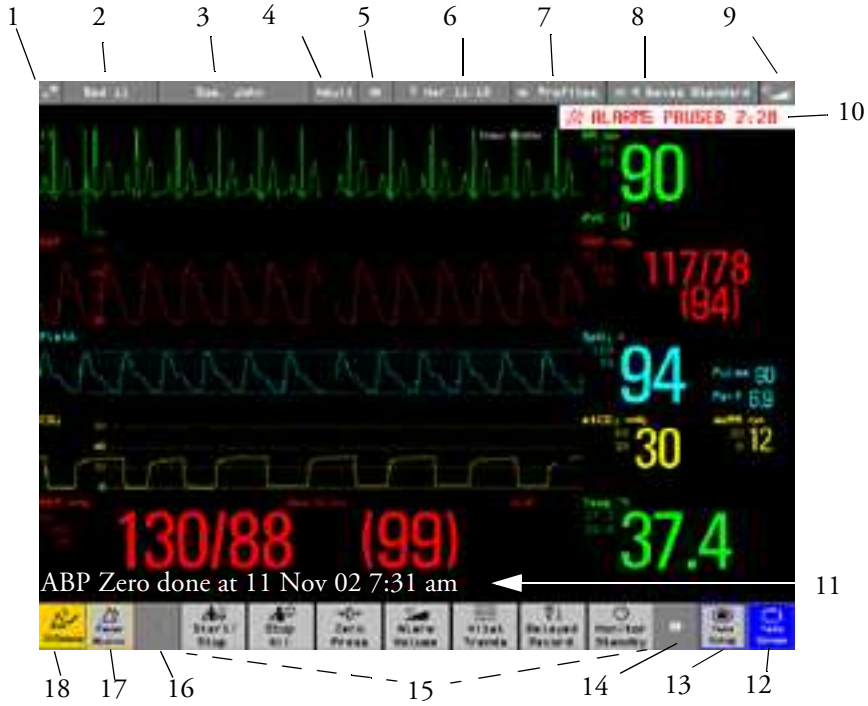
Anesthetic Gas Module (AGM)

See the AGM section of this Instructions for Use.

Operating and Navigating

Everything you need to operate the monitor is contained on its screen. Almost every element on the screen is interactive. Screen elements include measurement numerics, waveforms, screen keys, information fields, alarms fields and menus.

The configurability of the monitor means that often you can access the same element in different ways. For example, you might be able to access an item through its on-screen setup menu, via a hard key, or via a SmartKey. This Instructions for Use always describes how to access items via an on-screen menu. You may use which ever way you find most convenient.



Monitor information line		Other screen elements	
1	network connection indicator	10	alarm status area - shows active alarm messages
2	bed label	11	status line - shows information messages and prompting you for action
3	patient identification	12	close all open menus and windows and return to main screen
4	patient category	13	enter **Main Setup** menu
5	paced status	14	scroll right to display more SmartKeys
6	date and time	15	SmartKeys - these change according to your monitor's configuration
7	access the profiles menu	16	scroll left to display more SmartKeys
8	current screen name/enter change screen menu	17	**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.
9	adjust volume/level indicator	18	**Silence** - acknowledges all active alarms by switching off audible alarm indicators and lamps permanently or temporarily, if alarm reminder (ReAlarm) is configured on.

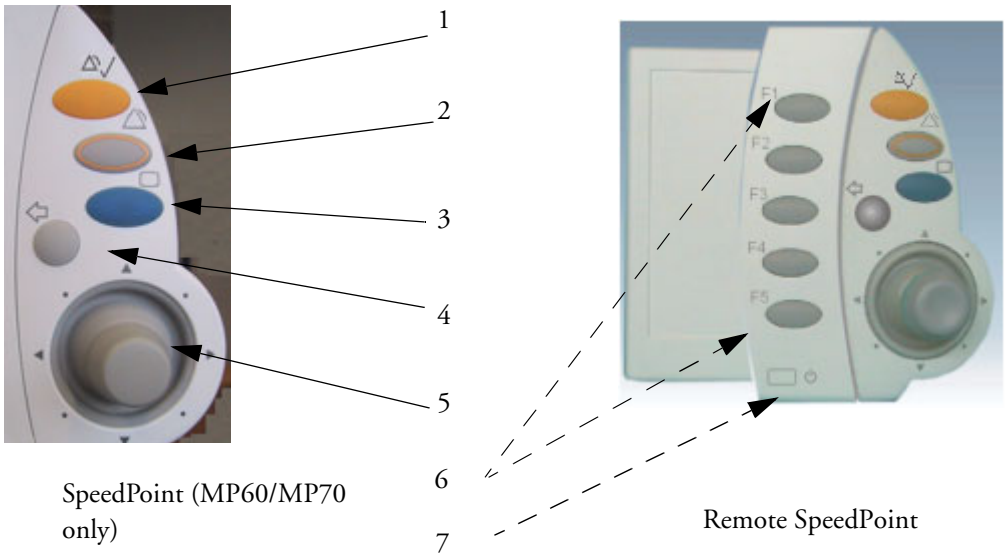
Select a screen element to tell the monitor to carry out the actions linked to the element. For example, select the Patient Identification element to call up the **Patient Demographics** window, or select the HR numeric to call up the **Setup ECG** menu. Select the ECG wave segment to call up the ECG lead menu. The network indicator and bed label elements show menus whose function is documented in the Information Center Instructions for Use.

Using the Touchscreen

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

Using the MP60/MP70/MP90 SpeedPoint

MP60/70/90 Only



SpeedPoint (MP60/MP70 only)

Remote SpeedPoint

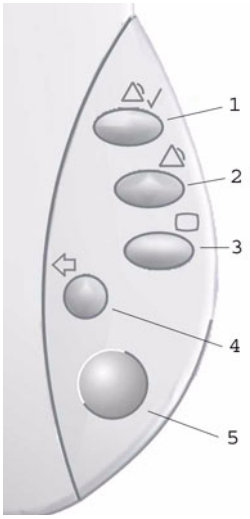
1	**Silence** - acknowledges all active alarms by switching off audible alarm indicators and lamps. Behavior follows the Silence permanent key configuration.
2	**Alarms Off/Pause Alarms**- pauses alarm indicators. Behavior follows the Pause Alarms permanent key configuration.
3	**Main Screen** - close all open menus and windows and return to the main screen.
4	**Back** - go back one step to the previous menu.
5	**SpeedPoint knob** - rotate and tilt to highlight elements. Press to select.
6	**Function keys on remote SpeedPoint** - function identical to the first five SmartKeys configured for a screen.
7	**On/standby key**

Rotate the SpeedPoint knob left or right. With each click, the highlight jumps to the neighboring screen element. Alternatively, tilt the knob to move it in the direction of a screen element. A cursor moves across the screen, following the direction of the knob. Any screen element under the cursor is highlighted. When you reach the screen element you want, press the knob to select the element.

Using the remote SpeedPoint, you can operate the monitor from a distant location such as at the foot of the bed. The remote SpeedPoint can also be used with the MP40/MP50.

Using the MP40/MP50 Navigation Point

MP40/MP50 only



1 **Silence**- acknowledges all active alarms by switching off audible alarm indicators and lamps. Exact behavior depends on permanent key configuration

2 **Alarms Off/Pause Alarms**- pauses alarm indicators. Exact behavior depends on Pause Alarms permanent key configuration

3 **Main Screen** - closes all open menus and windows and return to the main screen.

4 **Back** - takes you back one step to the previous menu.

5 Navigation Point knob

Setup
Alarm Messages
Alarm Limits
Alarm Volume
My Care Group
Screens
Profiles
Admit/Discharge
Paced No

To use the navigation point, rotate it left or right. With each click, the highlight jumps to the neighboring screen element. The element under the cursor is highlighted. When you reach the screen element you want, press the knob to select the element.

The elements at the top of the Screen are grouped together for ease of navigation. Select any item at the top of the Screen to open the Setup menu; scroll down the menu to highlight the element you want then press the navigation point to select the element.

Using a Mouse or Trackball

If you are using a mouse or trackball, select screen elements by clicking on them (press and release the left mouse button). While you are moving the mouse, a cursor appears and a highlight shows your current position.

Using Keys

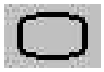
The monitor has four different types of keys.

Permanent Keys

A permanent key is a graphical key that remains on the screen all the time to give you fast access to functions.

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.

Silence - acknowledges all active alarms by switching off audible alarm indicators and lamps.



Main Screen - close all open menus and windows and return to the main screen.

Main Setup - enter main setup menu.

SmartKeys

A SmartKey is a configurable graphical key, located at the bottom of the main screen. They give you fast access to functions. Their availability, and the order in which they appear on your screen, depends on how your monitor is configured.

enter profile menu

set alarm limits

change alarm volume

end case to discharge a patient

enter standby mode - suspends patient monitoring. All waves and numerics disappear from the display. All settings and patient data information are retained.

review beat labels (annotate arrhythmia wave)

change amplitude (size) of ECG wave

change screen

enter patient identification menu to admit/discharge/transfer

change QRS volume

view information for patients in other beds

change screen brightness (not for independent displays)

re-learn arrhythmia

enter cardiac output procedure


start veni puncture (inflate cuff to subdiastolic pressure)


- start/stop manual NBP measurement
- start auto series
- stop current automatic measurement within series


start NBP STAT measurement


stop automatic or STAT NBP measurement and measurement series


set the NBP repeat time


access patient reports


zero invasive pressure transducer


start a delayed recording


Realtime Record SmartKey to access pop-up recording keys

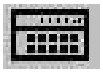

access wedge procedure window

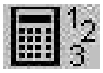

access the Loops window

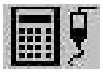

review vital signs trend


review graph trend


access event surveillance

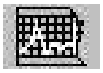

access calculations


access the calculator


access the Drug Calculator


suppress AGM zero


display VueLink information


start 12-Lead Capture (only available if Information Center is connected)


access remote applications (if Application Server is connected)

Hardkeys

A hardkey is a physical key on a monitoring device, such as the zero pressure key on the MMS or a setup key on a module.

Pop-Up Keys

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

Using the On-Screen Keyboard

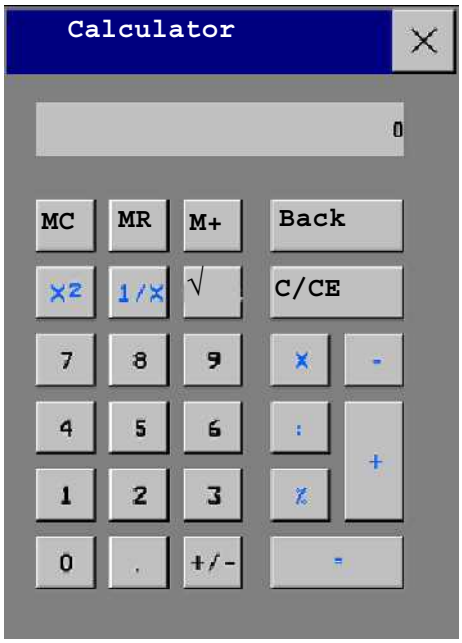
Use this as you would a conventional keyboard. Enter the information by selecting one character after another. Use the **Shift** and capital **Lock** keys to access uppercase letters. Use the **Back** key to delete single characters, or use the **Clr** key to delete entire entries. Select **Enter** to confirm what you have entered and close the on-screen keyboard.

If a conventional keyboard is connected to the monitor, you can use this instead of or in combination with the on-screen keyboard.

Using the On-Screen Calculator

You can use the on-screen calculator to perform any of the standard operations for which you would normally use a handheld calculator.

- To access the on-screen calculator, select the **Calculator** SmartKey, or select **Main Setup** -> **Calculations** -> **Calculator**.



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 **Monitor**.

3 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, every day working mode that you use for monitoring patients. You can change elements such as alarm limits, patient category and so forth. When you discharge the patient, these elements return to their default values. Changes can be stored permanently only in Configuration Mode. You may see items, such as some menu options or the altitude setting, that are visible but 'grayed out' so that you can neither select nor change them. These are for your information and can be changed only in Configuration Mode.
- **Demonstration Mode**: Passcode protected, this is for demonstration purposes only. You must not change into Demonstration Mode during monitoring. In Demonstration Mode, all stored trend information is deleted from the monitor's memory.

- **Configuration Mode**: Passcode protected, this mode is for personnel trained in configuration tasks. These tasks are described in the Configuration 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, the number of waves you see and so forth.
- **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 with the mode name in the center of the Screen and in the bottom right-hand corner. Select this field to change to a different mode.

Disabling Touchscreen Operation

- To temporarily disable touchscreen operation of the monitor, press and hold the Main Screen permanent key. A padlock will appear on the Main Screen permanent key.
- Press and hold the Main Screen permanent key again to re-enable the touchscreen operation.

Using a Second Display

A second display, showing the same Screen as the main display, can be connected to any of the monitors, for viewing only.

A second display showing a different Screen can be connected to the MP90, for viewing only. The second Screen cannot be operated using any input device. You can change the selection of screen elements shown on the Screen of the second display in the monitor's Configuration Mode.

To choose Screens for two displays,

1 Select **Profiles** in the monitor info line of the primary display,

2 Select **Display 1**, then select the Screen you want to display on the primary display from the list of available Screens.

3 Select **Display 2**, then select the Screen you want to display on the second display from the list of available Screens.

The second display Screen may take a few seconds to load.

Tailoring Your Monitor

You can tailor your monitor's default settings.

Understanding Screens

Your monitor comes with a set of preconfigured screens, optimized for common monitoring scenarios such as OR adult, or ICU neonatal. A screen defines the overall selection, size and position of waves, numerics and SmartKeys on the monitor screen when you switch on. You can easily switch between different screens during monitoring. Screens do NOT affect alarm settings, patient category and so forth.

Switching to a Different Screen

1 To switch to a different Screen, select the current Screen name in the monitor info line, or select the **Change Screen** SmartKey.

2 Choose the new screen from the pop-up list.

When you switch from a complex to a less complex screen layout, some measurements may not be visible but are still monitored in the background. If you switch to a more complex screen with, for example, four invasive pressure waves but you have only two pressures connected to the monitor, the "missing" two pressures are either left blank or the available space is filled by another measurement.

Using the Visitor Screen

If a visitor Screen is configured for your monitor, you can use it to clear the screen of all waves and numerics but continue to monitor the patient with active alarms and trend storage at the bedside and Information Center.

- To activate this Screen, select the Screen name in the monitor info line to open the **Screen** menu, then select the name of the Visitor Screen configured for your monitor from the list of available Screens.
- Select any element on the Screen to open the **Screen** menu and select a different Screen to show waves and numerics again.

Changing a Screen's Content

If you do not want to change the entire screen content, but only some parts of it, you can substitute individual waves. When you select a wave for display, its numeric is usually automatically selected along with it. Permanently storing the change can be done only in Configuration Mode.

1 Select the wave segment on the monitor screen where you want the new wave to appear. This calls up the **Wave** menu.

2 In the **Wave** menu, select **Change Wave**.

3 From the wave list, select the wave you want.

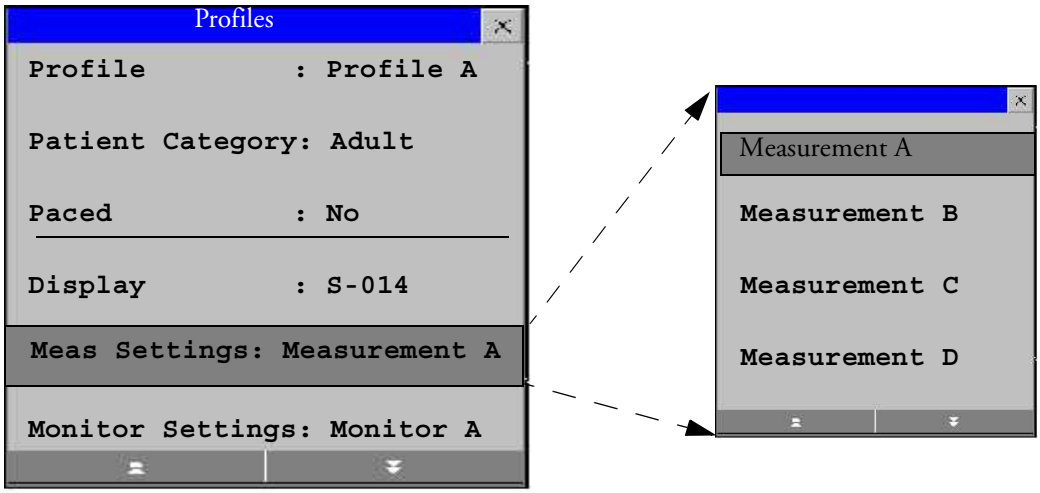
Understanding Profiles

Profiles are predefined monitor configurations. They let you change the configuration of the whole monitor so you can adapt it to different monitoring situations. The changes that occur when you change a complete profile are more far reaching than those made when you change a Screen. Screens affect only what is shown on the display. Profiles affect all monitor and measurement settings.

The settings that are defined by Profiles are grouped into three categories. Each category offers a choice of 'settings blocks' customized for specific monitoring situations. These categories are:

- **Display (screens)**
  - Each profile can have a choice of many different predefined screens. If you are using a second display, each display can have its own individual screen selection. When you change the profile, the screen selection configured for the new profile becomes active.
- **Monitor Settings**
  - Each profile can have a choice of different predefined monitor settings. These relate to the monitor as a whole; for example, display brightness, alarms off/paused, alarm volume, QRS tone volume, tone modulation, prompt tone volume, wave speed, resp wave speed, pulse source.

- **Measurement Settings**
  - Each profile can have a choice of different predefined measurement settings. These relate directly to individual measurements, for example, measurement on/off, measurement color, alarms limits, NBP alarm source, NBP repeat time, temperature unit (°F or °C) pressure unit (mmHg or kPa).



Profiles Menu, showing current settings

Available choices in measurement menu

You can change from one complete profile to another or swap individual settings blocks (display screen/monitor settings/measurement settings) to change a subset of a profile. Changes you make to any element within the settings blocks are not saved when you discharge the patient, unless you save them in Configuration Mode.

You might find it helpful to think of the three categories in terms of a restaurant menu. The Screens are like the first course, offering you a choice of "starters" (many different screen configurations from which you can choose the one that best suits your requirements). The Monitor Settings category is like the main course, offering a choice of different "main dishes" from which you can pick one. The Measurement Settings are like the dessert course. From these you build your meal. You can choose one from the "starters", one from the main course, then one from the dessert or simply pick one or two courses without having a full meal.

Depending on your monitor configuration, when you switch on or discharge a patient the monitor either continues with the previous profile, or resets to the default profile configured for that monitor.

WARNING If you switch to a different profile, the patient category and paced status normally change to the setting specified in the new profile. However some profiles may be setup to leave the patient category unchanged. Always check the patient category, and all alarms and settings, when you change profiles.

When you leave Demonstration Mode, or Service Mode, the monitor uses the default profile.

Swapping a Complete Profile

1 Select **Profiles** in the monitor info line, or select the Profiles SmartKey.

2 In the **Profiles** menu, select **Profile**.

3 Chose a profile from the pop-up list.

4 Confirm your selection.

Swapping a Settings Block

1 Select **Profiles** in the monitor info line, or select the Profiles SmartKey.

2 In the **Profiles** menu, select **Display** or **Measmnt. Settings** or **Monitor Settings** to call up a list of the settings blocks in each category.

3 Choose a settings block from the pop-up list.

4 Confirm your selection.

Default Profile

Your monitor has a default profile that it uses when you leave Demonstration, or Service modes, or when you discharge a patient. This profile is indicated by a diamond ◆ .

Locked Profiles

Some profiles are locked, so that you cannot change them, even in Configuration Mode. These are indicated by this lock symbol.

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 to enter its setup menu. For example, to enter the **Setup ECG** menu, select the HR (heartrate) numeric.
- via the Setup hardkey (on plug-in modules) - press the Setup hardkey on the module front.
- 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 popup list. With this SmartKey you can access any setup menu in the monitor.

This guide always describes the entry method using the setup menu. But you can use any method you prefer.

Switching a Measurement On and Off

When a measurement is off, its waves and numerics are removed from the monitor's screen. The monitor stops data acquisition and alarming for this measurement. A measurement automatically switches off if you disconnect its module or measurement server. If you disconnect a transducer, the monitor replaces the measurement numeric with question marks.

1 Enter the measurement's setup menu and select the measurement.

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

Switching Numerics On and Off

For some measurements, such as EEG, you can choose which numerics to view on the screen.

♦ In the measurement's setup menu, select the numeric name to toggle between on and off.

For example in the Setup EEG menu, select the EEG numeric name to toggle between on and off.

Adjusting a Measurement Wave

♦ To quickly adjust wave-related measurement settings (such as speed or size), select the measurement wave itself. This displays the measurement **`Wave`** menu, which has only wave-related measurement settings.

Changing a Wave Speed

Lowering the wave speed compresses the wave and lets you view a longer time period. Increasing the speed expands the waveform, giving you a more detailed view.

Changing the speed of one wave changes the speed of all other waves, except respiratory waves such as Resp, CO_2, N_2O, O_2, which are usually viewed at a slower speed, and waves from EEG and BIS, which also have an independent speed control setting.

1 Enter the **`Wave`** menu for the desired measurement by selecting the wave.

2 Select **`Speed`** (or **`Resp Speed`**).

3 Select the speed you want.

Using Labels

You can measure multiple invasive pressures and temperatures simultaneously. The monitor uses labels to distinguish between them. The default settings defined in the profile (such as measurement color, wave scale, and alarm settings) are stored within each label. When you assign a label to a measurement, the monitor automatically applies these default settings to the measurement. The labels assigned are used throughout the monitor, in reports, recordings, and in trends.

Changing Measurement Labels (e.g. Pressure)

To change a measurement label of a measurement with multiple labels (invasive pressure, temperature, or SpO_2),

1 Enter the **Wave** menu of the measurement.

2 Select **Label**.

3 Choose a label from the list.

The monitor automatically applies the scale, color, etc. settings stored in the Profile for the label you select. You can change scale settings in Monitoring Mode, but color can only be change in the monitor's Configuration Mode.

Any labels already being used in the monitor are shown "grayed-out" in the list and cannot be selected.

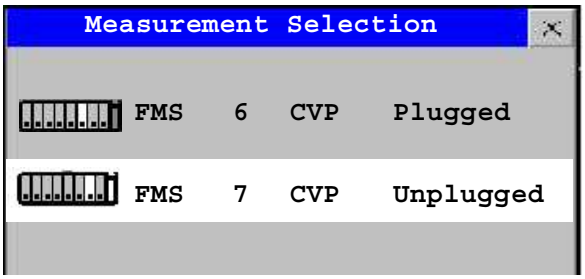
Give me an example Let's imagine you used a Press module to monitor your previous patient's CVP. Now you want to use the same module to measure ABP with a new patient. You've set up your arterial line. When you connect the pressure transducer to the module, the pressure shown on the screen still uses the CVP color and wave scale and is labeled CVP. To rectify this, just change the pressure label to ABP. Now the pressure has the correct color, the wave is shown in the correct scale, and the appropriate alarm limits for ABP are active.

Resolving Label Conflicts

Each label is unique, that is, it can only be assigned once. You cannot monitor two pressures labelled "ICP" at the same time. If you need to use two identical pressures, you must assign different labels to them, for example, P and ICP.

Measurement labels are stored in the measurement device. If you try to use two measurement devices that have identical labels, the monitor displays the conflict indicator.

To resolve a label conflict,



1 Select the conflict indicator or select **Main Setup** -> **Measurement Selection** to display the Measurement Selection window. This lists conflicting devices.

2 Select the line that shows the device whose label you want to correct.

3 From the pop-up keys, choose from:

- **Change Label**: change the conflicting device's label to a different label.
- **Plug/Unplug**: disable the conflicting device by "virtually" unplugging it. It retains its label for future use but becomes invisible to the monitor.
- **Modify Driver** (VueLink only) - change the VueLink device driver.

Changing Monitor Settings

- To change monitor settings such as date and time, brightness, or QRS tone volume, select the **Main Setup** SmartKey and then 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. Select the **Brightness** SmartKey.
2. Select the appropriate setting for the screen brightness. 10 is the brightest, 1 is the least bright.

If you are using an MP90 with an external display, the **Brightness** SmartKey does not adjust the brightness of this display. See the instructions supplied with the external display for instructions.

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. In the **Main Setup** menu, select **User Interface**
2. Select **TouchToneVolume**, 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

If your monitor is connected to an Information Center, the date and time are automatically taken from this. Once it is set, the internal clock retains the setting even when you switch off the monitor.

WARNING Changing the date or time will affect the storage of trends and events.

1. Select the **Date, 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, only) and **Minute** as necessary.
3. Select **Store Date, Time** to change the date and time.

Checking Your Monitor Revision

- Select **Main Setup** -> **Revision** to open the **Revision Window**.

The monitor revision will be shown in the format a.bc.de, where a.b indicates the major monitor release, c indicates the revision of the hardware purchased, and d and e indicate the software revision. If the **Revision Screen** shows B.05.60, then the monitor has the hardware revision 5 and the software revision 60 from the B.0 monitor release.

Getting Started

Once you understand the basic operation principles, you can get ready for monitoring.

Inspecting the Monitor

WARNING Do not use the system for any monitoring procedure on a patient if you suspect the monitor is not working properly, or if it is mechanically damaged.

1 Before you start to make measurements, carry out the following checks on the monitor including all connected Measurement Servers, modules, or measurement server extensions.
   – Check for any mechanical damage.
   – Check all the external cables, plug-ins and accessories.

2 Plug the power cord into the AC power source. If you are using an MP40/MP50 monitor, ensure that the battery has sufficient power for monitoring. When you use a battery for the first time, you must charge it, following the instructions given in the section “Charging Batteries” on page 263.

3 Check all the functions of the instrument that you need to monitor the patient, and ensure that the instrument is in good working order.

Switching On

♦ Press the on/off switch on the monitor for one second. The monitor performs a self test and is then ready to use. If you see a message such as **`CO2 Sensor Warmup`** wait until it disappears before starting monitoring that measurement. Connected devices usually take their power from the monitor. External devices such as AGM and those connected via VueLink have their own power switches.

Setting up the Measurement Modules

1 Decide which measurements you want to make.

2 Connect the required modules, Measurement Servers, or measurement server extensions.

3 Check that you have the correct patient cables and transducers plugged into the modules. The module connectors are color-coded to the patient cables and transducers for easy identification.

Starting Monitoring

After you switch on the monitor,

1 Admit your patient to the monitor.

2 Check that the profile, alarm limits, alarm and QRS volumes, patient category and paced status and so forth are appropriate for your patient. Change them if necessary.

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

Disconnecting from Power

The On/Standby switch does not disconnect the monitor from the ac power source. To disconnect, unplug the power cable.

Networked Monitoring

If your monitor is connected to a network, a network symbol is displayed in the upper left corner next to the bed label.

Select **Bed Label** from the monitor info line to see details of the Care Group, the equipment label and technical information about the network.

Using Remote Applications

If your monitor is connected to a Philips Application Server, you can access applications hosted remotely on the Application Server and display and operate them on the bedside monitor screen. The Application Server provides portal technology to allow information access through a web browser, terminal emulation, or served applications. The applications available depend on the Application Server configuration: see the device documentation for details.

To display remote applications on the monitor,

1 In the **Main Setup** menu, select **Remote Applics**, or select the **Remote Applications** SmartKey.

2 Select the required application from the pop-up list of available applications.

3 Operate the application with your preferred monitor input device: touchscreen, SpeedPoint, navigation point or mouse.

2

What's New?

This section lists the most important new features and improvements to the monitor and its user interface introduced with each release. Further information is provided in other sections of this book.

You may not have all of these features, depending on the monitor configuration purchased by your hospital.

What's New in Release B.0?

IntelliVue MP40/MP50 The MP40/MP50 patient monitor is a new addition to the IntelliVue patient monitor family. It uses the same measurement devices as the MP60/MP70/MP90 monitors and shares the same technological platform and user interface, but is more compact in size and can be operated by battery.

M3012A Measurement Server Extension The new Hemodynamic Measurement Server Extension extends measurement capability by adding two additional pressures and Cardiac Output.

M1020B SpO_2 Module New SpO_2 measurement module, M1020B, enables dual SpO_2 measurement without the need to use the VueLink module. Two options are available:

- Option A01 for use with Philips reusable and disposable sensors and Nellcor "R-Cal" disposable sensors.
- Option A02 for use with Nellcor OxiMax sensors, including the MAX-FAST forehead sensor.

M1020B Option A02 for use with Nellcor OxiMax sensors may not be available in all countries.

PV Loops: compares graphic representations of airway waves to help detect changes in the patient airway condition.

High-resolution waves per Screen: the number of high-resolution waves that can be shown on a Screen is increased, limited only by the Axx Option purchased.

Alarms symbols: New alarm symbols are introduced, and "short" yellow alarms were renamed "one-star" yellow alarms (yellow arrhythmia alarms).

Aperiodic measurements available as Screen Trends: patient trend information for NBP, C.O., C.I., and Wedge can now be permanently displayed on the Screen in tabular and graphical form.

What's New in Release A.2?

12-Lead ECG recordings: 12-Lead ECG waves and numerics can be sent to a connected recorder

High-Resolution Trend Report: high-resolution trend report can be sent to a connected printer

ST Snippets ST snippets, showing a one second wave segment for each measured ST lead, can be permanently displayed on the Screen or called up as required.

EEG Wave Speed: new EEG-specific wave speeds have been added to the list of wave speeds available

Drug Calculator: this new feature helps you to calculate drug dosages for your patients

On-Screen Calculator: a mathematics calculator can be used on the Screen

Visitor Screen: this new Screen is designed to hide sensitive patient information from the Screen. Monitoring and alarm generation function as usual.

Touch selection volume control: The volume of the audio prompt given when a screen element is selected is now adjustable

VueLink interface: the VueLink on-screen appearance and controls are improved

M3001A: Trend upload from the Multi-Measurement Server (M3001A) improved

Screen Trends: lets you display patient trend information in graphic form permanently on the Screen

Alarm Limits Page: lets you view and control alarm settings for all measurements in one window

New Option for Event Surveillance: a new neonatal event review option #C04 is introduced

Second display To simultaneously show two different Screens, a second display can be connected to the MP90. The second display is for viewing only.

3

Alarms

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

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

Red and yellow alarms are patient alarms. A red alarm indicates a high priority patient alarm such as a potentially life threatening situation (for example, asystole). A yellow alarm indicates a lower priority patient alarm (for example, a respiration alarm limit violation). Yellow arrhythmia alarms are specific to arrhythmia-related patient conditions (for example, ventricular bigeminy).

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

Alarms are indicated after the 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. If more than one alarm of the same severity is active in the same measurement, it announces the most recent. Your monitor may be configured to increase alarm indicator volume automatically during the time when the alarm is not acknowledged.

Visual Alarm Indicators

Alarm message: An alarm message text appears in the alarm status area 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, * for yellow arrhythmia 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 "**`**SpO2 LOW`**" or
- in numeric form, for example "**`**SpO2 94<96`**", where the first number shows the maximum deviation from the alarm limit, and the second number shows the currently set limit.

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.

Alarm lamp: A lamp on the monitor's front panel flashes. This has the same color as the alarm priority.

Nurse call systems: Alarm conditions are indicated on any device connected to the nurse call relay, if configured to do so.

Audible Alarm Indicators

The audible alarm indicators configured for your 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 patient monitoring. Adjustment of alarm volume to a low level or off during patient monitoring may result in patient danger. Remember that the most reliable method of patient 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:

- increase the alarm volume of unacknowledged alarms at regular intervals
- change the interval between alarm sounds (ISO/IEC Standard 9703-2 alarms only)
- change the base volume of the red and yellow alarm tones and the INOP tones
- change the alarm sound to suit the different alarm standards valid in different countries.

Traditional Audible Alarms (HP/Agilent/Philips/Carenet)

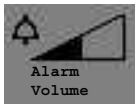
- Red alarms: A high pitched sound is repeated once a second.
- Two-star yellow alarms: A lower pitched sound is repeated every two seconds.
- One-star yellow alarms (arrhythmia alarms): The audible indicator is the same as for yellow alarms, but of shorter duration.
- INOPs: an INOP tone is repeated every two seconds.

ISO/IEC Standard 9703-2 Audible Alarms

- Red alarms: A high pitched tone is repeated five times, followed by a pause.
- Two-star yellow alarms: A lower pitched tone is repeated three times, followed by a pause.
- One-star yellow alarms (arrhythmia alarms): The audible indicator is the same as for yellow alarms, but of shorter duration.
- 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, select the volume symbol and then select the required volume from the pop-up selection.



♦ If you want to see a numerical indication of the current alarm volume on a scale from zero to 10, select the **Alarm Volume** SmartKey. The volume scale pops up. The current setting is indented. To change the setting, select the required number on the scale. Any settings that are inactive ("grayed out") have been disabled in the monitor's Configuration Mode.

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

Minimum Volume for No Central Monitoring INOP

If your monitor is connected to a Central Station, and the connection is interrupted, the INOP message **No Central Monit.** will appear, accompanied by an INOP tone. To help ensure that this INOP, and any other active alarm, is not overlooked, the INOP and alarm tones may be configured to have a minimum volume. In this case, INOP and alarm tones will sound even if the monitor alarm volume is set to zero.

Acknowledging Alarms

To acknowledge all active alarms and INOPs, select the **Silence** permanent key. This switches off the audible alarm indicators and alarm lamps. Alternatively, you can acknowledge alarms by pressing the **Silence** hardkey on the MMS or on the SpeedPoint. The hardkeys follow the behavior configured for the permanent key.

A check mark beside the alarm message indicates that the alarm has been acknowledged. If the monitor is configured to re-alarm, a dashed check mark will be shown.

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. The only exception is ECG/Resp: acknowledging a disconnect INOP for ECG leads does not switch off the ECG and Resp measurements. Acknowledging a disconnect INOP at the Information Center switches off the audible INOP indicator but does not switch off the measurement. Unplugging an MMS or a plug-in module automatically switches off its measurements.

Alarm Reminder (ReAlarm)

If Alarm Reminder is configured on for your monitor, you will get an audible reminder of alarm conditions that remain active after you have acknowledged the alarm. This reminder may take the form of a repetition of the alarm tone for a limited time, or an unlimited repetition of the alarm tone (this is the same as a new alarm). There is no alarm reminder for INOPs.

In Configuration Mode, you can set the interval between silencing the alarm and sounding the reminder tone to one, two, or three minutes.

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 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** -> **Alarm Settings**

2 Check the **Alarms Off** setting.

This setting can only be changed in the monitor's Configuration Mode.

To Pause All Alarms

- Select the **Pause Alarms** permanent key. If your monitor is configured to infinite pause time, the permanent key is labelled **Alarms Off**, and selecting it switches alarms off.
- Or press the Alarms hardkey on the MMS SpeedPoint. The hardkeys follow the behavior configured for the permanent key.

To Switch All Alarms Off

You can only switch alarms off permanently if your monitor is configured to allow infinite alarms pause and the permanent key is labelled **Alarms Off**.

- Select the **Pause Alarms** permanent key. If your monitor is configured to infinite pause time, the permanent key is labelled **Alarms Off**.
- Or press the Alarms hardkey on the MMS SpeedPoint. The hardkeys follow the behavior configured for the permanent key.

Pausing alarms infinitely is the same as switching them off.

To Switch Individual Measurement Alarms On or Off

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

- The red Alarms Paused lamp on the monitor front panel is lit.
- 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.

ALARMS PAUSED 1:28

- No alarms are sounded and no alarm messages are shown.
- INOP messages are shown but no INOP tones are sounded.
- The nurse call relay is not active.

ALARMS OFF

Restarting Paused Alarms

- To manually switch on alarm indication again after a pause, select the permanent key **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.

Resetting Arrhythmia Alarm Timeouts

- To reset the arrhythmia alarm timeout period, select the **Alarms Off** or **Pause Alarms** permanent key and then reselect it.

Extending the Alarm Pause Time

If your monitor has extended alarm pause enabled, you can extend the alarm pause time. Use this to prevent alarms being indicated, for example, while you are washing a patient or carrying out a procedure. Only extend the alarm pause time when you are sure that clinical personnel are available to monitor the patient's condition closely.

To extend the alarm pause time to five or 10 minutes,

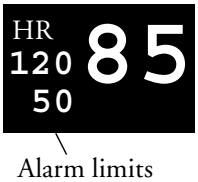
1. Select one of the alarm fields. This calls up the **Alarm Messages** window.
2. Select either the pop-up key **Pause Al. 5 min** or the pop-up key **Pause Al. 10 min**. Each time you select one of these pop-up keys, the Alarm Pause Time is reset to five (or 10) minutes.

Alarm Limits

The alarm limits you set determine the conditions that trigger yellow and red limit alarms. For some measurements (for example, BIS and SpO_2), where the value ranges from 100 to 0, setting the high alarm limit to 100 switches the high alarm off, and switching the low alarm limit to 0 switches it off. In these cases, the alarms off symbol is not displayed.

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

Viewing Individual Alarm Limits



Alarm limits

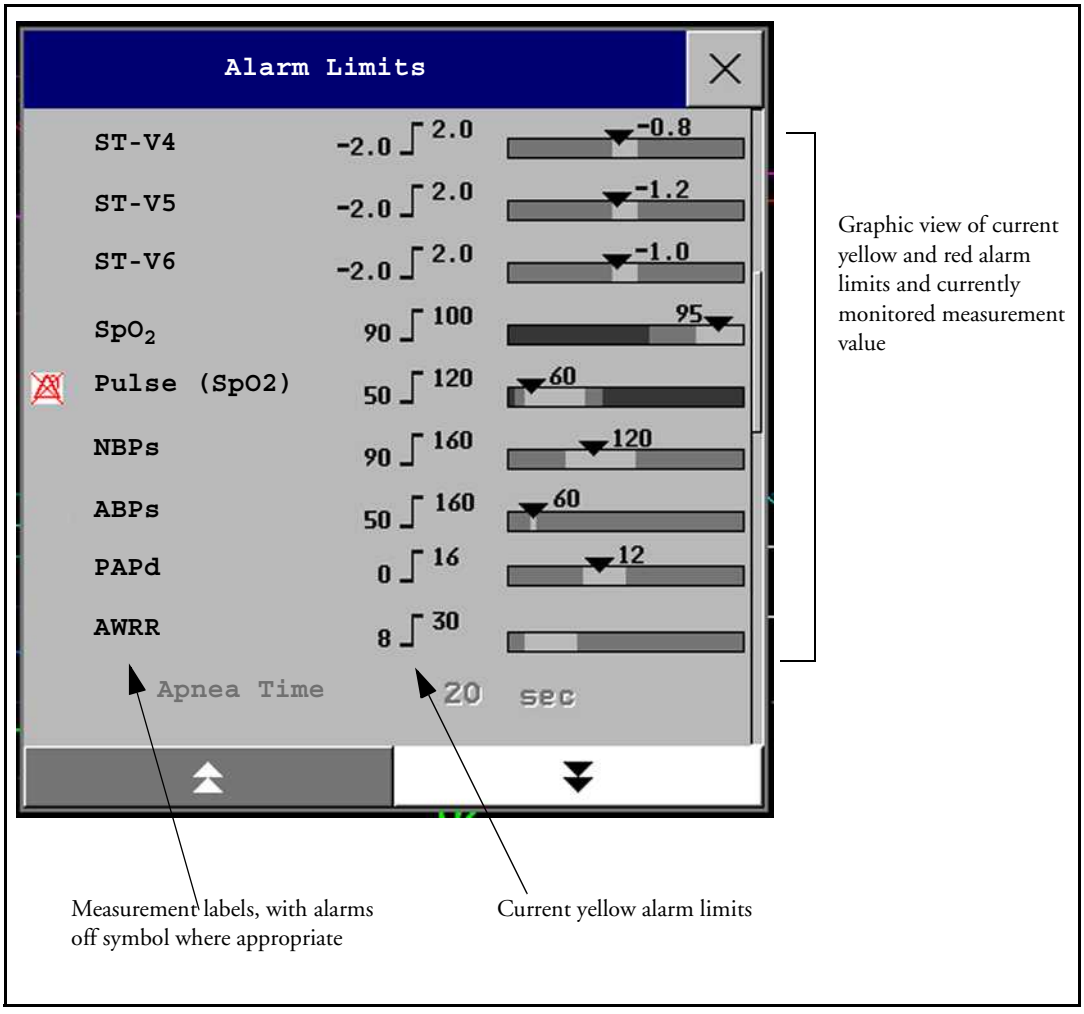
You can usually see the alarm limits set for each measurement next to the measurement numeric on the main screen.

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.

Viewing All Alarm Limits

The **Alarm Limits** overview window lists the currently set alarm limits for all measurements. If an Apnea alarm delay time is set, this is also shown. The **Alarms Off** symbol is shown beside the measurement label of any measurement whose alarm switched off.

To open the **Alarm Limits** window, either select any alarm field to open the **Alarm Messages** window, then select the **Alarm Limits** pop-up key, or select the **Alarm Limits** SmartKey, if configured.



You can use the pop-up keys that open with the **Alarm Limits** window to perform common tasks:

- **All Al. On/All Al. Off**,
- **All Narrow/All Wide** to set narrow or wide alarm AutoLimits for all measurements
- **Print Limits/Record Limits** to print a list of all current alarm limit settings on a connected printer or recorder.

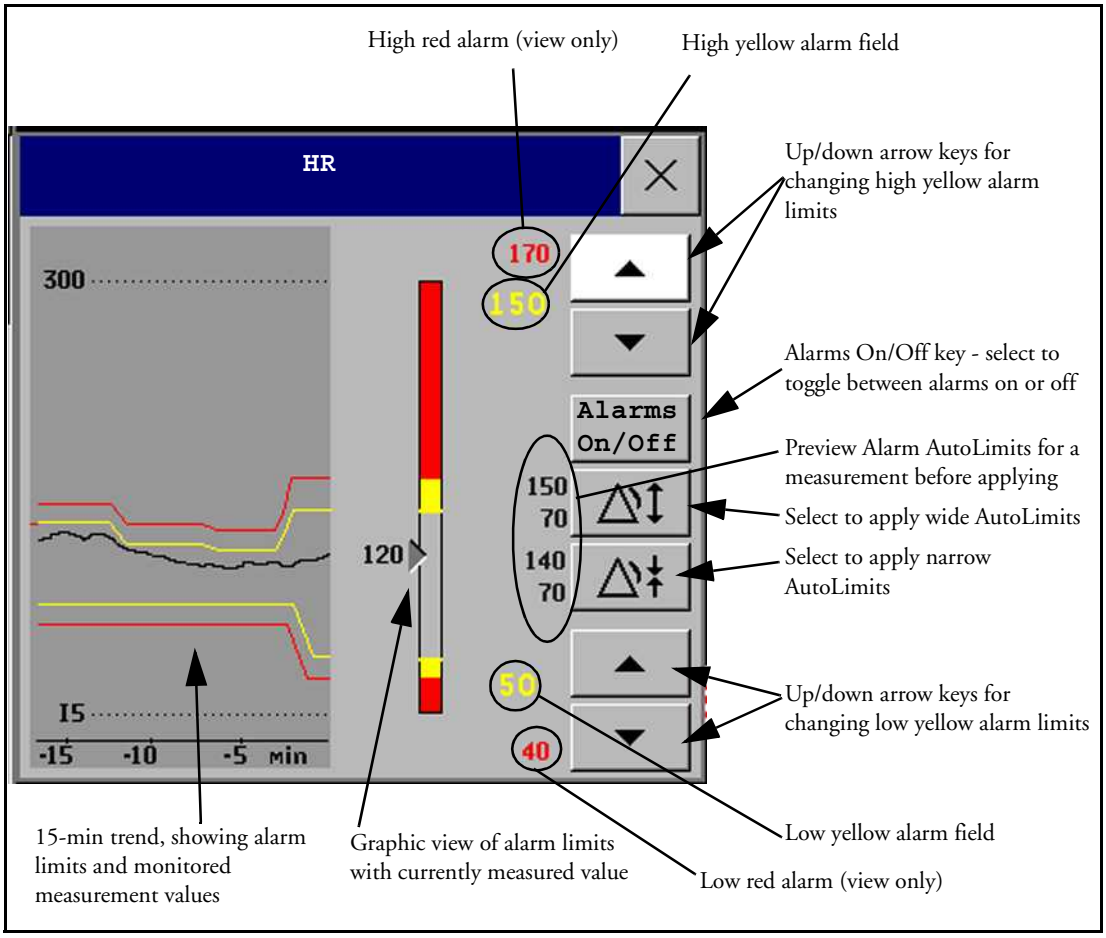
Changing Alarm Limits

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.

Alternatively, you can use the keys in the measurement Change Limits window, which you access by selecting the measurement label in the **`Alarm Limits`** window.



To change alarm limits,

1 In the **`Change Limits`** window,

– if you are using touch, select the up or down arrow buttons to adjust the high and low alarm limits as required.

– if you are using a SpeedPoint, position the cursor in the high yellow alarm field, then press the knob inwards. Rotate the knob to the left or right to adjust the limit. Press the knob again to set the displayed limit.

2 Repeat to set the low yellow alarm limit.

If you set the yellow alarm limit outside the red alarm limit, the monitor will automatically set the red alarm to the yellow alarm limit.

About Automatic Alarm Limits (AutoLimits)

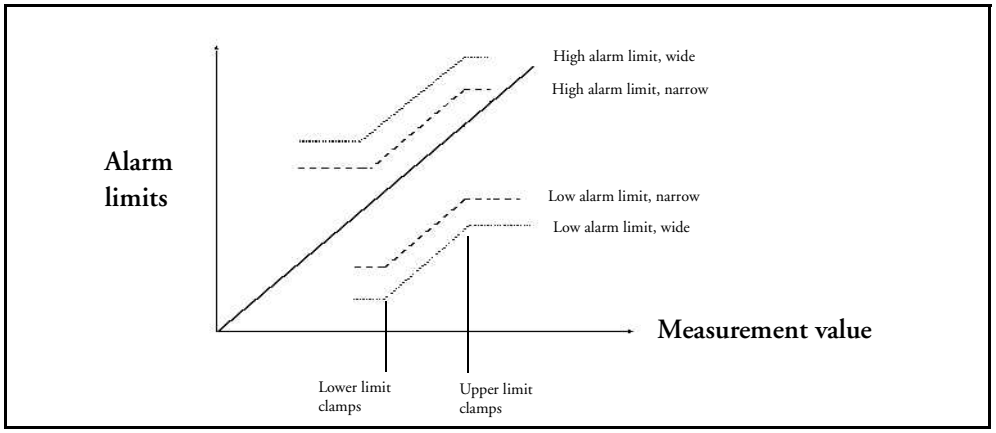
The monitor can automatically set alarm limits suited to your individual patient, using the Automatic Alarm Limits function. This tells the monitor to adapt the alarm limits of selected measurements to the measured vital signs within a defined safe limit. The monitor calculates safe AutoLimits for each patient based on the measured values from the last 12 seconds.

The defined safe limits never exceed the non-pathological range.

Limits Narrow sets limits close to the currently measured values for situations where it is critical for you to be informed about small changes in your patient's vital signs.

Limits Wide sets limits further away from the currently measured values for situations where small changes are not so critical.

- Use the keys in the **Change Limits** window to apply AutoLimits for individual measurements. These keys are not available if AutoLimits have been disabled for the measurement in the monitor's Configuration Mode.



AutoLimits are not available for all measurements. The list of measurements for which AutoLimits can be used is defined in the monitor's Configuration mode.

Use the Change Limits window to check AutoLimits before you apply them to ensure that they are appropriate for your individual patient and their clinical condition. Once applied, AutoLimits are shown on the monitor screen just like manually-set alarm limits. If the AutoLimits are not appropriate for your patient, you must set alarm limits manually. The limits remain unchanged until you set them again or change them manually.

Documenting Alarm Limits

The alarm limits pop-up keys appear with the **Alarm Limits** and **Change Limits** windows.

- Select the **Print Limits** pop-up key to print an overview of all alarm limits on a connected printer.
- Select the **Record Limits** pop-up key to send a recording of the alarm limits to a recorder.

Reviewing Alarms

To review the currently active alarms and INOPs, select any of the alarm status areas on the 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 change to Demonstration Mode.

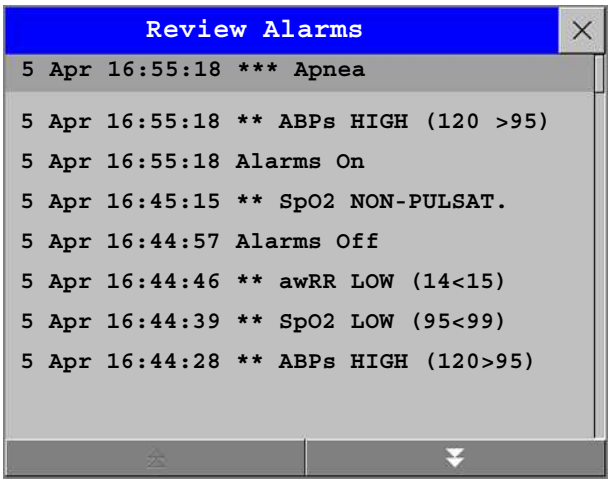
Alarm Messages Window

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 patient 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. If alarm pause extension is disabled, the pause pop-up keys are inactive ("grayed-out"). Selecting the **Review Alarms** pop-up key opens the **Review Alarms** window.

Alarm Limits	Review Alarms		Pause Al. 5 Min.	Pause Al. 10 Min.

Review Alarms Window



The **Review Alarms** window contains a list of up to 100 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.

The information in the Review Alarms window is deleted when a patient is discharged, when the monitor is switched off for longer than one minute, and when you enter Demonstration Mode.

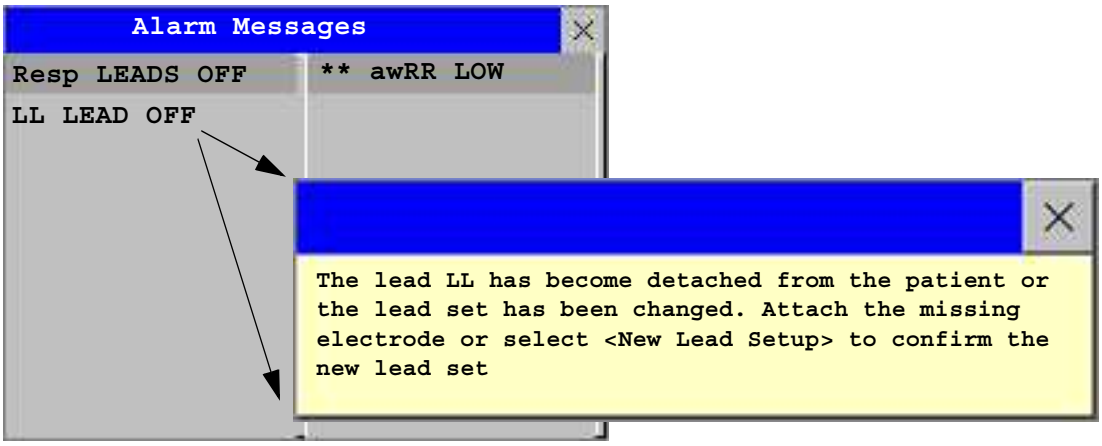
The **Review Alarms** window pop-up keys appear when the window is opened. If alarm pause extension is disabled, the pause pop-up keys are inactive. Selecting the **Active Alarms** pop-up key opens the **Alarm Messages** window.

Alarm Limits	Active Alarms		Pause Al. 5 Min.	Pause Al. 10 Min.

Understanding Alarm Messages

If you do not immediately understand an INOP or alarm message, refer to its help text.

- In the **Alarm Messages** window, select the INOP message. This calls up a help window with an explanation of the INOP message and, where appropriate, a suggested solution for the problem.



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.

You can change this setting only in the monitor's 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. These choices can be combined to give the following settings:

Visual Latching	R&Y	R&Y	R&Y	R	R	Off
Audible latching	R&Y	R	Off	R	Off	Off

Alarm Latching Behavior

Red and Yellow Measurement Alarms		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 lamp on. Alarm message. Flashing numerics.		
	Alarm condition no longer present.	All audible and visual alarm indicators automatically stop.	Alarm tone on. Alarm lamp on. Alarm message. Flashing numerics.	Alarm message. Flashing numerics. Audible alarm indicators automatically stop.
Alarm has been acknowledged.	Alarm condition still present.	Audible alarm acknowledged. Alarm lamp off. Alarm message. Flashing numerics. Audible alarm reminder (if configured).		
	Alarm condition no longer present.	Audible and visual alarm indicators automatically stop.		

INOPs and short yellow arrhythmia alarms are always non-latching.

Silencing Latched Alarms from an Information Center

Alarms set to visual latching only cannot be silenced at an Information Center. If you need to be able to silence bedside monitor alarms at an Information Center, you must make sure that the configured latching settings include an audible element.

Testing Alarms

When you switch the monitor on, a selftest is started. You must check that the alarms lamps light, one after the other, and that you hear a single tone. This indicates that the visible and audible alarm indicators are functioning correctly.

Alarm Behavior at On/Off

When you switch alarms on, the settings defined in the currently active Profile are used.

If the monitor is switched off for longer than one minute and then switched on again, or after a loss of power lasting longer than one minute, or when a patient is discharged, the monitor can be configured to restore either the alarm settings from the monitor's configured default Profile, or the most recently used alarm settings. After any of these situations, you should check that the alarm settings are appropriate for your patient, and if necessary, select the correct Profile and patient category.

If power is lost for less than one minute, the alarm settings prior to the power loss are restored.

4

Patient Alarms and INOPs

This chapter lists patient alarms and technical alarms (INOPs) alphabetically, irrespective of their priority. INOPs start on page 47.

Patient Alarm Messages

The measurement labels and abbreviations for pressure, temperature, SpO_2, and anesthetic agent alarms are explained in the individual chapters.

Note that yellow arrhythmia alarms (“short yellow alarms”) may be shown with one or with two stars, depending on the monitor and Information Center revision you are using.

Alarm Message	From	Condition	Indication
*****APNEA** or *****APNEA xxx sec**	CO_2, Resp, AGM	Respiration has stopped for longer than the preset apnea time. “xxx” denotes the Apnea duration.	numeric flashes, red alarm lamp, alarm tone.
*****ASYSTOLE**	ECG	No QRS detected for a period greater than the asystole threshold (in the absence of Vfib or chaotic ECG).	numeric flashes, red alarm lamp, alarm tone.
****awRR HIGH**	CO_2, Resp, AGM	The airway respiration rate has exceeded the high alarm limit.	numeric flashes and high limit is highlighted, yellow alarm lamp, alarm tone.
****awRR LOW**	CO_2, Resp, AGM	The airway respiration rate has dropped below the low alarm limit.	numeric flashes and low limit is highlighted, yellow alarm lamp, alarm tone.
****BIS HIGH**	BIS	The Bispectral Index value has exceeded the high alarm limit.	numeric flashes and high limit is highlighted, yellow alarm lamp, alarm tone.
****BIS LOW**	BIS	The Bispectral Index value has dropped below the low alarm limit.	numeric flashes and low limit is highlighted, yellow alarm lamp, alarm tone.
*****BRADY (Pulse)** **or** *****BRADY xxx<yyy**	Press, 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 lamp, alarm tone.
****CCO/CCI HIGH**	CCO	Continuous Cardiac Output or CC Index is above the high alarm limit.	numeric flashes and high alarm limit is highlighted, yellow alarm lamp, alarm tone.

Alarm Message	From	Condition	Indication
****CCO/CCI LOW**	CCO	Continuous Cardiac Output or CC Index is below the low alarm limit.	numeric flashes and low alarm limit is highlighted, yellow alarm lamp, alarm tone.
****CPP HIGH**	CPP	The CPP value has exceeded the high alarm limit.	numeric flashes and high limit is highlighted, yellow alarm lamp, alarm tone
****CPP LOW**	CPP	The CPP value has fallen below the low alarm limit.	numeric flashes and low limit is highlighted, yellow alarm lamp, alarm tone.
*****DESAT** or *****DESAT xxx<yyy**	SpO_2	The SpO_2 value has fallen below the desaturation alarm limit. xxx denotes the lowest measured value, and yyy is the desaturation limit.	numeric flashes, red alarm lamp, alarm tone.
****et <Agent label> HIGH**	AGM	The end tidal agent high alarm limit has been exceeded.	numeric flashes and high limit is highlighted, yellow alarm lamp, alarm tone.
****et <Agent label> LOW**	AGM	The end tidal agent value has fallen below the low alarm limit.	numeric flashes and low alarm limit is highlighted, yellow alarm lamp, alarm tone.
****etCO2 HIGH**	CO_2, Resp, AGM	The end tidal CO_2 high alarm limit has been exceeded.	numeric flashes and high limit is highlighted, yellow alarm lamp, alarm tone.
****etCO2 LOW**	CO_2, Resp, AGM	The end tidal CO_2 value has fallen below the low alarm limit.	numeric flashes and low limit is highlighted, yellow alarm lamp, alarm tone.
****etO2 HIGH**	O_2, AGM	The end tidal O_2 high alarm limit has been exceeded.	numeric flashes and high limit is highlighted, yellow alarm lamp, alarm tone.
****etO2 LOW**	O_2, AGM	The end tidal O_2 value has fallen below the low alarm limit.	numeric flashes, and low limit is highlighted, yellow alarm lamp, alarm tone.
*****EXTREME BRADY**	ECG	The bradycardia limit has been exceeded.	numeric flashes and alarm limit is highlighted, red alarm lamp, alarm tone.
*****EXTREME TACHY**	ECG	The tachycardia limit has been exceeded.	numeric flashes and alarm limit is highlighted, red alarm lamp, alarm tone.
****HR HIGH**	ECG	The heart rate high alarm limit has been exceeded.	numeric flashes and high limit is highlighted, yellow alarm lamp, alarm tone. The sound switches off after 5 seconds if Arrhythmia is On.
****HR LOW**	ECG	The heart rate has fallen below the low alarm limit.	numeric flashes and low limit is highlighted, yellow alarm lamp, alarm tone. The sound switches off after 5 seconds if Arrhythmia is On.
****imCO2 HIGH**	CO_2, Resp, AGM	The inspired minimum CO_2 high alarm limit has been exceeded.	numeric flashes and high limit is highlighted, yellow alarm lamp, alarm tone.

Alarm Message	From	Condition	Indication
****in <Agent label> HIGH**	AGM	The inspired agent high alarm limit (3.4 vol.%) has been exceeded.	numeric flashes, high limit is highlighted, yellow alarm lamp, alarm tone.
****in <Agent label> LOW**	AGM	The inspired agent value has fallen below the AGT low alarm limit (1.0 vol.%).	numeric flashes, low limit is highlighted, yellow alarm lamp, alarm tone.
****inN2O HIGH**	N_2O, AGM	The inspired N_2O high alarm limit has been exceeded.	numeric flashes, high limit is highlighted, yellow alarm lamp, alarm tone.
****inO2 HIGH**	O_2, AGM	The inspired O_2 high alarm limit has been exceeded.	numeric flashes, high limit is highlighted, yellow alarm lamp, alarm tone.
****inO2 LOW**	O_2, AGM	The inspired O_2 value has fallen below the low alarm limit.	numeric flashes, low limit is highlighted, yellow alarm lamp, alarm tone.
*****inO2 LOW OXYGEN**	O_2, AGM	The inspired O_2 value has fallen below 18 vol.%.	numeric flashes, low limit is highlighted, red alarm lamp, alarm tone.
***/**IRREGULAR HR**	ECG/ Arrhythmia	Consistently irregular heart rhythm.	numeric flashes, yellow alarm lamp, short yellow audible alarm.
***/**MISSED BEAT**	ECG/ Arrhythmia	No beat detected for 1.75*R-R interval, or if HR>120bpm no beat detected for one second (non-paced patients only).	numeric flashes, yellow alarm lamp, short yellow audible alarm.
***/**MULTIFORM PVCs**	ECG/ Arrhythmia	Two differently shaped Vs detected, each occurring at least twice within the last 300 beats and at least once within the last 60 beats.	numeric flashes, yellow alarm lamp, short yellow audible alarm.
****NBP HIGH**	NBP	The measured NBP 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 lamp, alarm tone.
****NBP LOW**	NBP	The measured NBP 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 lamp, alarm tone.
***/**NON-SUSTAIN VT**	ECG/ Arrhythmia	A run of Vs having a ventricular HR>V-Tach HR limit, but lasting for less than the V-Tach Run limit has been detected.	numeric flashes, yellow alarm lamp, short yellow audible alarm.
***/**PACER NOT CAPT**	ECG/ Arrhythmia (paced patients only)	A missed beat with a pace pulse was detected.	numeric flashes, yellow alarm lamp, short yellow audible alarm.
***/**PACER NT PACING**	ECG/ Arrhythmia (paced patients only)	A missed beat without a pace pulse was detected.	numeric flashes, yellow alarm lamp, short yellow audible alarm.

Alarm Message	From	Condition	Indication
***/**PAIR PVCs**	ECG/ Arrhythmia	A non-ventricular contraction, followed by two ventricular contractions, followed by a non-ventricular contraction has been detected.	numeric flashes, yellow alarm lamp, short yellow audible alarm.
***/**PAUSE**	ECG/ Arrhythmia	No beat detected for a period greater than the pause threshold.	numeric flashes, yellow alarm lamp, short yellow audible alarm.
*****<Pressure> DISCONNECT**	PRESS	The pressure is non-pulsatile and the mean pressure is continuously less than 10mmHg (1.3kPa). This alarm occurs only with arterial pressures (P, ABP, ART, AO, UAP, PAP).	numeric flashes, red alarm lamp, alarm tone.
****<Pressure> HIGH**	PRESS	The measured 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, high limit is highlighted, yellow alarm lamp, alarm tone.
****<Pressure> LOW**	PRESS	The measured 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 lamp, alarm tone.
****PULSE HIGH**	PRESS SpO_2	The pulse rate has exceeded the high alarm limit.	numeric flashes and high limit is highlighted, yellow alarm lamp, alarm tone.
****PULSE LOW**	PRESS SpO_2	The pulse rate has dropped below the low alarm limit.	numeric flashes and low limit is highlighted, yellow alarm lamp, alarm tone.
***/**PVCs/min HIGH**	ECG/ Arrhythmia	More premature ventricular contractions have been detected in a minute than the limit.	numeric flashes, yellow alarm lamp, short yellow audible alarm.
***/**R-ON-T PVCs**	ECG/ Arrhythmia	For HR <100, a PVC with R-R interval < 1/3 the average interval followed by a compensatory pause of 1.25 x average R-R interval or two such Vs without compensatory pause occurring within 5 minutes of each other. (When HR >100, 1/3 R-R interval is too short for detection.).	numeric flashes, yellow alarm lamp, short yellow audible alarm.
****RR HIGH**	RESP	The respiration rate has exceeded the high alarm limit.	numeric flashes and high limit is highlighted, yellow alarm lamp, alarm tone.
****RR LOW**	RESP	The respiration rate has dropped below the low alarm limit.	numeric flashes and low limit is highlighted, yellow alarm lamp, alarm tone.
***/**RUN PVCs HIGH**	ECG/ Arrhythmia	A run of PVCs greater than 2 was detected.	numeric flashes, yellow alarm lamp, short yellow audible alarm.
****<SpO2 label> HIGH**	SpO_2	The arterial oxygen saturation has exceeded the high alarm limit.	numeric flashes and high limit is highlighted, yellow alarm lamp, alarm tone.

Alarm Message	From	Condition	Indication
**<SpO2 label> LOW	SpO_2	The arterial oxygen saturation has fallen below the low alarm limit.	numeric flashes and low limit is highlighted, yellow alarm lamp, alarm tone.
**ST<n> HIGH	ECG/ Arrhythmia (Adult patients only)	The ST elevation in lead <n> is higher than the limit.	numeric flashes and high alarm limit is highlighted, yellow alarm lamp, alarm tone.
**ST<n> LOW	ECG/ Arrhythmia (Adult patients only)	The ST depression in lead <n> is lower than the limit.	numeric flashes and low alarm limit is highlighted, yellow alarm lamp, alarm tone.
**SvO2 HIGH	$S\bar{v}O_2$	The $S\bar{v}O_2$ value has exceeded the high limit.	numeric flashes and high alarm limit is highlighted, yellow alarm lamp, alarm tone.
**SvO2 LOW	$S\bar{v}O_2$	The $S\bar{v}O_2$ value has fallen below the low limit.	numeric flashes and low alarm limit is highlighted, yellow alarm lamp, alarm tone.
*/**SVT	ECG/ Arrhythmia	A run of supraventricular beats greater than the SVT run limit has been detected and the HR has exceeded the SVT HR limit.	numeric flashes, yellow alarm lamp, alarm tone.
***TACHY (Pulse) or ***TACHY xxx>yyy	Press, SpO_2	The heart rate from the Pulse signal has exceeded the tachycardia limit. xxx denotes the highest measured value; yyy is the tachycardia limit.	numeric flashes, alarm limit is highlighted, red alarm lamp, alarm tone.
**Tblood HIGH	C.O.	The blood temperature value has exceeded the high alarm limit.	numeric flashes, high alarm limit is highlighted, yellow alarm lamp, alarm tone.
**Tblood LOW	C.O.	The blood temperature value has fallen below the low alarm limit.	numeric flashes, low alarm limit is highlighted, yellow alarm lamp, alarm tone.
**tcpO2 HIGH/ **tcpCO2 HIGH	tcGas	The $tcpO_2$ or $tcpCO_2$ value has exceeded the high alarm limit.	numeric flashes, high alarm limit is highlighted, yellow alarm lamp, alarm tone.
**tcpO2 LOW/ **tcpCO2 LOW	tcGas	The $tcpO_2$ or $tcpCO_2$ value has fallen below the low alarm limit.	numeric flashes, low alarm limit is highlighted, yellow alarm lamp, alarm tone.
**<Temperature label> HIGH	TEMP	The temperature has exceeded the high alarm limit.	numeric flashes and high limit is highlighted, yellow alarm lamp, alarm tone.
**<Temperature label> LOW	TEMP	The temperature has fallen below the low alarm limit.	numeric flashes and low limit is highlighted, yellow alarm lamp, alarm tone.
*/**VENT BIGEMINY	ECG/ Arrhythmia	A dominant rhythm of N, V, N, V (N = supraventricular beat, V = ventricular beat) was detected.	numeric flashes, yellow alarm lamp, short yellow audible alarm.

Alarm Message	From	Condition	Indication
***VENT FIB/TACH	ECG	A fibrillatory waveform for 4 consecutive seconds was detected.	numeric flashes, red alarm lamp, alarm tone.
*/**VENT RHYTHM	ECG/ Arrhythmia	A dominant rhythm of adjacent Vs > vent rhythm limit and ventricular HR < VTach HR limit was detected.	numeric flashes, yellow alarm lamp, short yellow audible alarm.
*/**VENT TRIGEMINY	ECG/ Arrhythmia	A dominant rhythm of N, N, V, N, N, V (N = supraventricular beat, V = ventricular beat) was detected.	numeric flashes, yellow alarm lamp, short yellow audible alarm.
***VTACH	ECG, Arrhythmia	Ventricular tachycardia has been detected (Consecutive PVCs exceed V-Tach Run limit and HR exceeds V-Tach HR limit).	numeric flashes, yellow alarm lamp, short yellow audible alarm.

Technical Alarm Messages (INOPs)

The measurement labels and abbreviations for pressure, temperature, SpO_2, anesthetic agent, and VueLink INOP messages are explained in the individual chapters.

INOP Message, Indication	Source	What to do
ABP INOPS	PRESS	See <Pressure label> INOPS (under P).
AGENT MIXTURE Numerics shown with -?-	AGM	The Gas Analyzer has detected more than one agent in the gas sample. Agent measurement accuracy is likely to be reduced.
AGM ACCURACY? Numerics shown with -?-	AGM	Gas Analyzer measurement accuracy may be reduced. Check that the gas inlet, watertrap, and gas outlet tubing are not occluded. If this INOP persists, contact your service personnel.
AGM ALARM SUPPRESS	AGM	Gas Analyzer alarms will be suppressed until breathing activity is first detected.
AGM INCOMPATIBLE INOP tone	AGM	This version of the Gas Analyzer is not supported. Contact your service personnel.
AGM MALFUNCTION Numerics replaced by -?-, INOP tone	AGM	There is a problem with the Gas Analyzer hardware. Check the connection to the monitor. Switch the Gas Analyzer off and then on again. If this INOP persists, contact your service personnel.
AGM NO BREATH Numerics replaced by -?-	AGM	No breath detected. Check the patient connections.
AGM NOT AVAILABLE INOP tone.	AGM	The Gas Analyzer is either disconnected or switched off.
AGM OCCLUSION Numerics replaced by -?-, INOP tone	AGM	Make sure that the sample line and exhaust line tubing is not kinked. Check the airway adapter for a build up of water. Empty the fluid and reposition the adapter if necessary. Ensure that the airway adapter port is facing upwards. Try replacing the sample line, watertrap, or exhaust line. If this INOP persists, contact your service personnel.
AGM SELFTEST Numerics replaced by -?-	AGM	The Gas Analyzer selftest is running. Wait until this INOP disappears to start monitoring.
AGM STANDBY	AGM	To resume gas monitoring, select Exit Standby in the **Setup GA** menu.
AGM UNABLE TO MEAS Numerics replaced by -?-, INOP tone	AGM	No action necessary. This situation usually corrects itself after a few seconds.
AGM UNPLUGGED INOP tone.	AGM	Make sure that the Anesthetic Gas Module is connected to the monitor. All AGM measurements are off while the AGM is unplugged.
AGM WARMUP Numerics shown with -?-	AGM	The Gas Analyzer has not yet reached operating temperature and the measurement accuracy may be reduced.
AGM ZERO FAILED Numerics shown with -?-	AGM	A Gas Analyzer zero calibration failed. Check the exhaust tube for an occlusion or kinking and replace if necessary. Manually start another zero. If the zero has failed more than once, contact your service personnel.
AGM ZERO RUNNING First zero: numerics shown with -?-, Second zero: numerics replaced by -?- ,INOP tone	AGM	Autozero in progress. If first auto zero fails then system will retry; if the retry fails then the **AGM MALFUNCTION** INOP is activated.

INOP Message, Indication	Source	What to do
AGT ID MALFUNCTION Numerics replaced by -?-, INOP tone (in Auto mode)	AGM	There is a problem with the automatic agent identification. To continue monitoring, switch to manual agent selection. The Gas Analyzer numeric cannot reliably be derived. Contact your service personnel.
<AGT> CHANGE SCALE	AGM	The wave of the agent shown is clipped (DES/ENF/HAL/SEV/ISO). Select a more appropriate wave scale to display the whole wave.
AGT ID ZERO FAILED Numerics replaced by -?-, INOP tone (in Auto mode)	AGM	An automatic agent identification zero calibration failed. To continue monitoring, switch to manual agent selection. Contact your service personnel.
<AGT> MEAS DISTURBED Numerics replaced by -?-	AGM	The agent numeric cannot be reliably derived. If this INOP persists, contact your service personnel.
AGT MEAS RESTARTNG	AGM	The agent measurement is restarting. Wait until this INOP disappears before resuming monitoring.
<AGT> UNABLE TO MEAS Numerics replaced by -?-, INOP tone	AGM	The Gas Analyzer currently cannot measure the agent shown (DESFL/ENFL/HALOTH/SEVOFL/ISOFL). If this INOP persists, contact your service personnel.
ALL ECG ALARMS OFF	ECG/ Arrhythmia	All ECG alarms have been switched off, or the HR alarm source is not ECG. To resume ECG alarm generation, switch ECG alarms on or select ECG as the alarms source.
Ao INOPS	PRESS	See <Pressure label> INOPS (under P).
ART INOPS	PRESS	See <Pressure label> INOPS (under P).
AWRR OVERRANGE Numerics shown with -?-	AGM	The measured respiration rate is higher than the maximum measurable range.
BAD SERVERLINK INOP tone	Monitor	1) An MMS with an incompatible software revision is connected to the monitor. This combination does not allow monitoring, OR 2) You cannot use this combination of monitor, MMS and cable. Switch off the monitor and contact your service personnel.
BATTERIES EMPTY or **BATT 1/ BATT 2 EMPTY** INOP tone, battery LED flashes During this INOP, alarms cannot be paused or switched off.	Batteries	The estimated remaining battery-powered operating time of the indicated battery or batteries is less than 10 minutes. Replace the batteries immediately. If the condition persists, this INOP is re-issued one minute after you acknowledge it.
BATTERIES INCOMPAT or **BATT 1/BATT 2 INCOMPAT** INOP tone, battery LED flashes	Batteries	The indicated batteries cannot be used with this monitor. Replace with the correct batteries (M4605A).
BATTERIES LOW or **BATT 1/ BATT 2 LOW** INOP tone, battery LED flashes	Batteries	The estimated battery-powered operating time remaining is less than 20 minutes.
BATTERIES MALF or **BATT 1/ BATT 2 MALFUNCTION** INOP tone, battery LED flashes During this INOP, alarms cannot be paused or switched off.	Batteries	The monitor cannot determine the battery status. If this INOP persists, replace the faulty battery or batteries. Place the batteries in a different monitor. If the same INOP is shown, contact your service personnel.

INOP Message, Indication	Source	What to do
BATT 1/BATT 2 MISSING Battery LED flashes During this INOP, alarms cannot be paused or switched off.	Batteries	The monitor requires two batteries but can detect only one functioning battery. Replace the missing or faulty battery immediately.
BIS DSC DISCONN INOP tone	BIS	DSC is not properly connected OR either DSC or BIS engine may be faulty. Make sure that the DSC is properly connected to the BIS Engine. If INOP persists, replace DSC with a known good one of the same type. If INOP persists replace BIS engine. Silencing this INOP switches the measurement off.
BIS DSC INCOMPT INOP tone	BIS	DSC is not supported by the BIS engine or new DSC connected to an old BIS engine. A software upgrade may be required. Contact your service personnel.
BIS DSC MALFUNC	BIS	Electrocautery used during self-test OR malfunction in the DSC hardware. Make sure not to use electrocautery during the self-test procedure. Disconnect and reconnect the DSC to the BIS engine. If the INOP persists, replace the DSC or contact your service personnel.
BIS DSC UPDATE INOP tone	BIS	DSC update currently being carried out. This INOP will disappear when the DSC update is finished. Do not disconnect the DSC during the update. No action is needed.
BIS ENGINE DISCONN INOP tone	BIS	BIS engine not connected OR Module Cable defective. Make sure that the Module Cable is properly connected. If INOP persists, replace the Module Cable. Silencing this INOP switches the measurement off.
BIS ENGINE INCOMPAT INOP tone	BIS	BIS Engine software is not supported. A software upgrade may be required. Contact your service personnel.
BIS ENGINE MALFUNC INOP tone	BIS	Malfunction in the BIS engine hardware. Disconnect and reconnect the BIS engine. If the INOP persists, replace BIS engine.
BIS EQUIP MALF INOP tone		There is a malfunction in the BIS hardware. Unplug and replug the BIS Interface Module. If the INOP persists, contact your service personnel.
BIS HIGH IMPEDANCE INOP tone may sound	BIS	Impedance of one or more electrode(s) is above the valid range, most often caused by bad skin preparation. Check the sensor montage and press the electrode pads firmly. If this INOP persists, replace the sensor(s) in question using correct skin preparation. If INOP persists, contact your service personnel.
BIS IMPEDANCE CHCK INOP tone may sound	BIS	The Cyclic Impedance check is running. It will stop automatically if all impedances are within the valid range. If any electrodes do not pass the impedance test, check the sensor montage and press the electrode pads firmly. To manually stop the Cyclic Impedance Check, select **Cyclic Check Off** in the **Setup BIS** menu.
BIS ISOELECTRC EEG	BIS	No discernible EEG activity is detected for longer than one minute. Check the patient. Check that the electrodes are properly connected.

INOP Message, Indication	Source	What to do
BIS LEAD OFF INOP tone	BIS	One or more electrodes have no skin contact and therefore impedances cannot be measured. Check the sensor montage and press the electrode pads firmly. If this INOP persists, replace the sensor(s) in question, using correct skin preparation.
BIS OVERCURRENT INOP tone	BIS	Unplug and replug the BIS module. If the INOP persists, contact your service personnel.
BIS SENSOR DISCONN INOP tone	BIS	The sensor is not properly connected to the patient interface cable (PIC) and/or the PIC is not properly connected to DSC, or the sensor/PIC/DSC may be faulty. Check all the connections. Disconnect and reconnect the PIC and DSC. If the INOP persists, replace the sensor. If the INOP persists, replace PIC. If INOP persists, contact your service personnel.
BIS SENSOR INCOMPT INOP tone	BIS	Unsupported sensor connected or sensor type unknown. Replace the sensor, using only Philips supported sensors.
BIS SENSOR MALFUNC INOP tone	BIS	Malfunction in the sensor hardware, most often caused by liquids permeating into the connectors OR patient interface cable (PIC) or DSC may be faulty. Replace the sensor. Manually initiate a Cyclic Impedance Check. Make sure all electrodes pass the test. Make sure that the both sides of the PIC connector (between PIC and sensor) are dry. If you are not sure that the connector is dry, replace the PIC until it has dried. If this INOP persists, contact your service personnel.
BIS SENSOR USAGE INOP tone	BIS	Excessive sensor usage. Replace sensor. A Cyclic Impedance Check will start automatically.
BIS SQI < 15% (INOP tone) OR **BIS SQI < 50%** (no INOP tone)	BIS	If the signal quality is below 50%, BIS numerics cannot be reliably derived. If the signal quality is below 15%, no BIS numerics can be derived. This may occur as a result of artifacts such as those generated from motion or the presence of electrocautery devices. Make sure the sensor is properly attached to the patient. Manually initiate a Cyclic Impedance Check. Make sure all electrodes pass the test. Make sure the patient is completely relaxed (even small motions of the facial muscles affect the signal quality).
BIS UNPLUGGED INOP tone	BIS	Plug in the BIS Interface Module. Silencing this INOP switches off the measurement.
CANNOT ANALYZE ECG	Arrhythmia	The arrhythmia algorithm cannot reliably analyze the ECG data. Check the ECG signal quality of the selected primary and secondary leads. If necessary, improve lead position or reduce patient motion. If you are not getting a reliable HR because the signal is below a minimum amplitude, unstable, or contains artifact, *and* you have tried to improve the system performance by choosing another lead and changing electrodes, you should consider turning arrhythmia analysis off.

INOP Message, Indication	Source	What to do
CANNOT ANALYZE ST	ST	The ST algorithm cannot generate a valid ST value. Possible causes are large variations in the measured ST values for consecutive beats, or ventricular paced beats. Review the ECG signal quality and the ST measurement points. If the patient has a ventricular pacemaker, ST analysis is not possible.
CCI NO BSA CCI numeric unavailable INOP tone	C.O.	CCI cannot be calculated because the patient's body surface area is unknown. Enter the patient weight and height to provide the BSA for CCI calculation.
CCO BAD PRESS SIGN numeric displays -?- INOP tone	C.O.	The arterial pressure wave can currently not be used for pulse contour calculation for CCO or CCI measurement. Possible causes are air bubbles in the tubing or a physiological condition, for example severe arrhythmia.
CCO NO <Pressure label> numeric displays -?- INOP tone may sound	C.O.	CCO/CCI cannot be calculated. Make sure that the pressure chosen in the **Setup CCO** menu under **CCO From** matches the pressure measured with the arterial catheter for CCO measurement. A VueLink pressure cannot be used. Select another pressure label, either ABP, Ao, ART or UAP.
CCO NO CALIBRATION numeric displays -?-	C.O.	The CCO measurement is currently not calibrated.
CCO NOT SUPPORTED numeric displays -?- INOP tone	C.O.	A catheter for transpulmonary C.O. measurements has been unplugged and replaced with a Right Heart C.O. catheter, or the measurement mode has been changed manually. Silencing this INOP switches the measurement off.
CCO/CCI OVERRANGE numeric displays -?- INOP tone	C.O.	The measured CCO or CCI value is not within the specified range for CCO/CCI measurement.
CCO <Pressure label> INVALID numeric displays -?- INOP tone may sound	C.O.	The arterial pressure selected for pulse contour calculation for CCO is available but currently invalid. Make sure the pressure transducer is connected and the zero calibration is valid.
CCO PRESS OVERRANG numeric displays -?- INOP tone	C.O.	The mean value of the arterial pressure values used for pulse contour calculation for CCO is below 0 mmHg or above 300 mmHg.
CCO PULSE OVERRANG numeric displays -?- INOP tone	C.O.	The pulse rate of the pressure used for pulse contour calculation for CCO is below 30 bpm or above 240 bpm.
CCO/Tbl NO TRANSD Numeric displays -?- INOP tone	C.O.	No transducer attached to the module or catheter disconnected.
CCO RECALIBRATE numeric displays -?-	C.O.	The most recent CCO or CCI calibration was made over 8 hours ago. You should recalibrate CCO or CCI with transpulmonary C.O. measurements at least every 8 hours or when the hemodynamic condition of the patient has changed.
CHARGER MALFUNCT INOP tone, battery LED flashes	Batteries	There is a problem with the battery charger in the monitor. Connect the monitor to mains power and contact your service personnel.
CHECK AGENT Numerics replaced by -?-, INOP tone	AGM	The agent selected for monitoring does not match the agent detected by the Gas Analyzer. Check that the correct agent is selected.

INOP Message, Indication	Source	What to do
CHECK ALARM LAMPS INOP tone.	Monitor	Perform a visual check of the alarm lamp to establish whether there is a problem. Contact your service personnel to check the internal connections to the alarm lamps.
CHECK FLEX TEXTS INOP tone	Monitor	Check the names of the monitor menus, for example the labels for screens, profiles, event or trend group names, before you resume monitoring. If they are unexpected, there may be a problem with the monitor software. Contact your service personnel.
CHECKINTERNVOLTAGE INOP tone.	Monitor	There is a problem with the voltages (5V,12V) in the monitor. Contact your service personnel.
CHECK KEYBOARD INOP tone	Monitor	Perform a visual and functional check of the keyboard. Contact your service personnel.
CHECK MAIN BOARD 2 INOP tone.	Monitor	There is a problem with the second main board in the monitor. Contact your service personnel.
CHECK MONITOR TEMP INOP tone	Monitor	The temperature inside the monitor is too high. Check that the monitor ventilation is not obstructed. If the situation continues, 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 MSL VOLTAGE INOP tone	Monitor/ Measuremt Server	There is a problem with the voltage of the Measurement Server Link (MSL). Contact your service personnel.
CHECK NETWORK CONF INOP tone	Monitor	The monitor is receiving network topology information from more than one source, e.g.the Database Server and an Application Server. Contact your service personnel.
CHECK NURSE RELAY INOP tone	Monitor	There is a problem with the connection to the nurse relay. Contact your service personnel.
CHECK SCREEN RES INOP tone	Monitor	The Screen you have selected uses a resolution which is not supported by the display. The monitor will show a generic Screen instead until you select a different Screen. Contact your service personnel if you want the Screen deleted from the Profile(s) to avoid this in future.
CHECK SPEEDPOINT INOP tone.	Monitor	Perform a visual and functional check of the SpeedPoint input device. Contact your service personnel.
CHECK TOUCH INPUT	Monitor	Perform a visual and functional check of the touch input device. Contact your service personnel.
CHECK WAVES INOP tone	Monitor	The options purchased with this monitor may not support the number of waves required to show the selected Screen, so some waves or high resolution trends are missing from the Screen. Select a different Screen with fewer waves. Contact your service personnel if you want the Screen deleted from the Profile(s) to avoid this in future.
C LEAD OFF HR numeric is displayed with a -?- for 10 seconds. INOP tone.	ECG	The C electrode has become detached from the patient or the lead set has been changed. Reattach the electrode or select **New Lead Setup** in the **Setup ECG** menu to confirm the new lead set.
CO_2 AUTO ZERO Numeric is replaced by a - ? - if the Autozero lasts >15 sec, INOP tone sounds.	CO_2	The automatic zero calibration is in progress. This typically takes 10 seconds. During this time the CO_2 values may not be updated, or they may be replaced by -?-. Wait until the zero calibration is complete to resume monitoring.

INOP Message, Indication	Source	What to do
CO_2 CAL MODE CO_2 numeric displays current CO_2 value for accuracy check	CO_2	Currently no calibration is running. Accuracy can be checked by placing the transducer on the two cells of the calstick and starting calibration. To start monitoring, leave Cal. Mode.
CO_2 CAL RUNNING Numeric is replaced by a - ? -	CO_2	Wait until calibration is finished.
CO_2 CHANGE SCALE	CO_2	The CO_2 wave is clipped. Select a more appropriate wave scale to display the whole wave.
CO_2 CHECK CAL Numeric is replaced by a - ? - INOP tone.	CO_2	The CO_2 value is outside the measurement range. Perform an accuracy check for both calstick cells and, if necessary, recalibrate the transducer.
C.O. EQUIP MALF Numeric is replaced by a - ? - INOP tone.	C.O.	There is a problem with the C.O. hardware. Contact your service personnel.
CO_2 EQUIP MALF Numeric is replaced by - ? - INOP tone.	CO_2	The Measurement Server Extension is faulty. Unplug and replug the Measurement Server with Extension. If you are using the mainstream method, unplug and replug the transducer or try another transducer. If the INOP persists, contact your service personnel.
CO_2 FAILED CAL Numeric is replaced by -?- INOP tone.	CO_2	Make sure that the Cal cell was changed between CAL1 and CAL2. Repeat the calibration. If the INOP reappears, try another transducer. If the INOP persists, contact your service personnel.
CO_2 MEAS DISTURBED Numeric is replaced by -?-. INOP tone.	CO_2 (AGM)	The Gas Analyzer etCO_2 or imCO_2 numeric cannot be reliably derived. If this INOP persists, contact your service personnel.
CO_2 NO TRANSDUC Numeric is replaced by - ? - INOP tone.	CO_2	There is no CO_2 transducer connected. If you replace the transducer, the new transducer must be calibrated. If you silence this INOP the CO_2 measurement will be switched off.
CO_2 NO TUBING Numeric is replaced by - ? - INOP tone.	CO_2	Either the FilterLine is disconnected, or an incorrect line is attached. Check the connection. If necessary, connect another Microstream® Filterline (only Microstream accessories can be used). If you silence this INOP, the measurement will be switched off.
CO_2 OCCLUSION Numeric is replaced by a - ? - INOP tone.	CO_2	The FilterLine or exhaust tube is blocked. Check the FilterLine and exhaust tube, then disconnect and reconnect the FilterLine. If the INOP persists, connect a new FilterLine.
CO_2 OVERRANGE Numeric is replaced by - ? - INOP tone.	CO_2	The CO_2 value is higher than the measurement range. If you suspect a false high value, contact your service personnel.
CO_2 PURGING Numeric is replaced by a - ? - INOP tone.	CO_2	The Filterline is being purged to remove an occlusion in the line or airway adapter. If the occlusion is removed, the INOP will disappear. If not, the INOP **CO2 OCCLUSION** is displayed.
CO_2 SENSOR WARMUP Numeric is displayed with a - ? - Microstream CO_2: INOP tone. Mainstream CO_2: no INOP tone	CO_2	Wait until the sensor reaches operating temperature and the INOP disappears.
CO_2 UNABLE TO MEAS Numeric is replaced by -?-. INOP tone	CO_2 (AGM)	The Gas Analyzer currently cannot measure CO_2. If this INOP persists, contact your service personnel.

INOP Message, Indication	Source	What to do
C.O. UNPLUGGED numeric displays -?- INOP tone.	C.O.	Plug in the C.O. module. Silencing this INOP switches off the measurement.
CO_2 UPDATE FW Numeric is replaced by a - ? - INOP tone.	CO_2	The software in the Measurement Server Extension does not match the software in the MMS. Contact your service personnel.
CO_2 WAIT CAL2 Numeric is replaced by a - ? -	CO_2	Calibration on the first calstick cell is complete. Place the transducer on the other calstick cell and start the CAL2 calibration cycle.
CPP CHK SOURCES Numeric is replaced by a - ? -	CPP	Not all measurements or values required to perform the calculation are available. Check the measurement sources.
CPP CHK UNITS Numeric is replaced by a - ? -	CPP	The monitor has detected a conflict in the units used for this calculation. Check the unit settings.
CUFF NOT DEFLATED Numeric is displayed with a - ? - INOP tone. During this INOP, alarms cannot be paused or switched off.	NBP	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 repeating the measurement. You can silence the INOP, but the INOP message remains visible until the next NBP measurement is started or the **Stop All** SmartKey is selected. [*Adult or pediatric patients*: The NBP cuff pressure has exceeded 15mmHg (2kPa) for more than 3 minutes. *Neonatal patients*: The NBP cuff pressure has exceeded 5mmHg (0.7kPa) for more than 90 seconds.]
CVP INOPS	PRESS	See <Pressure label> INOPS (under P).
ECG EQUIP MALF Numeric is displayed with a - ? - INOP tone.	ECG	Contact your service personnel. The ECG hardware is faulty.
<ECG LEAD> LEAD OFF Numeric is displayed with a - ? - INOP tone.	ECG	Not all the required leads for ECG monitoring are connected. Check the ECG connections and make sure that the electrode indicated by <ECG lead> (RA, LA, LL, RL, V) electrodes is attached. In EASI mode, all 5 electrodes must be connected.
ECG EL. NOISY <ECG LEAD>	ECG	The ECG signal from the named ECG electrodes (RA, LA, LL, RL, V) is noisy. Check the ECG connections and make sure that the electrode indicated is attached.
ECG NOISY SIGN. INOP tone.	ECG	The ECG signal is too noisy. Check that the electrodes are properly placed and have not dried out. Remove any possible sources of signal noise (such as power cords) from the area around the cable and the patient. The ECG signal may be saturated or overloaded.
EEG EQUIP MALFUNC INOP tone	EEG	The EEG hardware is faulty. Contact your service personnel.
EEG IMPEDANCE HIGH or **EEG1** and/or **EEG2 IMPED. HIGH**	EEG	The signal electrode in one or both channels exceeds the user-selected impedance limit, or the impedance of a single electrode exceeds the limit. Check the impedance. If the impedance is too high, reconnect the electrodes according to the EEG monitoring setup guidelines.If the INOP persists, contact your service personnel.
EEG LEADS OFF **EEG<X> LEAD(S) OFF** [X = *lead label*]	EEG	Connect specified electrodes (start with reference electrode). Lead electrodes are not connected to the patient's head.

INOP Message, Indication	Source	What to do
EEG LINE NOISE **EEG 1** or **2 LINE NOISE**	EEG	Excessive line noise has been detected in either channel EEG1 or EEG2, or in both EEG channels. Keep all cables together and away from metallic bodies, other cables & radiated fields.
EEG MUSCLE NOISE **EEG 1** or **2 MUSCLE NOISE**	EEG	Too much power above 30 Hz has been detected in channel EEG1 or EEG2, or both. Check the Electrode-to-Skin Impedance and reposition the electrode away from possible muscle activity, if necessary.
EEG NO TRANSDUCER INOP tone	EEG	The trunk cable is disconnected from the EEG plug-in module. Reconnect the trunk cable.
EEG UNPLUGGED INOP tone	EEG	Plug in module. Silencing this INOP switches off the measurement.
EEG OVERRANGE, or **EEG<X> OVERRANGE**	EEG	Input signal is too high in one or both channels. This is usually caused by interfering signals such as line noise or electrosurgery. X denotes the EEG channel.
FMS UNPLUGGED INOP tone.	FMS	Make sure that the Flexible Module Server is connected to the monitor. All FMS measurements are off while the FMS is unplugged.
GAS CONTAMINANT Numerics may be shown with -?- INOP tone.	AGM	The Gas Analyzer has detected a contaminant gas in the gas sample. Check the breathing system for the presence of contaminating gases and flush if needed.
ICP INOPs	PRESS	See <Pressure label> INOPS (under P).
INTERNAL.COMM.MALF INOP tone	Monitor	There is a problem with I2C Bus communication in the monitor. Contact your service personnel.
LA LEAD OFF Numeric is displayed with a -?- for 10 seconds; INOP tone.	ECG	The LA electrode has become detached from the patient or the lead set has been changed. Reattach the electrode or select **New Lead Setup** in the **Setup ECG** menu to confirm the new lead set.
LAP INOPs	PRESS	See <Pressure label> INOPS (under P).
LEADS OFF Numeric is displayed with a -?- for 10 seconds; INOP tone.	ECG	Check that all of the required ECG leads are attached, and that none of the electrodes have been displaced.
LL LEAD OFF Numeric is displayed with a -?- for 10 seconds; INOP tone.	ECG	The LL electrode has become detached from the patient or the lead set has been changed. Reattach the electrode or select **New Lead Setup** in the **Setup ECG** menu to confirm the new lead set.
MEASSRV UNSUPPORTD	Monitor	The measurement server is not supported by the monitor. Contact your service personnel.
MMS UNPLUGGED INOP tone.	MMS	Make sure that the Multi-Measurement Server is connected to the monitor. All MMS measurements are off while the MMS is unplugged.
MSL POWER HIGH	Monitor	The power consumption of the devices connected to the Measurement Server Link (MSL) cable is too high. If this situation continues, the MSL will be switched off. Contact your service personnel.
MSL POWER OFF INOP tone.	Monitor	The power consumption of the devices connected to the Measurement Server Link (MSL) cable was too high for too long and the MSL has been switched off. Contact your service personnel.

INOP Message, Indication	Source	What to do
MSL POWER OVERLOAD INOP tone.	Monitor	The power consumption of the devices connected to the Measurement Server Link (MSL) cable is much too high or there has been a short circuit. The MSL has been switched off. Contact your service personnel.
N_2O CHANGE SCALE	AGM	The N_2O wave is clipped. Select a more appropriate wave scale to display the whole wave.
N_2O MEAS DISTURBED Numerics replaced by -?-. INOP tone	AGM	The Gas Analyzer numeric cannot reliably be derived. If this INOP persists, contact your service personnel.
N_2O UNABLE TO MEAS. Numerics replaced by -?-. INOP tone	AGM	The Gas Analyzer currently cannot measure N_2O. If this INOP persists, contact your service personnel.
NBP CUFF OVERPRESS Numeric displayed with -?- ; INOP tone. During this INOP, alarms cannot be paused or switched off.	NBP	The NBP 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 displayed with a -?- INOP tone.	NBP	Remove the cuff from the patient. The NBP 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 displayed with a -?- INOP tone.	NBP	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.
NBP MEASURE FAILED Numeric is displayed with a -?- INOP tone.	NBP	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 NBP 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.
O_2 CHANGE SCALE Numerics replaced by -?-	AGM	The O_2 wave is clipped. Select a more appropriate wave scale to display the whole wave.
O_2 EQUIP MALF INOP tone	AGM	There is a problem with the Gas Analyzer O_2 sensor. If this INOP persists, contact your service personnel.
O_2 MEAS DISTURBED Numerics replaced by -?-. INOP tone	AGM	The Gas Analyzer numeric cannot reliably be derived. If this INOP persists, contact your service personnel.

INOP Message, Indication	Source	What to do
O_2 UNABLE TO MEAS Numerics replaced by -?-. INOP tone	AGM	The Gas Analyzer currently cannot measure O_2. If this INOP persists, contact your service personnel.
O_2 ZERO FAILED Numerics replaced by -?-. INOP tone	AGM	An O_2 zero calibration failed. Contact your service personnel.
P INOPS	PRESS	See <Pressure label> INOPS (under P).
PAP INOPS	PRESS	See <Pressure label> INOPS (under P).
<Pressure label> ARTIFACT Numeric displayed with -?-	PRESS	A non-physiological event is detected (for example, a flush or blood sample). A resulting high limit alarm will be suppressed.
<Pressure label> DEACTIVATED INOP tone	PRESS	You have connected a measurement device (module or measurement server) that uses a label the monitor has already assigned to a different source. To activate the new source, choose a new label in the Measurement Selection window.
<Pressure label> EQUIP MALF Numeric displayed with -?- INOP tone.	PRESS	Contact your service personnel. The pressure hardware is faulty.
<Pressure label> NO TRANSDUCER Numeric is displayed with a -?- INOP tone.	PRESS	Make sure that the pressure transducer is connected to the measurement server or module server. If you silence this INOP, the measurement will be switched off.
<Pressure label> NOISY SIGNAL Pulse numeric is displayed with a -?- INOP tone.	PRESS	This INOP can only arise when a pressure is selected as the pulse source. It occurs when the pulse detector finds a pulse rate above 350bpm. This is usually caused by movement artifact or electrical interference.
<Pressure label> NON-PULSATILE Pulse numeric is displayed with a -?- INOP tone.	PRESS	This INOP can only arise when a pressure is selected as the pulse source. It occurs when the pulse rate being measured is less than 25 beats per minute or the amplitude is less than three mmHg. Check the catheter and connections to the patient.
<Pressure label> OVERRANGE Numeric is displayed with a -?- INOP tone.	PRESS	Make sure that the measurement has been properly prepared and zeroed, and that the transducer is level with the heart. If this INOP persists, try another transducer. Possible causes are a measured pressure outside the allowed pressure range, or a broken wire to the transducer.
<Pressure label> REDUCE SIZE	PRESS	Increase the scale for the pressure wave.
<Pressure label> TRANSDUC MALF Numeric is displayed with a -?- INOP tone.	PRESS	Contact your service personnel. The transducer is faulty.
<Pressure label> UNPLUGGED	PRESS	The pressure measurement is switched on but the accessories have been unplugged. Silencing this INOP switches off the measurement.
<Pressure label> ZERO+CHECK CAL Numeric is displayed with a -?-	PRESS	Perform a zero and check the calibration of the transducer.
RA LEAD OFF Numeric is displayed with a -?- INOP tone.	ECG	The RA electrode has become detached from the patient or the lead set has been changed. Reattach the electrode or select **New Lead Setup** in the **Setup ECG** menu to confirm the new lead set.
RAP INOPS	PRESS	See <Pressure label> INOPS (under P).

INOP Message, Indication	Source	What to do
REM.ALARMDEV.MALF INOP tone	Monitor	There is a problem with the connection to the remote alert device. Contact your service personnel to check the remote alert device and its connections.
RESP EQUIP MALF Numeric is displayed with a -?- INOP tone.	RESP	Contact your service personnel. The RESP hardware is faulty.
RESP ERRATIC Numeric is displayed with a -?-	RESP	The monitor has detected too many artifacts in the measured Resp signal. Check that the RA and LL electrodes are correctly attached and have not dried out.
RESP LEADS OFF Numeric is displayed with a -?- INOP tone.	RESP	Not all the required leads for Resp monitoring are attached. Make sure that the RA and LL leads are attached.
RL LEAD OFF Numeric is displayed with a -?- for 10 seconds; INOP tone.	ECG	The RL electrode has become detached from the patient or the lead set has been changed. Reattach the electrode or select **New Lead Setup** in the **Setup ECG** menu to confirm the new lead set.
SETTINGS MALFUNC. INOP tone.	Monitor	The monitor cannot use the predefined settings for monitoring. Contact your service personnel.
SOME ECG ALARMS OFF	Arrhythmia	This message appears (if configured to do so) when the on/off settings of the yellow arrhythmia alarms differ from the current Profile.
SPEAKER MALFUNCT. INOP tone	Monitor	Contact your service personnel to check the speaker and the connection to the speaker.
ΔSpO$_2$ CHK SOURCES Numeric is displayed with a -?-	SpO_2 Difference	Not all measurements or values required to perform the calculation are available. Check measurement sources.
ΔSpO$_2$ CHK UNITS Numeric is displayed with a -?-	SpO_2 Difference	The monitor has detected a conflict in the units used for this calculation. Check the unit settings.
<SpO$_2$ label> DEACTIVATED INOP tone	SpO_2	You have connected a measurement server that uses a label the monitor has already assigned to a different source. To activate the new source, choose a new label in the Measurement Selection window.
<SpO$_2$ label> EQUIP MALF Numeric is replaced by a -?- INOP tone.	SpO_2	The MMS is faulty. Unplug and replug the MMS. If the INOP persists, contact your service personnel.
<SpO$_2$ label> 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.
<SpO$_2$ label> EXTD. UPDATE Label is displayed with a -?- (questionable numeric)	SpO_2	The update period of displayed values is extended due to an NBP measurement on the same limb or an excessively noisy signal.
<SpO$_2$ label> 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 .
<SpO$_2$ label> LOW PERF Label is displayed with 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
<SpO$_2$ label> 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.
<SpO$_2$ label> 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 NBP measurement on the same limb, wait until the NBP measurement is finished.
<SpO$_2$ label> 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.
<SpO$_2$ LABEL> POOR SIGNAL Label is displayed with a ? (questionable numeric)	SpO$_2$	The signal condition of the SpO$_2$ measurement is poor and measurement accuracy may be compromised.
<SpO$_2$ LABEL> PULSE? Numeric is replaced by -?- INOP tone	SpO$_2$	The detectable pulsations of the SpO$_2$ signal are outside the specified pulse rate range.
<SpO$_2$ LABEL> SEARCHING Numeric unavailable	SpO$_2$	SpO$_2$ is analyzing the patient signal to derive Pulse, SpO$_2$ and Perf values. Please wait until the search analysis is complete.
<SpO$_2$ label> 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.
<SpO$_2$ LABEL> 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.
<SpO$_2$ LABEL> 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.
<SpO$_2$ LABEL> UPGRADE Label is displayed with a -?-, numeric is unavailable	SpO$_2$	The SpO$_2$ measurement is currently in UPGRADE mode. Monitoring is not possible in this mode.
Sp - vO$_2$ CHK SOURCES Numeric is displayed with a -?-	Sp - vO$_2$	Not all measurements or values required to perform the calculation are available. Check measurement sources.
Sp - vO$_2$ CHK UNITS Numeric is displayed with a -?-	Sp - vO$_2$	The monitor has detected a conflict in the units used for this calculation. Check the unit settings.
SvO$_2$ CAL FAILED $S\bar{v}O_2$ numeric is displayed with ?	$S\bar{v}O_2$	The calibration failed. Check the catheter-to-Optical-Module connection. Manually restart the calibration. Try another catheter and Optical Module. If the catheter is already inserted, perform an in-vivo calibration.
SvO$_2$ CAL MODE $S\bar{v}O_2$ numeric displays -?-	$S\bar{v}O_2$	Pre-insertion calibration is complete, but the catheter tip is still inside the optical reference. The catheter is now ready for insertion.
SvO$_2$ CAL REQUIRED $S\bar{v}O_2$ numeric displays -?-. INOP tone may sound	$S\bar{v}O_2$	There is no valid calibration data in the Optical Module. Perform either a pre-insertion or an in-vivo calibration.
SvO$_2$ CONFIGURATION $S\bar{v}O_2$ numeric displays -?-. INOP tone	$S\bar{v}O_2$	The Optical Module has been configured to SaO$_2$ Mode. Use **Change to SvO2** in the **Setup SvO2** menu to reconfigure to SvO$_2$ Mode.
SvO$_2$ CONNCT OPTMOD $S\bar{v}O_2$ numeric displays -?-. INOP tone	$S\bar{v}O_2$	The Optical Module was disconnected during data storage. Reconnect the Optical Module for at least 20 seconds.

INOP Message, Indication	Source	What to do
SvO_2 EQUIP MALF $S\bar{v}O_2$ numeric displays -?-. INOP tone	$S\bar{v}O_2$	The $S\bar{v}O_2$ Module or Optical Module is faulty. Unplug and replug the Optical Module and SvO_2 module. Exchange the modules. If the INOP persists, contact your service personnel.
SvO_2 IN-VIVO CALIB $S\bar{v}O_2$ numeric displays -?-.	$S\bar{v}O_2$	The in-vivo calibration is not yet complete. Lab values must be stored to the Optical Module to complete the calibration. Either continue with the next steps of the current calibration or recall the previous calibration.
SvO_2 LIGHT INTENS $S\bar{v}O_2$ numeric displays -?- or numeric is displayed with ? INOP tone with -?- display	$S\bar{v}O_2$	The intensity changed considerably since the last light intensity calibration. This may indicate that the catheter tip is positioned against a blood vessel wall or that there is low blood flow. Reposition the catheter and perform a light intensity calibration.
SvO_2 LOW LIGHT $S\bar{v}O_2$ numeric displays -?- or numeric is displayed with ? INOP tone may sound	$S\bar{v}O_2$	The optical signal levels are too low. Check that the catheter is either in the optical reference or inserted into the patient. Check the catheter-to-Optical Module connection. If INOP persists, try another catheter and Optical Module.
SvO_2 NO OPTMOD $S\bar{v}O_2$ numeric displays -?-. INOP tone	$S\bar{v}O_2$	Connect the Optical Module. If the INOP persists, try another Optical Module. Silencing this INOP switches the measurement off.
SvO_2 OPTMOD DEFECT	$S\bar{v}O_2$	The Optical Module memory is faulty, and calibration data cannot be stored for transport or during power failure. If this feature is needed, use another Optical Module.
SvO_2 OPTMOD WARMUP $S\bar{v}O_2$ numeric is displayed with ?	$S\bar{v}O_2$	The Optical Module has not yet reached the operating temperature. Wait a few minutes until warm-up is finished.
SvO_2 PRE-INS CALIB $S\bar{v}O_2$ numeric displays -?- INOP tone	$S\bar{v}O_2$	The pre-insertion calibration is running. This typically takes one minute. During this time $S\bar{v}O_2$ alarms are switched off. Wait until the calibration is complete.
SvO_2 UNABL TO MEAS $S\bar{v}O_2$ numeric displays -?-. INOP tone	$S\bar{v}O_2$	The signal is out of the normal range, and no $S\bar{v}O_2$ value can be derived. Perform an in-vivo calibration. If the INOP persists, try another Optical Module and catheter.
SvO_2 UNPLUGGED $S\bar{v}O_2$ numeric displays -?-. INOP tone	$S\bar{v}O_2$	Measurement switched on and $S\bar{v}O_2$ module unplugged from the rack.
SVR/SVRI CHK SOURCES Numeric is displayed with a -?-	SVR/SVRI	Not all measurements or values required to perform the calculation are available. Check measurement sources.
SVR/SVRI CHK UNITS Numeric is displayed with a -?-	SVR/SVRI	The monitor has detected a conflict in the units used for this calculation. Check the unit settings.
SVR/SVRI SET CVP USED numeric displays - ? -	SVR/SVRI	A CVP value is required for this calculation, but is not currently being measured. The monitor is using the CVP value preset in the **Setup SVR** menu.
Tart INOPS	TEMP	See <Temp label> INOPs (under T)
Tblood NO TRANSDUC Numeric displays -?- INOP tone	C.O.	No transducer attached to the module or catheter disconnected.
Tblood OVERRANGE Numeric displays -?-	C.O.	Tblood out of range 17°C - 43°C.
Tcore INOPS	TEMP	See <Temp label> INOPs (under T).

INOP Message, Indication	Source	What to do
$tcpO_2$ (or $tcpCO_2$ or tcGas) CAL FAILED Numeric displays -?- INOP tone.	tcGas	A calibration failed. Check the cal. unit, gas pressure, and tubing connections, then restart the cal. If the cal. has failed more than once, remembrane the transducer and restart the calibration. If this INOP persists, contact your service personnel.
$tcpO_2$ (or $tcpCO_2$ or tcGas) CAL REQUIRD Numeric displays -?- INOP tone.	tcGas	Calibration is required before applying the transducer to the patient. Insert a membraned transducer into the cal. chamber on the module, connect the cal. unit to the cal. chamber, open the gas valve and start the calibration. If this INOP occurs during a calibration, there may be a module or transducer malfunction: contact your service personnel.
$tcpO_2$ (or $tcpCO_2$ or tcGas) CAL RUNNING Numeric displays first -?- , then numeric is displayed with a ?	tcGas	Wait until the $tcpO_2$/$tcpCO_2$ calibration is finished.
$tcpO_2$ (or $tcpCO_2$ or tcGas) CHECK TIME	tcGas	Site Timer due to time out in 15 minutes or less.
$tcpO_2$ (or $tcpCO_2$ or tcGas) CHANGE SITE If Heat Switch Off is configured to Yes, numeric displays -?- INOP tone.	tcGas	Site Timer has timed out. Change the application site to avoid skin burns. To reset the Site Timer, either calibrate and change the measurement site, or change the measurement site and reset the Site Timer manually by selecting the appropriate site time from the **Setup TCGas** menu.
$tcpO_2$ (or $tcpCO_2$ or tcGas) EQUIP MALF Numeric displays -?- INOP tone.	tcGas	There is a malfunction in the transducer or module. Connect another transducer. If this INOP persists, contact your service personnel.
$tcpO_2$ (or $tcpCO_2$ or tcGas) NO TRANSDUC Numeric displays -?- INOP tone.	tcGas	No transducer is connected to the $tcpO_2$/$tcpCO_2$ module. Silencing the alarm switches off the measurement.
$tcpO_2$ (or $tcpCO_2$ or tcGas) STABILIZING Numeric is displayed with a ?	tcGas	The transducer has not yet reached the selected temperature and/or skin hyperemization is not yet finished. This INOP will disappear within three minutes.
$tcpO_2$ (or $tcpCO_2$ or tcGas) UNPLUGGED Numeric displays -?- INOP tone.	tcGas	Module switched on and unplugged from rack. Silencing this INOP switches off the measurement.
<Temp label> - <Temp label> CHK SOURCES Numeric is displayed with a -?-	TEMP Difference	Not all measurements or values required to perform the calculation are available. Check measurement sources.
<Temp label> - <Temp label> CHK UNITS Numeric is displayed with a -?-	TEMP Difference	The monitor has detected a conflict in the units used for this calculation. Check the unit settings.
<Temp label> DEACTIVATED INOP tone	TEMP	You have connected a measurement device (module or measurement server) that uses a label the monitor has already assigned to a different source. To activate the new source, choose a new label in the Measurement Selection window.
<Temp label> EQUIP MALF Numeric is displayed with a -?- INOP tone.	TEMP	Contact your service personnel. The temperature hardware is faulty.

INOP Message, Indication	Source	What to do
<Temp label> NO TRANSDUCER Numeric is displayed with a -?- INOP tone.	TEMP	Make sure the TEMP probe is connected to the MMS or module. If you silence this INOP, the measurement will be switched off.
<Temp label> UNPLUGGED INOP tone	TEMP	The temperature measurement is switched on but the accessories have been unplugged. Silencing this INOP switches off the measurement.
<Temp label> OVERRANGE Numeric is displayed with a -?- INOP tone.	TEMP	Try changing the application site of the transducer. [The temperature is less than -1°C, or greater than 45°C.]
Tesop INOPS	TEMP	See <Temp label> INOPs (under T).
Tnaso INOPS	TEMP	See <Temp label> INOPs (under T).
TOO MANY AGENTS	AGM	More agents are detected than agent channels are available. Check that both agent channels are switched on in the gas analyzer setup menu
Trect INOPS	TEMP	See <Temp label> INOPs (under T).
Tskin INOPS	TEMP	See <Temp label> INOPs (under T).
Tven INOPS	TEMP	See <Temp label> INOPs (under T).
UAP INOPS	PRESS	See <Pressure label> INOPS (under P).
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.
UVP INOPS	PRESS	See <Pressure label> INOPS (under P).
<VueLink option> CHK CABLE INOP tone.	VueLink	No cable or the wrong cable connected to the VueLink module, or incorrect device selected. Silencing this INOP switches the measurement off. VueLink INOP abbreviations may differ slightly depending on the device category.
<VueLink option> CHK CONF. INOP tone.	VueLink	The wrong external device has been selected on the VueLink module, or the external device has not been correctly setup, or the wrong cable has been used to connect the device to the VueLink module. VueLink INOP abbreviations may differ slightly depending on the device category.

INOP Message, Indication	Source	What to do
<VueLink option> CHECK SETUP INOP tone.	VueLink	No information was received from the external device. The device may be switched off or disconnected. VueLink INOP abbreviations may differ slightly depending on the device category.
VueLnk EQUIP MALF INOP tone.	VueLink	Malfunction in the VueLink module. If this message appears repeatedly, the module must be replaced. Contact your service personnel. VueLink INOP abbreviations may differ slightly depending on the device category.
VueLnk NO CONFIG INOP tone.	VueLink	The VueLink module has not been configured during installation. The installation process should be completed by either your biomedical engineering department or the Philips service engineer. VueLink INOP abbreviations may differ slightly depending on the device category.
VueLnk UNPLUGGED INOP tone.	VueLink	The VueLink module has been unplugged from the rack, or the whole rack has been disconnected. Silencing this INOP switches off the measurement. VueLink INOP abbreviations may differ slightly depending on the device category.

5

Managing Patients

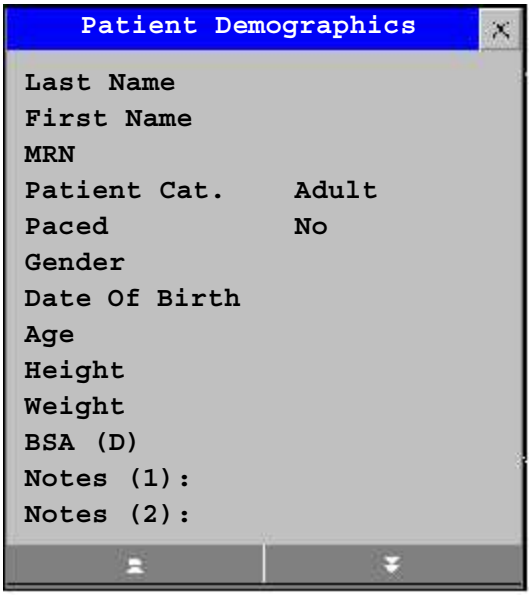
The monitor displays physiological data and stores it in the trends as soon as a patient is connected. This lets you monitor a patient who is not yet admitted. It is however important to fully admit patients so that you can clearly identify your patient on recordings, reports and networking devices. During admission you enter data that the monitor needs for safe and accurate operation. For example, the monitor uses patient category (Adult, Neo or Pedi) to determine the way the monitor processes and calculates some measurements, and the safety and alarm limits that apply to the patient.

All patient information entered at the bedside is automatically communicated to the Information Center and vice versa.

Admitting a Patient

You can admit a patient at either the bedside or the Information Center. When you admit a patient, the patient's name appears on the bedside monitor and the Information Center.

Use the Patient Demographics window and its associated pop-up keys to admit, discharge, and transfer (ADT) patients. To open the Patient Demographics window:



1 Select the patient name field or select the **Admit/Dischrge** SmartKey.

2 Clear any previous patient data by selecting the **Dischrge Patient** or **End Case** pop-up key and then **Confirm**.

If you do not erase data from the previous patient, it appears in the trends with the new patient's data. The monitor makes no distinction between the old and the new patient data.

3 Enter the patient information: select each field and use the on-screen keyboard or choose from the pop-up list of alternatives to input information. If a 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 **Smith.**

– **First name**: Enter the patient's first name, for example **Joseph.**

- **MRN**: Enter the patient's medical record number (MRN), for example **12345678**
- **Patient Cat**: Choose the patient category, either Adult, Pediatric, or Neonatal.
- **Paced**: Choose Yes or No (You must use "Yes" if your patient has a pacemaker).
- **Gender**: Choose male or female.
- **DOB**: Enter the patient's date of birth. Enter this in the form **dd/mm/yyyy**.
- **Age**: The monitor calculates the patient age automatically.
- **Height**: Enter the patient's height.
- **Weight**: Enter the patient's weight.
- **BSA**: The monitor calculates the body surface area automatically.
- **Notes**: Enter any extra information about the patient or treatment.

4 Select **Confirm.** The patient status changes to admitted.

Patient Category and Paced Status

The patient category setting determines the algorithm the monitor uses to process and calculate some measurements, the safety limits that apply for some measurements, and the alarm limit ranges.

The paced setting determines whether the monitor shows pacemaker pulses or not. When **Paced** is set to **No**, pace pulse are filtered and therefore do not show in the ECG wave.

WARNING **Patient Category** and **Paced** status will always contain a value, regardless of whether the patient is fully admitted or not. If you do not specify settings for these fields, the monitor uses the default settings from the current profile, which might not be correct for your patient.

Patient category Changing the patient category may change the arrhythmia and NBP alarm limits. Always check alarm limits to make sure that they are appropriate for your patient.

Paced status For paced patients, you must set **Paced** to yes. If it is incorrectly set to no, the monitor could mistake a pace pulse for a QRS and fail to alarm during asystole.

Quick Admitting a Patient

Use Quick Admit only if you do not have the time or information to fully admit a patient. Complete the rest of the patient demographic details later. If you do not, the patient name will be not be written on reports and on information stored in the database or sent to an Information Center.

1 Open the **Patient Demographics** window.

2 Clear any previous patient data by selecting the pop-up key **Dischrge Patient** and then **Confirm**.

3 Enter the patient category and paced status for the new patient.

4 Select **Confirm**.

The patient name field shows **no patient admitted** and the patient name space on printed reports is blank. You can discharge an "unadmitted" patient, but the documentation will not display a patient name. To fully admit this patient, select the **Patient Demographics** window again and complete the fields. This enables you to transfer this patient.

Editing Patient Information

To edit the patient information after a patient has been admitted, select the patient name field on the Main Screen to open the **Patient Demographics** window, and make the required changes.

Discharging a Patient

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

- clears the information in the Patient Demographics window
- erases all patient data (such as trend, event, calculation data) from the monitor, measurement servers and Information Center
- resets patient category and paced settings to the settings defined in the default Profile
- resets all monitor and measurement settings as well as the active Screen to the settings defined in the default Profile
- discharges the patient from the Information Center.

If the monitor is not connected to an Information Center, make sure that you have printed out any required reports before discharging to avoid losing patient data.

1 Select the patient name field to display the Patient Demographics window and associated pop-up keys.

2 Select the pop-up key for either:

- **End Case** - to first print any configured end case reports, discharge the patient and erase the patient database, then enter standby mode. If an **End Case** SmartKey is configured for your monitor, you can also select this instead and then confirm.

  Select the **Cancel End Case** pop-up key to end the End Case procedure.
- **Dischrge Patient** - to discharge patient and return to default settings (no printout). The monitor displays the Patient Demographics window, with no patient admitted.

Transferring a Patient

Different sets of patient- and measurement-related data are stored in the monitor and the Multi-Measurement Server. Understanding this will help you to understand what happens to patient data when you transfer patients.

Patient Information	Stored in Monitor	Stored in MMS and extensions
Patient demographics (name, DOB, MRN)	yes	yes
Monitor settings (alarm pause time, alarm volume)	yes	no
Measurement settings for all measurements (alarm limits, measurement on/off, etc.)	yes	most recent 8 hours of information, for all MMS and extensions measurements
Trend data	yes, all measurements (up to a maximum of 16 or 32, depending on your database configuration)	most recent 8 hours of information, for all MMS and extensions measurements
Calculation data (HemoCalc data)	yes	no
Events data	yes	no

WARNING The monitor is not battery-powered. You cannot monitor during transport.

Transferring a Centrally Monitored Patient

If your monitor is connected to the Information Center, you can move patients and re-admit them at new locations within the network without re-entering the patient demographic information.

1 Select the **Patient Demographics** window. Select the **Transfer** pop-up key.

2 Select **Confirm** to move the patient to the transfer list in the Information Center. The monitor displays the message **Patient prepared for transfer**.

3 When the monitor is at its new location, reconnect it to the local area network (LAN). If the patient is not already admitted at the Information Center, the monitor automatically admits the patient now.

4 Select **Confirm** to retain the patient demographic information.

If you accidentally transfer a patient, use **Re-admit** to restore this patient's data to the Information Center. If you are not connected to the network, select **Clear Transfer** to leave transfer mode.The patient data remains in the monitor.

Transferring a Patient with an MMS

To transfer a patient with an MMS,

1 Disconnect the MMS from the original monitor.

2 Silence the resulting **MMS UNPLUGGED** INOP.

3 Move the patient with the measurement server and connect the MMS at the new monitor.

4 If prompted, re-admit the patient to the new monitor: in the **Patient Selection** window, select **Continue MMS** to retain the data in the MMS. This will upload the patient demographics, and, if configured, the measurement settings and trend data stored in the MMS to the monitor. Verify that the settings for patient category and paced mode are correct.

Remember to discharge the patient from the original monitor to clear this data before starting to monitor a new patient.

Resolving Patient Information Mismatch

When you connect an MMS to a monitor, or a monitor to the network, the monitor compares patient category, paced status, and a unique patient identification number that is internally stored in both the MMS and the monitor. The monitor indicates a mismatch if the information is not identical.

Depending on your monitor's configuration, this mismatch may be automatically resolved or you may have to resolve it manually. If your monitor is configured to resolve mismatches automatically, depending on the configuration, either the monitor or the Multi-Measurement Server data is automatically retained.

Manually Resolving Patient Mismatch

The patient mismatch is indicated by question marks (???) beside the questionable fields in the Monitor Info Line and in the **Patient Demographics** window. The monitor displays a message such as **Different patients in Central and Monitor**. The **Patient Selection** window automatically opens so you can decide which patient data to use. You do not have to resolve the mismatch immediately, however, the indicators remain until you do. There can be up to three columns of data in the **Patient Selection** window if the patient is different in the Information Center, monitor, and MMS.

After you resolve the mismatch, the monitor displays a confirmation window that explains the consequences of your choice, telling you where the patient will be continued/discontinued. Confirm your choice. The monitor automatically displays the **Patient Demographics** window after confirmation. Verify that the settings shown are correct for the patient.

Gender, date of birth, height, weight, and nursing notes do not generate a mismatch. If these fields are different on different devices, the monitor resolves them itself. For example, it may take date of birth from the Information Center, whilst taking gender from the MMS. Always check the Patient Demographics after combining patients, to ensure that you are satisfied with the results. Change them if necessary.

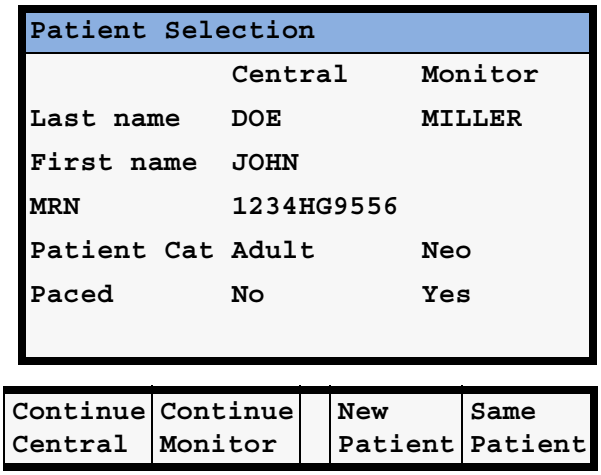
WARNING After resolving a patient mismatch, check that the monitor settings (for example, patient category, alarm limits) are correct for the patient.

Patient Mismatch - If One Set of Patient Data is Correct

- If there is a mismatch between an Information Center and a monitor, choose the data set you want to continue using for this patient, either:

  Continue Central: to continue with the patient demographics from the Information Center, discharge the patient in the monitor, and use the default monitor profile.

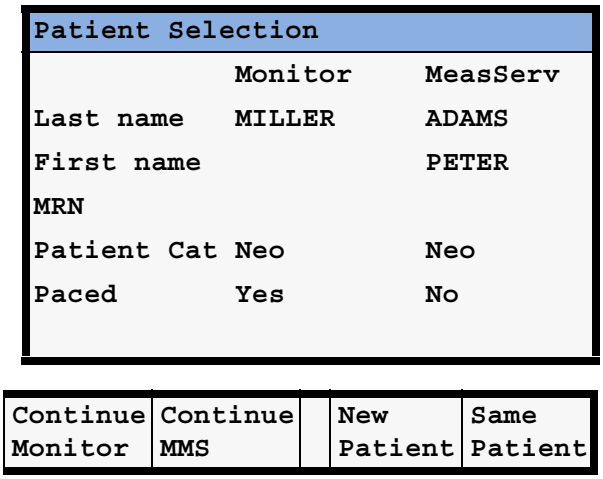
  Continue Monitor: to continue with the patient in the monitor and discharge the patient in the Information Center, permanently deleting all data in the Information Center.



- If there is a mismatch between a monitor and a measurement server, choose the data set you want to continue using for this patient, either:

  Continue Monitor: to continue with the patient demographics, trend data, and settings in the monitor. This discharges the patient in the measurement server, and resets all MMS settings to the defaults currently active for the monitor.

  Continue MMS: to upload the data - patient demographics, trend data (if configured), and measurement settings (if configured) - stored in the MMS to the monitor. This clears all data in the monitor, resets the monitor to the default Profile, and discharges the patient in the monitor.



Patient Mismatch - If Neither Patient Data Set is Correct

A patient mismatch where neither set of patient data is correct might occur if you connect a new MMS to a monitor in order to prepare for a new patient, before you actually start measuring.

- Select **`New Patient`** if you are sure that none of the information is correct. This discharges all patients, erases all data in both the monitor and MMS, resets all settings to the default Profile, and lets you admit a new patient.

Patient Mismatch - If Both Patient Data Sets Are Correct

A patient mismatch where both sets of patient data are correct might occur if you admit a new patient at the monitor (or Information Center) before the patient arrives at your unit and then connect the MMS that was used during the patient transport to the monitor.

♦ Select **`Same Patient`** if the patient information is different, but you are sure it is the same patient. This merges the demographics and updates them in the Information Center, monitor, and MMS, according to this table. Be aware that your monitor may be configured to merge trend data from the MMS and the monitor, and to upload measurement settings from the MMS to the monitor.

Patient Information	This information is taken from...
Patient name	the monitor, if the patient was admitted there. For centrally-admitted patients, this information is taken from the Information Center.
MRN	
Screen Notes	
Patient Category	the Multi-Measurement Server.
Date of Birth	
Height	
Weight	
Gender	
Paced Status	Paced status is always set to Yes where there is a conflict in patient information.
Trend data	if there is newer trend data stored in the MMS, it is uploaded to the monitor.

Automatically Resolving Patient Mismatch

Your monitor can be configured to automatically resolve mismatches in one of two ways.

- continue using the patient in the MMS, and delete the old data in the monitor. This is suitable for transport monitors.
- continue with the patient in the monitor, and delete the data in the MMS.

Care Groups

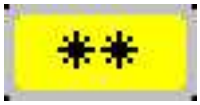
If your monitor is connected to an Information Center, you can group up to 12 bedside monitors in one Care Group. This lets you:

- view information on the monitor screen from another bed in the same or in a different Care Group.
- be notified of yellow or red alarm conditions at the other beds in the Care Group.
- see the alarm status of all the beds in the Care Group on each monitor screen.

Monitors must be assigned to Care Groups at the Information Center. See the Information Center documentation for instructions.

Understanding Care Group Symbols

The Care Group monitors' status is shown in symbol form in the Care Group overview bar.

Care Group Symbols	
	The highest priority alarm at this monitor is an INOP condition
	The highest priority alarm at this monitor is a yellow alarm
	The highest priority alarm at this monitor is a red alarm
	The alarms at this monitor are suspended
	No data is available from the chosen monitor
	The alarms are on but there are no currently active alarms at this monitor
	The monitor is in standby mode
	The monitor is in Demonstration Mode
	This is the currently displayed monitor
	This is a telemetry bed
	This bed is on a wireless network

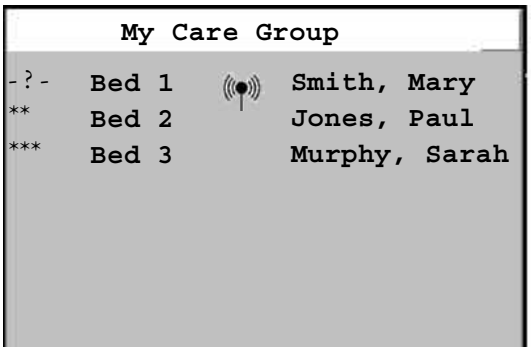
Viewing the Care Group Overview Bar

In the overview bar, flashing symbols indicate active alarms, symbols that are not flashing indicate alarms that have been acknowledged. The bed label and patient name for any Care Group beds in alarm condition rotate on the right. Selecting a bed symbol calls up the **Other Patient** window for that bed.

If the Care Group overview bar is not visible on your monitor, select a Screen which has been configured to show the bar.

Viewing the My Care Group Window

This window shows the alarm status, bed name, and patient name for every bed in the Care Group.



To enter the **My Care Group** window,

- select the **Other Patients** SmartKey, if configured, or
- in the **Main Setup** menu, select **My Care Group**.

Use the My Care Group pop-up keys to navigate through the Care Groups:

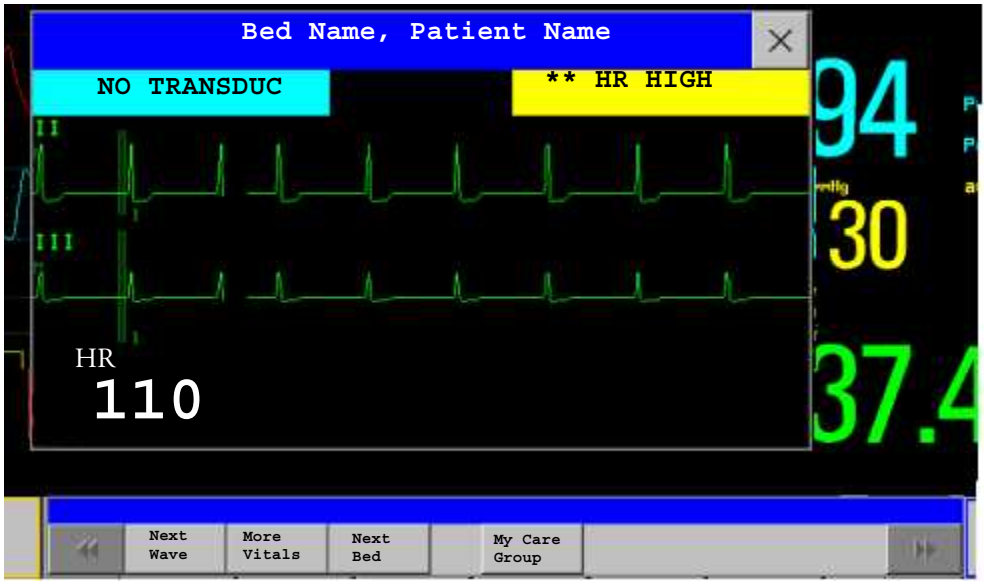
My Unit lets you view a list of all the Information Centers in your Care Unit. Select an Information Center to see a list of the monitors connected to it. Select any monitor to see the Other Patient window for that bed.

Other Units lets you view a list of all the Care Units in your Care Domain. Select any Care Unit to view a list of the Information Centers connected to it. Select an Information Center to see a list of the monitors connected to it. Select any monitor to see the Other Patient window for that bed.

Viewing the Other Patient Window

This window shows a subset of the waveform and numeric information from a selected monitor.

- To open the window, select the patient name or bed label in the **My Care Group** window, or select the bed symbol in the Care Group overview bar. You can also use the My Care Group pop-up keys.



Use the pop-up keys to navigate through the Care Group:

Next Wave lets you view waveforms not currently shown in the other bed window.

More Vitals lets you view more numerics not currently shown in the other bed window.

Next Bed lets you view waveforms and numerics from the next available bed.

My Care Group lets you call up the Care Group window.

Using Care Group Alarms

If automatic alarm notification is enabled at the beside monitor and at the Information Center, alarm conditions in the Care Group will be indicated at all the monitors in the Care Group. In Configuration Mode, you can choose whether the Other Patient window or the My Care Group window should pop up as notification, or you can switch notification off permanently. The prompt **Care Group alarm** also appears, announced by an audible tone.

In Monitoring Mode you can temporarily enable or disable automatic alarm notification at the bedside monitor, for example if you want to carry out a procedure:

1 Select the network symbol on the monitor screen to call up the Network menu.

2 Select **Auto Window** to toggle between the settings **Enabled** and **Disabled**.

This setting resets to the default at discharge and when the monitor is switched on. Always re-enable the Auto Window as soon as possible.

6

ECG, Arrhythmia, and ST Monitoring

The electrocardiogram (ECG) measures the electrical activity of the heart and displays it on the monitor as a waveform and a numeric. This section also tells you about arrhythmia monitoring (see page 91) and ST monitoring (see page 101).

Placing ECG Electrodes

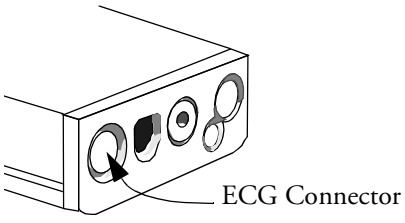
1 Prepare the patient's skin. Good electrode-to-skin contact is important for a good ECG signal, as the skin is a poor conductor of electricity.
   – shave hair from sites, if necessary
   – wash sites thoroughly with soap and water. We do not recommend using ether or pure alcohol, because this dries the skin and increases the resistance.
   – dry skin thoroughly by rubbing briskly to increase capillary blood flow in the tissues and remove dead skin cells and oil.

2 Attach the clips or snaps to the electrodes before placing them. If you are not using pre-gelled electrodes, apply electrode gel to the electrodes before placement.

3 Place the electrodes on the patient according to the lead placement you have chosen.

CAUTION To protect the monitor from damage during defibrillation, for accurate ECG information and to protect protection against noise and other interference, use only ECG electrodes and cables specified by Philips.

Connecting ECG Cables



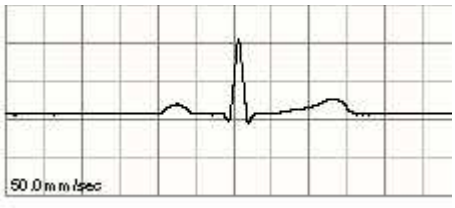
1 Attach the electrode cable to the patient cable.

2 Plug the patient cable into the white ECG connector on the measurement server. An ECG waveform and numeric appears on the monitor display.

Selecting the Primary and Secondary ECG Leads

The monitor uses the primary and secondary lead to compute HR and to analyze and detect cardiac arrhythmias. They are also available for recordings and for display on the Information Center.

The secondary lead setting is used only if your monitor is configured for multi-lead (instead of single-lead) arrhythmia analysis. It determines which additional lead will be used for arrhythmia analysis.



You should choose a lead as primary or secondary lead that has the following characteristics:

- the QRS should be either completely above or below the baseline and it should not be biphasic
- the QRS should be tall and narrow
- the P-waves and T-waves should be less than 0.2 mV

To select a lead as primary or secondary lead:

♦ In the **Setup ECG** menu, select **Primary Lead** or **Secondary Lead**, then select the appropriate lead. You can assign any available lead whether it is currently displayed or not.

Checking Paced Status

It is important to set the paced status correctly when you start monitoring ECG.

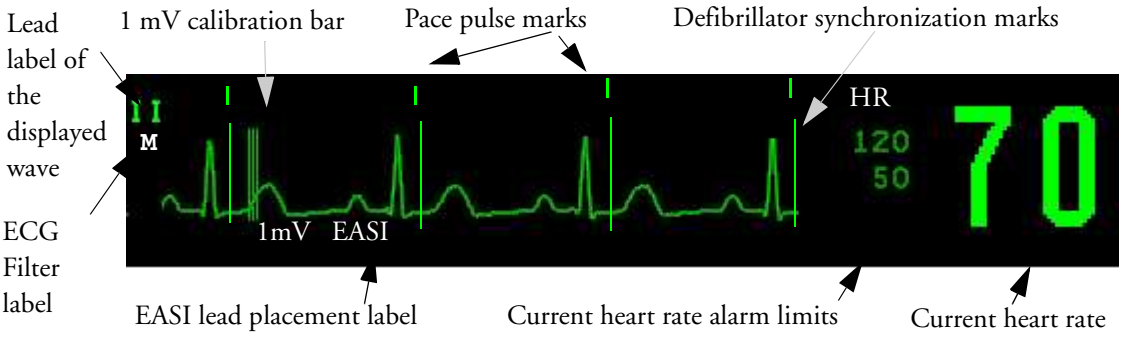
♦ To change the paced status in the **Setup ECG** menu, select **Paced**, then select **Yes** or **No**.

WARNING Pace pulse rejection must be switched on for paced patients by setting "Paced" to Yes. Switching pace pulse rejection off for paced patients may result in pace pulses being counted as regular QRS complexes, which could prevent an asystole alarm from being detected.

Some pace pulses can be difficult to reject. When this happens, the pulses are counted as a QRS complex, and could result in an incorrect HR and failure to detect cardiac arrest or some arrhythmias. Keep pacemaker patients under close observation.

Understanding the ECG Display

Your display may be configured to look slightly different.



ECG numeric: This is derived from the monitored ECG.

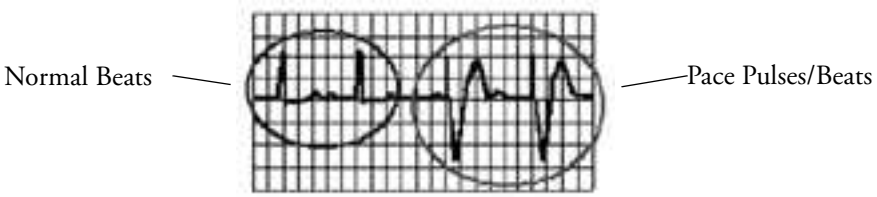
Pace pulse markers: These are shown if the **Paced** status has been set to **Yes** and the patient has a paced signal.

Defibrillator synchronization marks: If an HP/Agilent/Philips defibrillator is connected, the synchronization marks (vertical lines on the ECG wave) are shown on the ECG wave.

ST numerics in ECG wave: ST numerics can be configured to show underneath the ECG wave on the bottom left.

Monitoring Paced Patients

An ECG optimized for monitoring a paced patient should look like this:



You should choose a lead as primary or secondary lead that has these characteristics:

- the normal QRS should be either completely above or below the baseline and it should not be biphasic. For paced patients, the QRS complexes should be at least twice the height of pace pulses.
- the QRS should be tall and narrow
- the P-waves and the T-waves should be less than 0.2 mV.

Setting the Paced Status (Pace Pulse Rejection)

♦ In the **Setup ECG** menu, select **Paced** to toggle between **Yes** and **No**.

You can also change the paced status in the Patient Demographics window.

When **Paced** is set to **Yes**:

– Pace Pulse Rejection is switched on. This means that pacemaker pulses are not counted as extra QRS complexes.

– pace pulse marks are shown on the ECG wave as a small dash

– the paced symbol is displayed on the main screen.

When **Paced** is set to **No**, pacer spikes are not shown in the ECG wave.

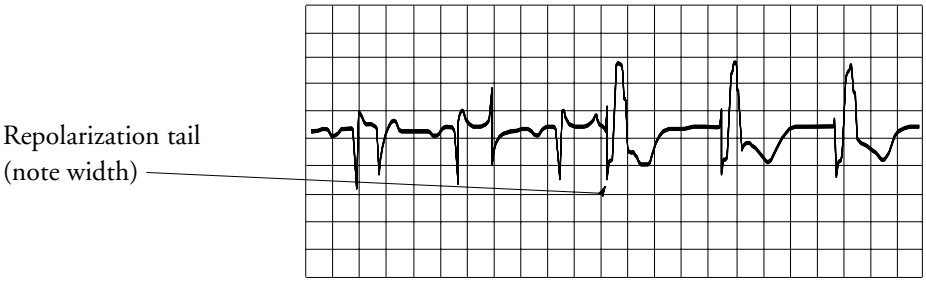
Paced

Non-Paced

Avoiding Pace Pulse Repolarization Tails

Some unipolar pacemakers display pace pulses with repolarization tails. These tails may be counted as QRSs in the event of cardiac arrest or other arrhythmias.

If you note a visible repolarization tail, choose a lead that decreases the size of the repolarization tail.



Changing the Size of the ECG Wave

If any of the displayed ECG waves is too small or clipped, you can change the size of one or all of the ECG waves on the screen.

Changing the adjustment factor only changes the visual appearance of the ECG wave on the screen. It does not affect the ECG signal analyzed by the monitor.

Comparing the wave size to the 1 mV calibration bar on the ECG wave segment can help you to get an idea of the true ECG signal strength. If you choose a fixed adjustment factor, the 1 mV calibration bar will be the same size for all the displayed ECG waves. If you choose AutoSize, the calibration bar may be a different size for each wave.

To Change the Size of an Individual ECG Wave

1 Select the wave segment you want to change. This calls up the lead menu for this segment.

2 In the lead menu, select **Size Up** to increase wave size or **Size Down** to decrease the size.

Selecting **AutoSize** lets the monitor choose the optimal adjustment factor for all displayed ECG waves.

To Change the Size of all the ECG Waves

To change the size of all the ECG waves on the screen by a fixed adjustment factor,

1 In the **Setup ECG** Lead menu, select **Adjust Size**.

2 Select the required adjustment factor from the line of pop-up keys.

- **Size x0.5** to halve the wave size
- **Size x1** to display the wave without zoom
- **Size x2** to double the wave size
- **Size x4:** to multiply the wave size by four
- **Previous Size**: to return one step to the previous size
- **Auto Size**: to let the monitor choose the optimal adjustment factor for all the ECG waves.

Changing the Volume of the QRS Tone

The QRS tone is derived from either the HR or Pulse, depending on which is currently selected as the alarm source. The QRS volume can be set from 0 to 10 (0 means off).

♦ To change the QRS volume, in the **Setup ECG** menu select **QRS Volume** and then select the appropriate volume from the pop-up list.

Changing the ECG Filter Settings

The ECG filter setting defines how ECG waves are smoothed. A letter indicating the filter type is shown underneath the lead label on the monitor display. Filter settings do not affect ST measurement. 12-Lead ECG captures are analyzed in the PIC using the diagnostic filter and displayed on the Information Center using the filter setting from the bedside monitor. Any changes you make to the filter setting at the bedside monitor may take up to a minute to be reflected at a connected Information Center. For this reason, you should wait one minute between changing the filter setting and sending a 12-lead capture to an Information Center.

♦ To change the filter setting, in the **Setup ECG** menu, select **Filter** and then select the appropriate setting.

- **Monitor**: Use under normal measurement conditions.
- **Filter**: The filter reduces interference to the signal. It should be used if the signal is distorted by high frequency or low frequency interference. High frequency interference usually results in large amplitude spikes making the ECG signal look irregular. Low frequency interference usually leads to a wandering or rough baseline. In the operating room, the Filter reduces artifacts and interference from electrosurgical units. Under normal measurement conditions, selecting **Filter** may suppress the QRS complexes too much and thus interfere with ECG analysis.

  If **AutoFilter** is set to **On** in Configuration Mode, the filter setting will automatically be set to **Filter** if electromagnetic interference is detected.
- **Diag** (Diagnostic): Use when diagnostic quality is required. The unfiltered ECG wave is displayed so that changes such as R-wave notching or discrete elevation or depression of the ST segments are visible.

  The setting **Diag** selects the highest available ECG bandwidth which is 0.05 to 150 Hz for the Adult and 0.5 to 150 Hz for the Pedi and Neo patient category. The term “diagnostic” relates

only to the ECG bandwidth requirements for diagnostic electrocardiographic devices as outlined in the ANSI/AAMI standard EC11-1991.

Choosing EASI or Standard Lead Placement

If EASI™ monitoring is available on your monitor, you must enable either standard lead placement or EASI lead placement.

- In the **Setup ECG** menu, select **Lead Placement** and then **Standard** or **EASI**.

EASI is shown beside the 1mV calibration bar on the ECG wave on the display, and **EASI** is marked on any recorder strips and printouts.

See the section on EASI ECG Lead Placement for electrode placement diagrams.

About ECG Leads

To make it possible to compare measured ECG signals, the electrodes (or lead sets) are placed in standardized positions, forming so-called "leads." To obtain ECG signals optimized for use in diagnosis and patient management in different care environments, different lead sets in varying lead placements can be used. You can use either standard lead placements or EASI lead placements with this monitor.

When placing electrodes, choose a flat, non-muscular site where the signal will not be interfered with by either movement or bones. Correct lead placement is always important for accurate diagnosis. Especially in the precordial leads, which are close to the heart, QRS morphology can be greatly altered if an electrode is moved away from its correct location.

ECG Leads Monitored

If you are using	these leads are available:	Resp is measured between electrodes:
a 3-electrode set	I, II, III	RA and LL
a 5-electrode set	I, II, III, aVR, aVL, aVF, V and MCL	RA and LL
a 10-electrode set	I, II, III, aVR, aVL, aVF, V1, V2, V3, V4, V5, V6	RA and LL
an EASI 5-electrode set	I, II, III, aVR, aVL, aVF, V1, V2, V3, V4, V5, V6	I and A

Changing Lead Sets

To change the ECG lead set,

1 Remove the electrodes and then replace them as required.

2 If the new lead set has more leads than the previous, the monitor automatically recognizes the new lead placement. If the new lead set has fewer leads, then you must select **New Lead Setup** in the **Setup ECG** menu. If you remove electrodes without selecting **New Lead Setup**, the monitor may issue a Leads Off INOP message.

ECG Lead Fallback

If fallback is configured on and there is a leads off INOP in the primary lead (and in the secondary lead, if you are using multi-lead monitoring) for longer than 10 seconds, and if another lead is available, this available lead automatically becomes the primary lead. This is known as lead fallback. When the Leads Off condition is corrected, the leads are automatically switched back.

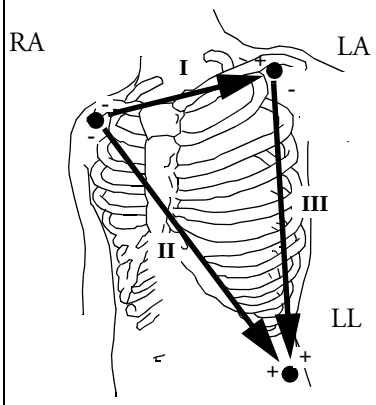
Lead fallback can be switched on and off in the monitor's Configuration Mode.

ECG Lead Placements

The labels and colors of the ECG electrodes differ according to the standards that apply for your hospital. The electrode placement illustrations in this chapter use the AAMI labels and colors.

Electrode labels			Electrode colors	
AAMI	**EASI**	**IEC**	**AAMI**	**IEC**
RA	I	R	White	Red
LA	S	L	Black	Yellow
LL	A	F	Red	Green
RL	N	N	Green	Black
V	E	C	Brown	White
V1		C1	Brown/Red	White/Red
V2		C2	Brown/Yellow	White/Yellow
V3		C3	Brown/Green	White/Green
V4		C4	Brown/Blue	White/Brown
V5		C5	Brown/Orange	White/Black
V6		C6	Brown/Violet	White/Violet

Standard 3-Lead Placement

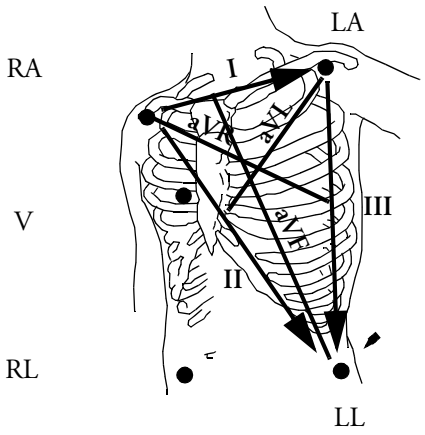


RA placement: directly below the clavicle and near the right shoulder

LA placement: directly below the clavicle and near the left shoulder

LL placement: on the left lower abdomen

Standard 5-Lead Placement



RA placement: directly below the clavicle and near the right shoulder

LA placement: directly below the clavicle and near the left shoulder

RL placement: on the right lower abdomen

LL placement: on the left lower abdomen

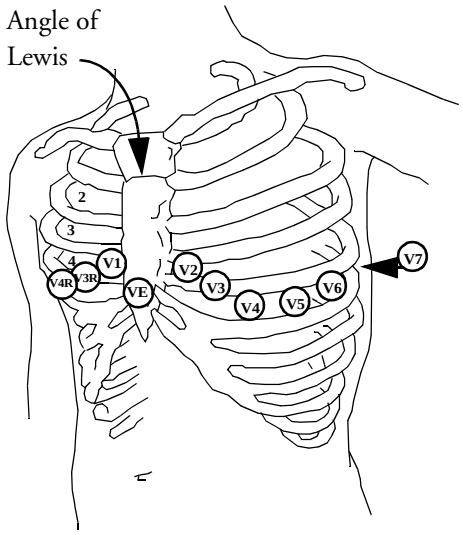
V placement: on the chest, the position depends on your required lead selection

Chest Electrode Placement

For accurate chest electrode placement and measurement, it is important to locate the fourth intercostal space.

1 Locate the second intercostal space by first palpating the Angle of Lewis (the little bony protuberance where the body of the sternum joins the manubrium). This rise in the sternum is where the second rib is attached, and the space just below this is the second intercostal space.

2 Palpate and count down the chest until you locate the fourth intercostal space.



V1 placement: on the fourth intercostal space at the right sternal border

V2 placement: on the fourth intercostal space at the left sternal border

V3 placement: midway between the V2 and V4 electrode positions

V4 placement: on the fifth intercostal space at the left midclavicular line

V5 placement: on the left anterior axillary line, horizontal with the V4 electrode position

V6 placement: on the left midaxillary line, horizontal with the V4 electrode position

V3R to V6R placement: on the right side of the chest in positions corresponding to those on the left

VE placement: over the xiphoid process

V7 placement: on posterior chest at the left posterior axillary line in the fifth intercostal space

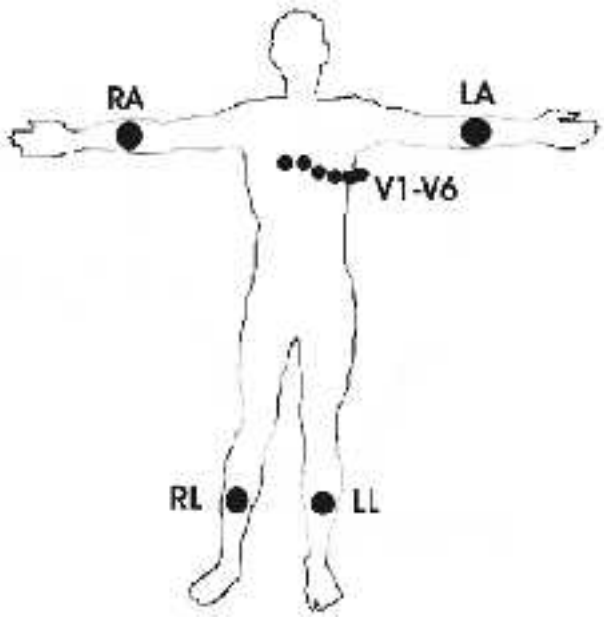
V7R placement: on posterior chest at the right posterior axillary line in the fifth intercostal space

10-Lead Placement

When monitoring 12-leads of ECG, using a 10-Electrode Lead Placement, it is important to correctly place electrodes and to label all 12-lead ECG reports with the correct lead placement.

Conventional 12-Lead ECG

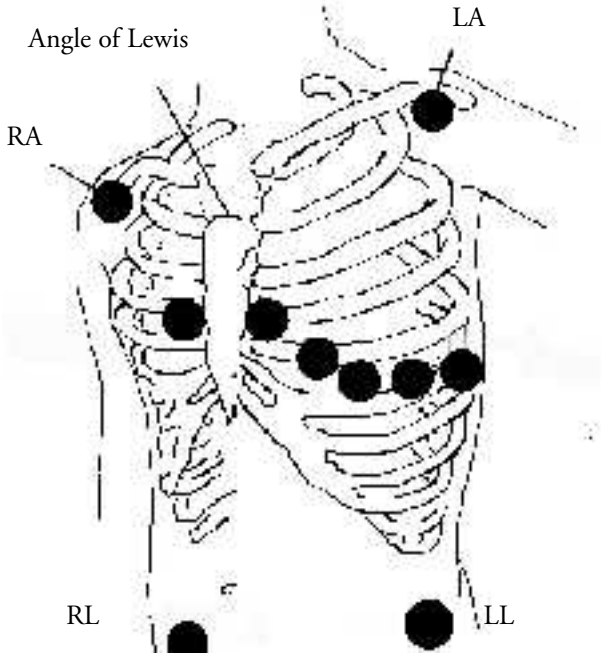
In conventional 12-Lead ECG using 10 electrodes, an electrode is placed on the right arm, left arm, right leg, and left leg. Six V- electrodes are placed on the chest. The right leg electrode is the reference electrode.



Modified 12-Lead ECG

If your institution uses modified 10 Lead ECG electrode placement (the Mason-Likar Lead System), place the four limb electrodes close to the shoulders and lower abdomen.

The six V electrodes are placed on the chest in the same position as the conventional 12-lead placement.



Choosing Standard or Modified Electrode Placement

If your institution uses modified 10 Lead ECG electrode placement (the Mason-Likar Lead System), you must switch **Mod. Lead Placment** to **On** in the monitor. To do this,

- in the **Setup ECG** menu, select **Mod. LeadPlacement** to toggle between **On** and **Off**.
  - When **Mod. Lead Placment** is set to **On**, 12 Lead ECG Reports will be labelled **12 Lead ECG Report (Mason-Likar)**, and captured 12-lead ECGs will be labelled **Mason-Likar** to the right of the bandwidth annotation at the Information Center.
  - When **Mod. LeadPlacment** is set to **Off**, 12 Lead ECG Reports will be labelled **12 Lead ECG Report**, and captured 12-lead ECGs will not be annotated at the Information Center.

WARNING Do not use ECG analysis interpretation statements and measurements for 12-lead ECGs obtained using the modified (Mason-Likar) limb electrode placement.This may lead to misdiagnosis since the modified (Mason-Likar) limb electrode placement does not look the same as the conventional 12-lead ECG and may mask inferior infarction due to calculated axis, R, P and T wave magnitudes shifts and ST slope.

Do not export 12-lead ECGs obtained using the modified (Mason-Likar) limb electrode placement. Captured 12-Lead ECGs using the modified (Mason-Likar) limb electrode placement exported from the Information Center are not annotated with the Mason-Likar label.

Labelling 12-Lead ECG Reports

To label 12-lead ECG monitor reports and Captured 12-lead ECGs reports:

- In the **Setup ECG** menu, select **Mod. LeadPlacement** to toggle between **On** and **Off**.

When **Mod LeadPlacement** is set to **On**:

- 12 Lead ECG Reports will be labelled **12 Lead ECG Report (Mason-Likar)**.
- Captured 12-lead ECGs will be labelled Mason-Likar to the right of the bandwidth annotation at the Information Center.

When **Mod. LeadPlacement** is set to **Off**,

- 12 Lead ECG Reports will be labelled **12 Lead ECG Report**.
- Captured 12-lead ECGs will have no annotation next to the bandwidth annotation at the Information Center.

Capture 12-Lead

If the monitor is connected to an Information Center, the **Capture 12-Lead** SmartKey may be configured to show on the screen. Selecting this exports 12-Lead ECG information to the Information Center for analysis. For details see the Instructions for Use supplied with the Information Center.

EASI ECG Lead Placement

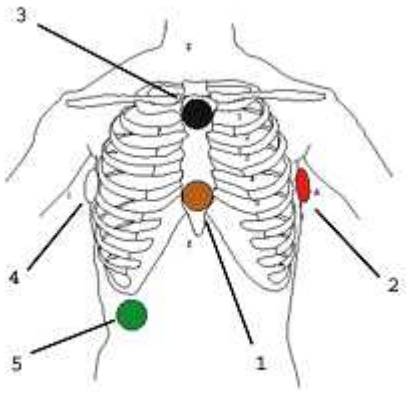
Using a standard 5-electrode set in EASI lead placement you can monitor up to 12 standard ECG leads simultaneously and continuously at the bedside. EASI-derived 12-lead ECGs and their measurements are approximations to conventional 12-lead ECGs. As the 12-lead ECG derived with EASI is not exactly identical to the 12-lead conventional ECG obtained from a electrocardiograph, it should not be used for diagnostic interpretations.

Respiratory monitoring is also possible with the EASI placement; respiration is measured between the I and A electrodes.

Place the electrodes as accurately as possible to obtain the best quality EASI measurements.

When EASI lead placement is selected, **EASI** is shown beside the 1mV calibration bar on the ECG wave on the display, and **EASI** is marked on any recorder strips and printouts.

EASI Monitoring During INOP Conditions If one of the derived EASI leads has an INOP condition (for example, **LEADS OFF**), a flat line is displayed. After 10 seconds, the directly acquired EASI AI, AS, or ES lead (depending on which is available) is displayed with the corresponding lead label. This causes an arrhythmia relearn.



EASI Electrode Placement			
1	E (V)	Brown	on the lower sternum at the level of the fifth intercostal space
2	A (LL)	Red	on the left midaxillary line at the same level as the E electrode
3	S (LA)	Black	on the upper sternum
4	I (RA)	White	on the right midaxillary line at the same level as the E electrode
5	N	Green	reference electrode - can be anywhere, usually below the sixth rib on the right hip

ECG, Arrhythmia, and ST Alarm Overview

The ECG, arrhythmia, and ST alarms available depend on which measurements are switched on, and the arrhythmia option enabled for your monitor.

- Cardiotach alarms are available when HR is on and the active alarm source is ECG
- Basic arrhythmia alarms are available when Arrhythmia is switched on
- Advanced arrhythmia alarms are available when Arrhythmia is switched on and the Advanced Arrhythmia option has been enabled for your monitor
- ST alarms are available when ST analysis is switched on and ST leads are selected for analysis.

Cardiotach Alarms	Alarms with Basic Arrhythmia Option	Alarms with Enhanced Arrhythmia Option	ST Alarms
***Asystole ***Ventricular Fibrillation/Tachycardia ***Extreme Bradycardia ***Extreme Tachycardia **High heart rate **Low heart rate	***Ventricular Tachycardia **Pacer Not Capture **Pacer Not Pacing **Frequent PVCs (PVC > limit/min)	**Supraventricular Tach **Missed Beat **Pause **Irregular HR **Ventricular Rhythm **Run PVCs High **Pair PVCs **R-on-T PVCs **Ventricular bigeminy **Ventricular trigeminy **Nonsustained V-Tach **Multiform PVCs	**ST <Lead> High **ST <Lead> Low

Using ECG Alarms

ECG alarms can be switched on and off and the high and low alarm limits changed just like other measurement alarms, as described in the Alarms section. Special alarm features which apply only to ECG are described here.

Extreme Alarm Limits

The extreme rate alarms, Extreme Tachy and Extreme Brady, generated by the active alarm source, either HR or Pulse, are set in Configuration Mode by adding a set value to the high and low alarm limits. You need to know what value has been configured for your monitor. Changing the high and low alarm limits automatically changes the extreme alarm limits within the allowed range.

♦ To see the extreme rate alarms set for your monitor, in the **`Setup ECG`** menu, see the menu items Δ**`ExtrTachy`** and Δ**`ExtrBrady`**.

ECG Alarms Off Disabled

Be aware that your hospital department may have decided to disable the setting ECG Alarms Off in the monitor's Configuration Mode. In this case, HR alarms cannot be switched off in Monitoring Mode. If you try to switch off the HR alarms, you will see the message **`To activate enter Config and enable Alarms Off`**.

HR Alarms When Arrhythmia Analysis is Switched Off

When arrhythmia analysis is switched off, only these HR-related alarms will be detected:

- the asystole alarm
- the ventricular fibrillation/ventricular tachycardia alarm
- the extreme tachycardia/extreme bradycardia alarms
- the high heart rate/low heart rate alarms.

HR Alarms When Arrhythmia Analysis is Switched On

WARNING When arrhythmia analysis is on, all yellow alarms connected with ECG are short (one-star). This means that the yellow alarm lamp and the tones are active for a configured number of seconds only, after which the flashing numeric and the alarm message remain for up to three minutes. Red alarms behave as usual.

ECG Safety Information

CAUTION Interference from instruments near the patient and ESU interference can cause problems with the ECG wave. See the monitor specifications for more information.

WARNING **Defibrillation and Electrosurgery:** Do not touch the patient, or table, or instruments, during defibrillation.
After defibrillation, the screen display recovers within 10 seconds if the correct electrodes are used and applied in accordance with the manufacturers instructions.
When using electrosurgical (ES) equipment, never place ECG electrodes near to the grounding plate of the ES device, as this can cause a lot of interference on the ECG signal.

General: When you are connecting the electrodes or the patient cable, make sure that the connectors never come into contact with other conductive parts, or with earth. In particular, make sure that all of the ECG electrodes are attached to the patient, to prevent them from contacting conductive parts or earth.

During surgery: Use the appropriate orange electrode ECG safety cable for measuring ECG in the operating room. These cables have extra circuitry to protect the patient from burns during cautery, and they decrease electrical interference. These cables cannot be used for measuring respiration.

Pacemaker failure: During complete heart block or pacemaker failure to pace/capture, tall P-waves (greater than 1/5 of the average R-wave height) may be erroneously counted by the monitor, resulting in missed detection of cardiac arrest.

Patients exhibiting intrinsic rhythm: When monitoring paced patients who exhibit only intrinsic rhythm, the monitor may erroneously count pace pulses as QRS complexes when the algorithm first encounters them, resulting in missed detection of cardiac arrest.
The risk of missing cardiac arrest may be reduced by monitoring these patients with low heart rate limit at or slightly above the basic/demand pacemaker rate. A low heart rate alarm alerts you when the patient's heart rate drops to a level where pacing is needed. Proper detection and classification of the paced rhythm can then be determined.

Filtered ECG signal from external instruments: Instruments such as defibrillators or telemetry units produce a filtered ECG signal. When this signal is used as an input to the bedside monitor, it is filtered again. If this twice-filtered signal is passed to the arrhythmia algorithm, it may cause the algorithm to fail to detect pace pulses, pacemaker non-capture, or asystole, thus compromising paced patient monitoring performance.

External pacing electrodes: When a pacemaker with external pacing electrodes is being used on a patient, arrhythmia monitoring is severely compromised due to the high energy level in the pacer pulse. This may result in the arrhythmia algorithm's failure to detect pacemaker noncapture or asystole.

Fusion beat pacemakers: Pacemakers that create fusion beats (pace pulse on top of the QRS complex) cannot be detected by the monitor's QRS detector.

Rate adaptive pacemakers: Implanted pacemakers which can adapt to the Minute Volume may occasionally react on the Impedance measurement used by patient monitors for the determination of the Resp value and execute pacing with the maximum programmed rate. Switching off the Resp measurement can prevent this.

About Arrhythmia Monitoring

Arrhythmia analysis provides information on your patient's condition, including heart rate, PVC rate, rhythm, and ectopics. The monitor uses the user-selected primary and secondary ECG leads for single-lead or multi-lead arrhythmia analysis. During arrhythmia analysis, the monitor continuously

- optimizes ECG signal quality. This is important for arrhythmia analysis. The monitor continuously filters the ECG signal to remove baseline wander, muscle artifact, and signal irregularities. Also, if the Patient Paced status is set to Yes, pace pulses are filtered out to avoid processing them as QRS beats.
- detects beats, for example, QRS complexes, identifying them for further analysis.
- measures signal features such as R-wave height, width, and timing.
- creates beat templates, and classifies and labels beats to aid in rhythm analysis and alarm detection.
- examines the ECG signal for ventricular fibrillation, asystole, and noise.

Arrhythmia Options

Your monitor has either the basic or the enhanced arrhythmia option. Both options provide rhythm and ectopic status messages and beat labelling. The number of rhythms being classified, events being detected, and alarms generated differs according to the option. The alarms available with the different options are listed in the section "ECG, Arrhythmia, and ST Alarm Overview" on page 88, the rhythm and ectopic messages detected are listed in "Arrhythmia Status Messages" on page 94.

Where can I find more information?

See the Application Notes on ST and Arrhythmia supplied on your documentation CD-Rom for detailed information on the arrhythmia algorithm and its clinical application.

Switching Arrhythmia Analysis On and Off

1 In the **Setup Arrhythmia** menu, select **Arrhythmia** to toggle between **On** and **Off**.

2 Select the **Confirm** pop-up key which appears at the bottom of the screen.

Be aware that when arrhythmia analysis is switched off,

- the message **Arrythmia OFF** appears beside the ECG wave, if configured to do so
- only the HR-related alarms are detected (the asystole alarm, the ventricular fibrillation/ventricular tachycardia alarm, the extreme tachycardia/extreme bradycardia alarms, the high heart rate/ low heart rate alarms)
- HR High and HR Low alarms behave like normal yellow alarms, no timeout periods are active.

Choosing an ECG Lead for Arrhythmia Monitoring

It is important to select a suitable lead for arrhythmia monitoring.

Guidelines for non-paced patients are:

- QRS should be tall and narrow (recommended amplitude > 0.5 mV)
- R-Wave should be above or below the baseline (but not bi-phasic)
- T-wave should be smaller than 1/3 R-wave height
- the P-wave should be smaller than 1/5 R-wave height.

For paced patients, in addition to the above, the pace pulse should be:

- not wider than the normal QRS
- the QRS complexes should be at least twice the height of pace pulses
- large enough to be detected, with no re-polarization.

To prevent detection of P-waves or baseline noises as QRS complexes, the minimum detection level for QRS complexes is set at 0.15 mV, according to AAMI-EC 13 specifications. Adjusting the ECG wave size on the monitor display (gain adjustment) does not affect the ECG signal which is used for arrhythmia analysis. If the ECG signal is too small, you may get false alarms for pause or asystole.

Aberrantly-Conducted Beats

As P-waves are not analyzed, it is difficult and sometimes impossible for the monitor to distinguish between an aberrantly-conducted supraventricular beat and a ventricular beat. If the aberrant beat resembles a ventricular beat, it is classified as ventricular. You should always select a lead where the aberrantly-conducted beats have an R-wave that is as narrow as possible to minimize incorrect calls. Ventricular beats should look different from these 'normal beats'. Instead of trying to select two leads with a narrow R-wave, it may be easier to just select one lead and use single lead arrhythmia monitoring. Extra vigilance is required by the clinician for this type of patient.

Atrial Fibrillation and Flutter

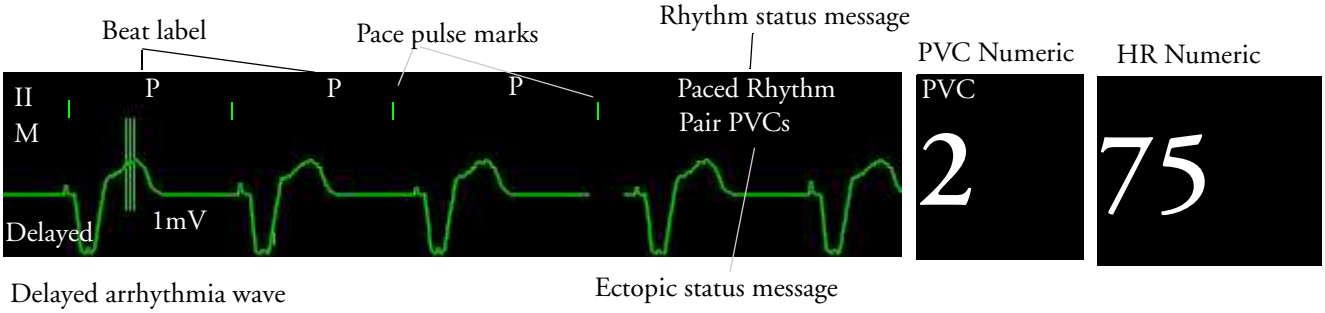
Since P-waves are not analyzed, it is not possible to discriminate atrial rhythms. If there is constant variance in the R-R interval, the rhythm is classified as Irregular. It is extremely important for accurate analysis of the rhythm to have p-waves with an amplitude of less than 1/5 the height of the R-wave or < 0.15 mV. If the p-waves are larger than this, they may be counted as QRS complexes.

Intermittent Bundle Branch Block

Bundle branch and the other fascicular blocks create a challenge for the arrhythmia algorithm. If the QRS during the block changes considerably from the learned normal, the blocked beat may be incorrectly classified as ventricular, causing false PVC alarms. You should always select a lead where the bundle branch block beats have an R-wave that is as narrow as possible to minimize incorrect calls. Ventricular beats should look different from these 'normal beats'. Instead of trying to select two leads with a narrow R-wave, it may be easier to just select one lead and use single lead arrhythmia monitoring. Extra vigilance is required by the clinician for this type of patient.

Understanding the Arrhythmia Display

Your monitor screen may look slightly different from the illustration.



Viewing Arrhythmia Waves

- To review arrhythmia beat labels, in the **Setup Arrhythmia** menu, select **Annotate Arrhy**.

  The wave showing the primary ECG lead will be delayed by six seconds and shown on a grey background. Beat labels will be annotated above the ECG wave and **Delayed** will be written beside it.

- To return to the normal ECG primary lead display, select **Annotate Arrhy** again.

Arrhythmia Beat Labels

Arrhythmia beat labels tell you how the monitor is classifying beats.

N = Normal
V = Ventricular Ectopic
S = Supra-ventricular Premature
P = Paced
' = Pacer spike
L = Learning patient's ECG
A = Artifact (noisy episode)
? = Insufficient information to classify beats
I = Inoperative condition (e.g., LEADS OFF)
M = Pause or missed beat

Arrhythmia Status Messages

The monitor displays two types of status messages:

- Rhythm Status Messages -- to indicate the patient's rhythm.
- Ectopic Status Messages -- to indicate the presence of ectopic beats.

These status messages are shown on the right hand side of the primary ECG wave. They are updated every second, with the exception of the Sinus and Supraventricular (SV) rhythm messages.

The Sinus and SV rhythm messages are updated based on the current heart rate, taking into account the patient category (adult, pediatric, or neonatal). For the message to change from one rhythm status to another, the HR must be in the new range for five beats.

If you have basic arrhythmia capability, you will get only messages for the alarms provided with this level.

Rhythm Status Messages

The label B or E indicates basic (B) or enhanced (E) arrhythmia capability.

Rhythm Status Message	Description	B or E
ASYSTOLE	No QRS for 4 consecutive seconds in absence of vent fib or chaotic signal	B, E
VENT FIB/TACH	A fibrillatory wave for 4 consecutive seconds	B, E
V-TACH	A dominant rhythm of adjacent Vs and a HR > the V-Tach Heart Rate Limit	B, E
SUST V-TACH	Ventricular tachycardia rhythm for more than 15 seconds	E
VENT RHYTHM	A dominant rhythm of adjacent PVCs and a HR ≤ the V-Tach HR Limit	E
VENT BIGEMINY	A dominant rhythm of N, V, N, V	E
VENT TRIGEMINY	A dominant rhythm of N, N, V, N, N, V	E
PACED RHYTHM	A dominant rhythm of paced beats	B, E
IRREGULAR HR	Consistently irregular rhythm	E
SINUS BRADY **SINUS RHYTHM** **SINUS TACHY**	A dominant rhythm of SV beats preceded by P-waves	B, E
SV BRADY **SV RHYTHM** **SV TACHY**	A dominant rhythm of SV beats not preceded by P-waves	B, E
UNKNOWN ECG RHYTHM	Rhythm cannot be determined	B, E
LEARNING ECG	Algorithm is learning the ECG beat morphology	B, E
LEARNING RHYTHM	Algorithm is learning the rhythm of the classified beats	B, E
CANNOT ANALYZE ECG	ECG signal is predominantly invalid and therefore cannot be analyzed	B, E

Ectopic Status Messages

The label B or E indicates basic (B) or enhanced (E) arrhythmia capability.

Ectopic Status Message	Explanation	B or E
(No message displayed)	No ectopic activity within the last minute	
RUN PVCs	More than 2 consecutive PVCs within the last minute	E
PAIR PVCs	Pair PVCs within the last minute	E
PACER NOT CAPT	Pause with pace pulse (paced patient only) within the last minute	B, E
PACER NOT PACE	Pause without pace pulse (paced patient only) within the last minute	B, E
PAUSE	No beat detected for 1.75 x average R-R interval for HR <120, or No beat for 1 second with HR >120 (non-paced patient only), or No beat detected for more than the set pause threshold.	E
R-ON-T PVCs	R-ON-T detected within the last minute	E
MULTIFORM PVCs	Multiform PVCs detected within the last minute	E
FREQUENT SVPBs	SVPB count within last minute is greater than 5	E
SVPBs	1-5 SVPBs in the last minute with a sinus rhythm and no Vs	E
SV BEATS	SV count within last minute and rhythm status is PACED	B, E
PACED BEATS	Paced beat count within last minute and rhythm status is NOT PACED	B, E

Arrhythmia Relearning

During a learning phase:

- Alarm timeout periods are cleared
- Stored arrhythmia templates are cleared
- Asystole, Vfib, and HR alarms (when there are enough beats to compute the HR) are active. No other alarms are active.

Initiating Arrhythmia Relearning Manually

1 To initiate relearning manually, in the **Setup Arrhythmia** menu, select **Relearn Arrhy**.
   – While the monitor is learning, the delayed arrhythmia wave displays the beat label **L** and the rhythm status message **LEARNING ECG**.
   – Next, the monitor determines the dominant rhythm. The beats are labeled **N**, and the rhythm status message changes to **LEARNING RHYTHM**.

2 After relearning is complete, you should check the delayed arrhythmia wave to ensure that the algorithm is labeling the beats correctly.

3 If beats are still not classified correctly, check that the ECG is optimized for arrhythmia monitoring. You may need to select a different lead or change the electrodes or electrode positions if there is excessive noise, unstable voltage, low amplitude, or large P- or T-waves.

Automatic Arrhythmia Relearn

Arrhythmia relearning is initiated automatically whenever:

- ECG monitoring is switched on
- The ECG Lead or Lead Label is changed manually, or when fallback occurs
- A **`Leads Off`** INOP condition (that has been active for > 60 seconds) ends.

If you are monitoring multi-lead arrhythmia and there is a change in one lead only, relearning happens only in the affected lead. During this learning phase, the system will continue monitoring using the other lead. Therefore, the delayed arrhythmia wave is not labeled **`L`** and there is no **`LEARNING ECG`** rhythm status message. In addition, alarm timeout periods are maintained, stored arrhythmia templates are maintained for the operative lead, and all alarms switched on are active.

Arrhythmia Relearn and Lead Fallback

Lead fallback triggers an automatic arrhythmia relearn.

WARNING If arrhythmia learning takes place during ventricular rhythm, the ectopics may be incorrectly learned as the normal QRS complex. This may result in missed detection of subsequent events of V-Tach and V-Fib.

For this reason you should:

- take care to initiate arrhythmia relearning only during periods of predominantly normal rhythm and when the ECG signal is relatively noise-free
- be aware that arrhythmia relearning can happen automatically
- respond to any INOP messages (for example, if you are prompted to reconnect electrodes)
- be aware that a disconnected EASI electrode triggers an arrhythmia relearn on all leads
- always ensure that the arrhythmia algorithm is labeling beats correctly.

Arrhythmia Alarms

Arrhythmia alarms can be switched on and off and the high and low alarm limits changed just like other measurement alarms, as described in the Alarms section. Special alarm features which apply only to arrhythmia are described here.

The different alarms detected and generated by the monitor depend on the level of arrhythmia analysis that is enabled. For a complete list of arrhythmia alarms and INOPs, see the Alarms chapter.

The monitor detects arrhythmia alarm conditions by comparing ECG data to a set of pre-defined criteria. An alarm can be triggered by a rate exceeding a threshold (for example, HR >xx), an abnormal rhythm (for example, Ventricular Bigeminy), or an ectopic event (for example, Pair PVCs).

Yellow Arrhythmia Alarms

Yellow arrhythmia alarms are short yellow alarms specific to arrhythmia-related patient conditions. Depending on your monitor and Information Center revision, they may be shown with one or two stars.

WARNING When arrhythmia analysis is on, all yellow alarms connected with ECG are short (one-star). This means that the yellow alarm lamp and the tones are active for a configured number of seconds only, after which the blinking numeric and the alarm message remain for up to three minutes. Red alarms behave as usual.

Arrhythmia Alarms and Latching

When using arrhythmia analysis, **`Visual Latching`** and **`Audible Latching`** should be on for red alarms, or at least **`Visual Latching`** should be on. Because of the transient nature of arrhythmia alarms, many arrhythmia conditions may go unnoticed if alarm latching is off. Alarm latching settings are defined in Configuration Mode.

Switching Individual Arrhythmia Alarms On and Off

Some arrhythmia alarms can be individually switched on or off. They are:

Pacer not capture, Pacer not pace, Non-Sustain VT, Vent Rhythm, Run PVCs, Pair PVCs, R-on-T PVCs, V.Bigeminy, V.Trigeminy, Multif.PVCs, Pause, SVT, Irregular HR, Missed Beat, PVCs/min.

♦ To switch individual alarms on or off, in the **`Setup Arrhythmia`** menu, select the alarm from the list to toggle between **`On`** and **`Off`**. The monitor displays the INOP message SOME ECG ALRMS OFF.

Switching All Yellow Arrhythmia Alarms On or Off

All yellow arrhythmia alarms can be switched on and off together. To do this,

♦ In the **`Setup Arrhythmia`** menu, select **`All Yellow Off`** or **`All Yellow On`**.

Adjusting the Arrhythmia Alarm Limits

Some arrhythmia alarms have limits which can be individually adjusted. They are:

Vtach HR, Vtach Run, PVCs/min, Vent Rhythm, SVT HR, SVT Run, Asystole Thresh., Pause Threshold.

1 To adjust alarm limits, in the **`Setup Arrhythmia`** menu, select the alarm to be adjusted.

2 Select the appropriate setting from the pop-up list.

Arrhythmia Alarm Timeout Periods

Be aware that the audible and visible indications of alarms may be inhibited

- if a more serious alarm condition is active
- if a timeout period is in effect for a particular alarm
- if a timeout period is in effect for a higher alarm in that chain.

When a yellow arrhythmia alarm is generated, it triggers visible and audible indicators. It also automatically initiates a timeout, or inhibitory period. During this period, the same alarm condition will not generate another alarm. When the timeout period is over, an alarm will be generated again if the condition still persists. Timeout periods are defined for your hospital in Configuration Mode.

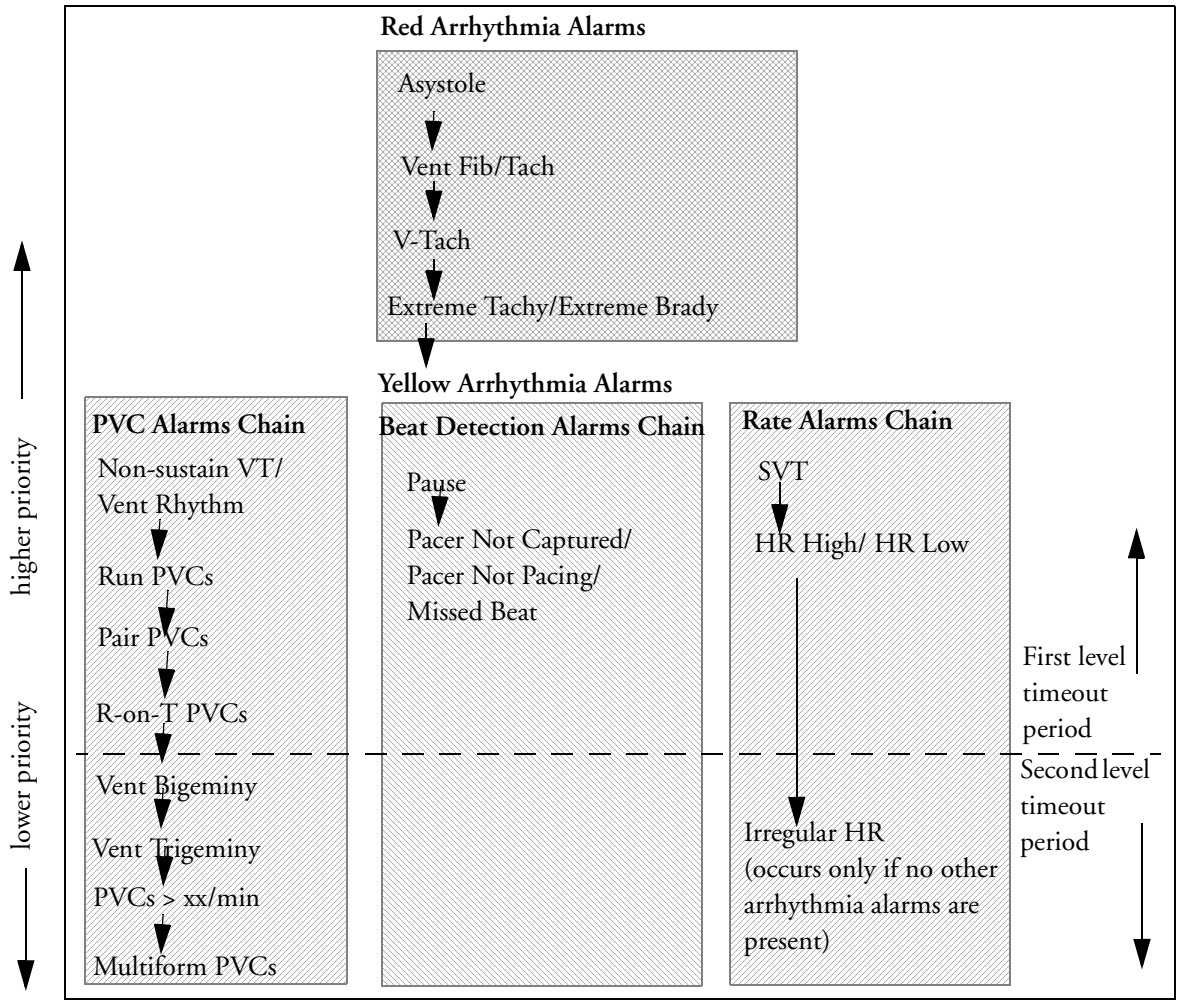
- To view the timeout period configured for your monitor, in the **Setup Arrhythmia** menu, see the menu items **TimeOut 1st** and **TimeOut 2nd**.
- To reset the timeout period, select the **Alarms Off** or **Pause Alarms** permanent key and then reselect it.

Arrhythmia Alarm Chaining

When arrhythmia analysis is switched on, multiple alarm conditions may be present. Announcing all of the detected alarm conditions would be confusing, and might hide a more serious condition. For this reason, arrhythmia alarms are prioritized in three alarm "chains": PVC Alarms; Beat Detection Alarms, and Rate Alarms.

Only the highest priority alarm condition in each chain is announced. Lower priority alarms in the same chain will not be announced while an alarm is active or during the configured timeout period. If alarm conditions of equal severity from different chains are detected, the alarm condition that occurred most recently is announced. The exception is Irregular HR, which only occurs if no other alarms are occurring.

See "ECG, Arrhythmia, and ST Alarm Overview" on page 88 for information on which alarms are included in the different arrhythmia options.



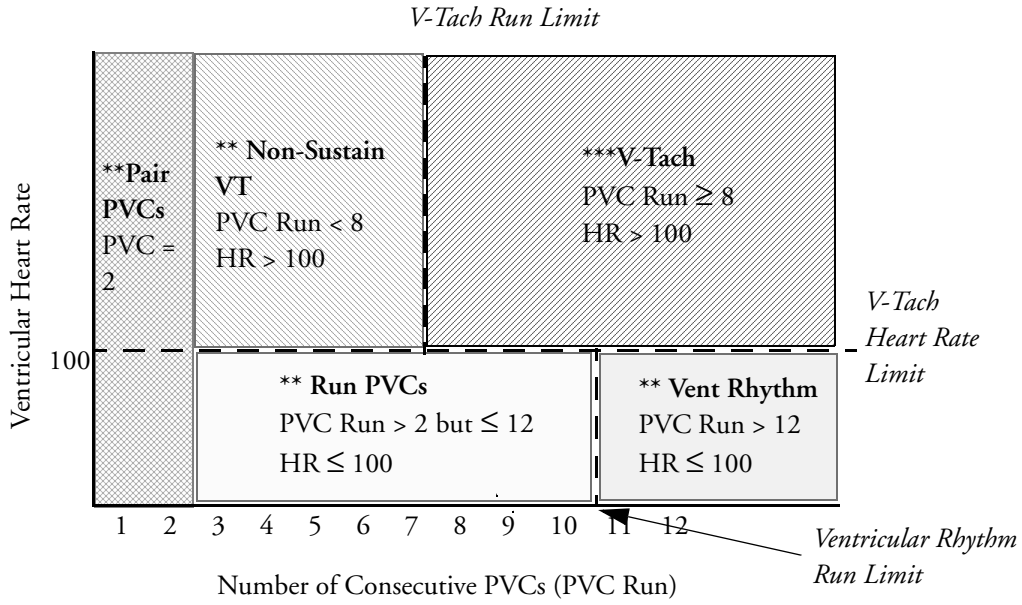
– If there is an active Vent Bigeminy alarm, a PVCs > xx/min will not be triggered because it is lower on the same chain. However, a high HR alarm will become active because it is on a different chain.

– Higher priority alarms supersede previous alarms. For example, if a Vent Trigeminy alarm is active and a Pair PVCs occurs, the Pair alarm will be activated.

Understanding PVC-Related Alarms

PVC-related alarms are detected on the basis of the current ventricular heart rate and the number of consecutive PVCs counted (referred to as PVC Runs). Changing one alarm limit automatically changes linked alarm limits.

Example: This diagram illustrates the conditions under which PVC alarms would be generated if the Vent Rhythm Run limit is set to 12, the V-Tach Run Limit is set to eight, and the V-Tach HR Limit is set to 100.



You will see that

- if both the V-Tach Heart Rate Limit and the V-Tach Run Limit are exceeded, a red V-Tach alarm is generated
- if the ventricular heart rate exceeds the V-Tach Heart Rate Limit but not the V-Tach Run Limit, a yellow Non-Sustain VT alarm is generated.

About ST Monitoring

The monitor performs ST segment analysis on normal and atrially paced beats and calculates ST segment elevations and depressions. This information can be displayed in the form of ST numerics and snippets on the monitor.

All available leads can be monitored continuously. The ECG waveform does not need to be displayed on the Screen for ST Segment analysis.

WARNING This monitor provides ST level change information; the clinical significance of the ST level change information should be determined by a physician.

Switching ST On and Off

♦ To switch all ST monitoring on or off, in the **Setup ST Analysis** menu, select **ST Analysis** to toggle between **On** and **Off**.

ST monitoring is automatically switched off if the Patient Category is not Adult. You should consider switching ST monitoring off manually if:

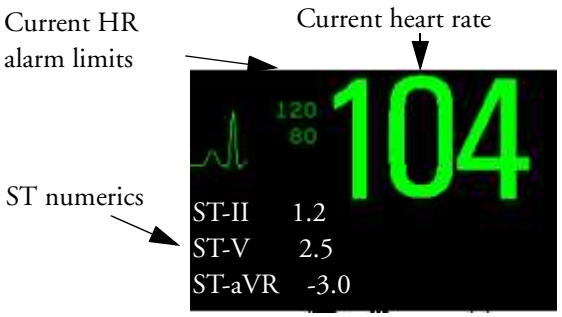
- you are unable to get a lead that is not noisy
- arrhythmias such as atrial fib/flutter cause irregular baseline
- the patient is continuously ventricularly paced
- the patient has left bundle branch block.

Selecting ST Leads for Analysis

♦ To switch ST monitoring for individual leads on or off, in the **Setup ST Analysis** menu, select **Setup ST Leads**. In the pop-up window, the leads in the left column under **Choices** are the leads you can choose from, and the leads in the right-hand column **Selected** are the leads chosen to be displayed. Select the ST leads on the left and use the arrow keys to move the leads from one list to the other, then select **Done** to apply the changes.

Understanding the ST Display

Your monitor screen may be configured to look slightly different from the illustrations.



ST Numerics Up to 12 ST numerics plus the ST index can be displayed on the monitor screen. They can be configured to show beside the measurement numerics, beside the ECG wave, or beside the ST snippet.

A positive ST value indicates ST segment elevation; a negative value indicates depression.

ST numerics are displayed in the order in which you select ST leads for analysis. If there is additional space in the field assigned to ST numerics, the monitor will display extra numerics in the order in which they appear in the **Setup ST Analysis** -> **Setup ST Leads** -> **Choices** list. Any ST leads switched on for analysis that do not fit in the assigned numerics field are shown in succession in place of the last ST numeric.

ST Index The ST index numeric (**STindx**) is the sum of the absolute values for the ST leads V2, V5, aVF. Because it is based on absolute values, it is always a positive number. If you haven't selected one of the leads V2, V5, and aVF for ST analysis, the STindx numeric will display a question mark "?".

- To switch the ST index numeric on or off for display, in the **Setup ST Analysis** menu, select **ST-Index** to toggle between **On** and **Off**.

ST Snippets ST snippets show a one second wave segment for each measured ST lead. The most recent snippet is drawn in the same color as the ECG wave, usually green, superimposed over the stored baseline snippet, drawn in a different color. The comparison shows any deviation in the measurement since the baseline snippet was stored, for example as a result of a procedure carried out on the patient.

The information is updated once per minute.

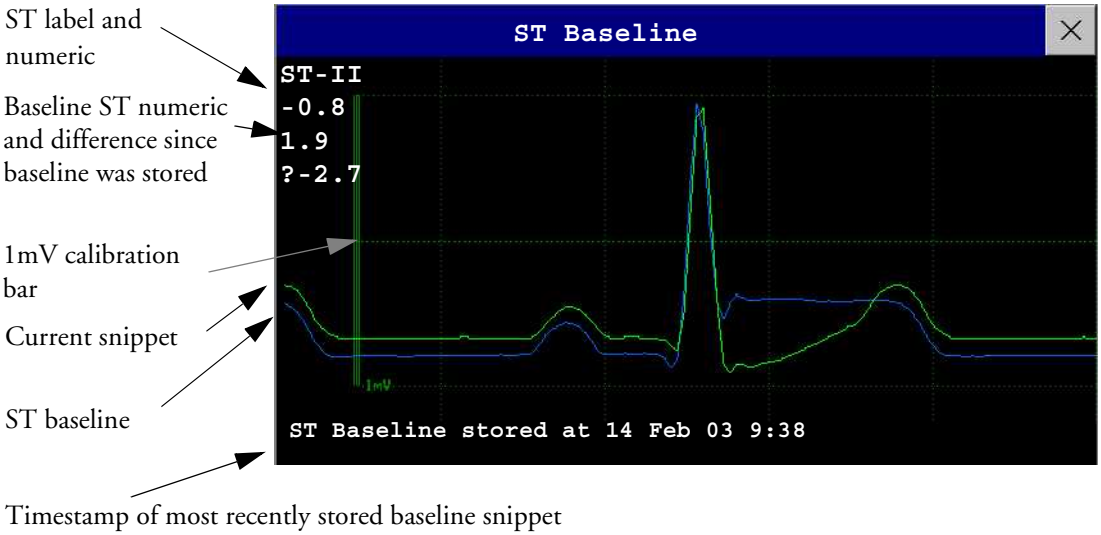
If you do not see ST snippets on the Screen, select the Screen name in the Monitor Info Line and select a Screen configured to show snippets from the pop-up list of available Screens.

ST Baseline Window The ST Baseline Window shows an ST snippet drawn on a grid that divides the one second of information into sections. The current ST numeric and the ST numeric stored with the baseline are shown, as well as the difference between these two numerics.

A "?" in front of the difference numeric indicates that the ST measurement points were adjusted since the baseline snippet was stored.

The Baseline Window it opens with the ST pop-up keys **Next Lead**, **Previous Lead**, **Update Baseline**, **Record ST**, **Change ST Lead**, and **Adjust ST Points** to let you carry out common ST tasks.

- To view the **ST Baseline** window, select any snippet on the Screen.



Updating ST Baseline Snippets

ST analysis requires valid samples to measure and store a snippet. ST Snippets and ST values are updated every minute. If there is artifact in the signal, it may take longer for an ST snippet and an ST value to appear.

The first baseline is stored automatically after ST monitoring is started, or when a new patient is admitted. To update ST baselines,

1 Select an ST snippet to open the **ST Baseline** window.

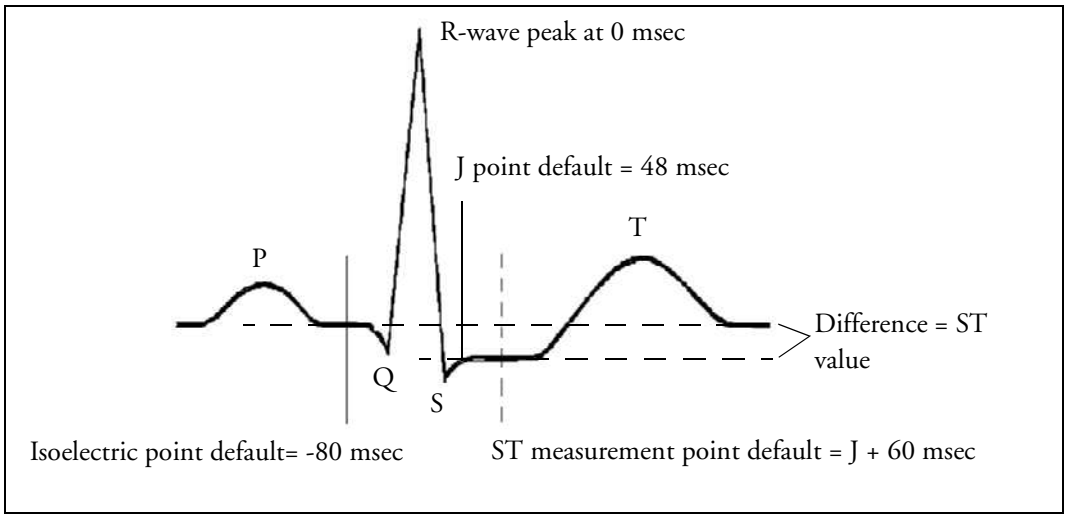
2 In the **ST Baseline** window, select **Update Baseline** to store all current snippets as baselines. This deletes all previously-stored baselines.

Recording ST Segments

♦ To record all currently available ST snippets and baselines, in the **ST Baseline** window, select the pop-up key **Record ST**.

Adjusting ST Measurement Points

The ST measurement for each beat complex is the vertical difference between two measurement points. The isoelectric point provides the baseline for the measurement and the ST point provides the other measurement point. It is positioned with reference to the J-point.



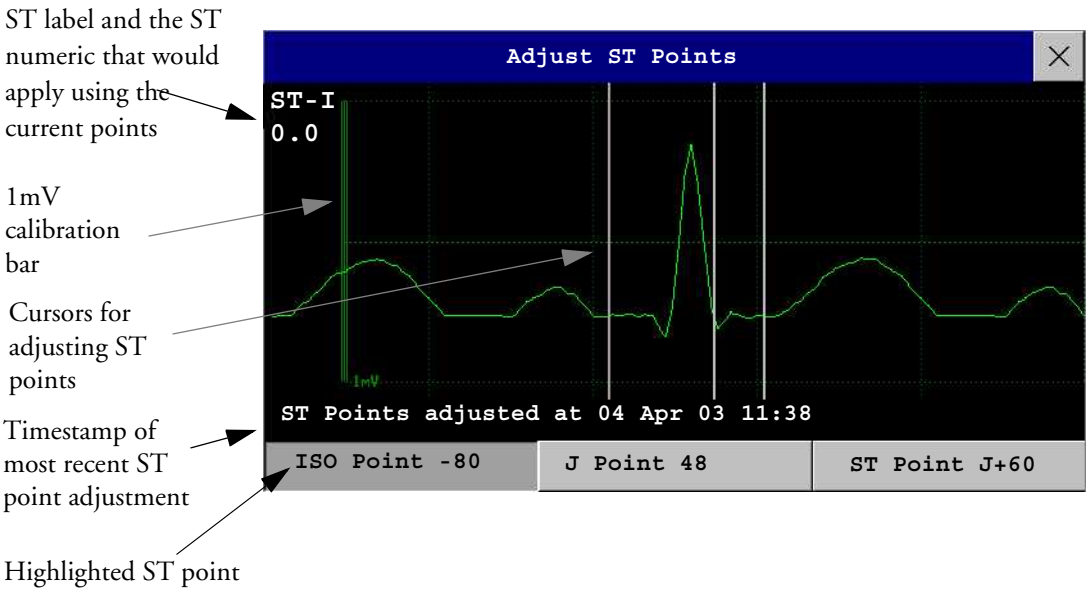
The ST measurement points need to be adjusted when you start monitoring, and if the patient's heart rate or ECG morphology changes significantly. Artifactual ST segment depression or elevation may occur if the isoelectric point or the ST point is incorrectly set.

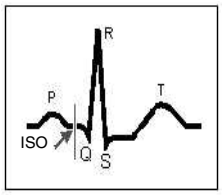
To adjust the ST measurement points,

1 In the **Setup ST Analysis** menu, select **Adjust ST Points** to open the **Adjust ST Points** window. Alternatively, you can use the **Adjust ST Points** pop-up key in the **ST Baseline** window.

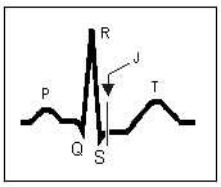
2 Select a suitable ECG lead for ST measurement, with a visible J-point and a visible P wave. To see the ST snippet for the other ECG leads, select the **Next Lead** or **Previous Lead** pop-up keys.

3 Use the **Select Point** pop-up key to scroll through the points and activate the point you need to adjust, then use the arrow keys to move the measurement point. Each point is highlighted while active.



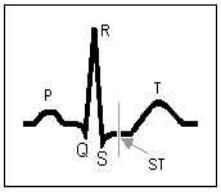


The ISO-point cursor positions the isoelectric point relative to the R-wave peak. The relation is shown beside the ISO-point in milliseconds. Position the ISO-point in the middle of the flattest part of the baseline (between the P and Q waves or in front of the P wave).



The J-point cursor positions the J-point relative to the R-wave peak. It helps you to correctly position the ST-point.

Position the J-point at the end of the QRS complex and the beginning of the ST segment.



The ST-point is positioned a fixed distance from the J-point, either **J + 60** or **J + 80**. Move the J-Point to position the ST-point at the midpoint of the ST segment.

4 To update the ST snippet shown in the **Adjust ST Points** window, select the **Update** pop-up key.

5 Select the **Apply Changes** pop-up key to activate the new ST measurement points and recalculate all ST values.

The most recent ST Points adjustment time is displayed in the **Adjust ST Points** window. This information is cleared when a patient is discharged or when a new Profile is loaded into the monitor.

ST Alarms

ST alarms are yellow alarms. Each ST lead has its own alarm limit. ST alarms are triggered when an ST value exceeds its alarm limit for more than one minute. Switching ST alarms off switches off alarms for all ST leads.

If more than one ST measurement is in alarm, the monitor only displays the alarm message of the ST lead which is currently furthest from its set alarm limits.

Single- or Multi-lead ST Alarming

Be aware that if multi-lead ST alarming is switched on, only alarms involving more than one ST lead will be announced.

To choose individual or multi-lead ST alarming,

- In the **Setup ST Analysis** menu, select **ST Alarm Mode** and select either **Single ST** or **Multi ST**.

Changing ST Alarm Limits

The monitor can detect alarms on each ST lead separately, so you can set high and low ST alarm limits individually for each ST lead. You can also set separate alarm limits for single-lead and multi-lead ST monitoring. Set the high and low alarm limits based on your assessment of the patient's clinical condition, unit protocols, physician orders or medication specified limits. A good guideline is + 1.0 mm or - 1.0 mm from the patients's ST, or follow your hospital protocol.

1. In the **Setup ST Analysis** menu, select **ST Alarm Mode** and select **Single ST** or **Multi ST**.
2. Select the alarm to be adjusted.
3. Select the appropriate setting.

7

Monitoring Pulse Rate

The pulse numeric counts the arterial pulsations that result from the mechanical activity of the heart in beats per minute (bpm). You can display a pulse from any measured SpO_2 signal (pleth wave) or any arterial pressure (ABP, ART, Ao, PAP, UAP, P: see the pressure section for an explanation of the pressure labels). The displayed pulse numeric is labeled and color-coded to match its source wave. If the pulse numeric is not displayed, see the **Setup Pulse** menu to check whether it is switched on.

Entering the Setup Pulse Menu

If a pulse numeric is displayed on the screen, select it to enter the **Setup Pulse (Pulse Source)** menu. If no pulse numeric is visible, in the **Setup SpO_2** menu or an **Setup** arterial pressure menu, select **Pulse (Pulse Source)**.

System Pulse Source

The currently active system pulse source is shown in the setup menus of the pulse source measurements. The pulse rate chosen as system pulse:

- is monitored as system pulse and generates alarms when you select pulse as the active alarm source
- is sent via the network to the Information Center, if available
- is trended in the HighRes Trends and stored in the monitor's databases.

To define which pulse rate is used as system pulse,

1 In the **Setup Pulse** menu, select **System Pulse**.

2 Select one of the SpO_2 or arterial pressure labels from the pop-up list, or select **Auto**.
If you select Auto, the monitor automatically chooses a pulse rate to be used as system pulse. It looks through the list from top to bottom and activates the first pulse rate that is switched on and available.

Switching Pulse On and Off

To switch a particular pulse numeric on or off, enter the **Setup Pulse** menu via the measurement setup menu or wave menu of the pulse source. For example, to switch an SpO_2 pulse numeric on or off,

1 Enter the **Setup Pulse** menu by selecting the Pulse numeric or by selecting **Pulse** in the **Setup SpO2** menu.

2 In the **Setup Pulse** menu, select **Pulse (Pulse source)** to toggle between **On** and **Off**.

To switch the system pulse on or off, in any **Setup Pulse (Pulse Source)** menu, check which measurement is currently selected as pulse source. Enter the **Setup Pulse** menu for this pulse source and then switch off the pulse measurement as described.

Using Pulse Alarms

You can change pulse rate alarm limits in the **Setup Pulse** menu accessed via any Pulse source, or in the **Setup ECG** menu. Changing the alarm limits for a specific Pulse numeric changes the alarm limits for all pulse rate alarms and heart rate alarms.

Pulse alarms are only generated when the active alarm source is set to Pulse and a pulse source is set as system pulse.

Selecting the Active Alarm Source: HR or Pulse?

In most cases the HR and Pulse numerics are identical. In order to avoid simultaneous alarms on HR and Pulse, the monitor uses either HR **or** Pulse as its active alarm source. To change the alarm source, select **Alarm Source** in the **Setup ECG** or **Setup Pulse** menu, then select either

– **HR**: if you want the HR to be the alarm source for HR/Pulse.

– **Pulse:** If you select Pulse as the active alarm source, the monitor will prompt you to confirm your choice. Be aware that if you select Pulse as the alarm source, all arrhythmia and ECG HR alarms are switched off.

– **Auto:** If the **Alarm Source** is set to **Auto**, the monitor will use the heart rate from the ECG measurement as the alarm source whenever the ECG measurement is switched on and a valid heart rate is available. If the heart rate becomes unavailable, for example if leads become disconnected, and if a Pulse source is switched on and available, the monitor will automatically switch to Pulse as the alarm source, using the pulse rate from the measurement currently selected as system pulse. While Pulse is the alarm source, all arrhythmia and ECG HR alarms are switched off. If the HR becomes available again, the monitor automatically uses this as alarm source.

WARNING Selecting Pulse as the active alarm source for HR/Pulse switches off the arrhythmia alarms listed in the section “ECG, Arrhythmia, and ST Alarm Overview” on page 88, and the heart rate alarms. This is indicated by the message **All ECG Alarms Off** (unless this has been configured off for your monitor), and the crossed-out alarm symbol beside the ECG heart rate numeric.

High and low pulse rate and extreme bradycardia and extreme tachycardia alarms from pulse are active.

Alarm Source Selection Disabled

If Alarm Source Selection is disabled, you cannot change the alarm source. If you try to change the source, the monitor displays the message **`To activate enter Config and enable AlarmSourceSel`**. Alarm source selection can only be re-enabled in Configuration Mode.

Changing HR/Pulse Alarm Limits

As Pulse and HR share the same high and low alarm limits, if you change the alarm limit in the **`Setup Pulse`** menu, the high or low alarm limits for HR in the **`Setup ECG`** menu change automatically, and vice versa. The only exceptions are caused by a low limit clamp for each measurement: the lowest value for Pulse when derived from SpO_2 is 30 bpm; for HR 15 bpm, and for Pressure 25 bpm.

Extreme Alarm Limits

The extreme rate alarms, Extreme Tachy and Extreme Brady, generated by the active alarm source, either HR or Pulse, are set in Configuration Mode by adding a set value to the high and low alarm limits. You need to know what value has been configured for your monitor. Changing the high and low alarm limits automatically changes the extreme alarm limits within the allowed range.

- To see the values added to the high and low limit alarms to create the extreme rate alarms for your monitor, in the **`Setup ECG`** menu, see the menu items **`ΔExtrTachy`** and **`ΔExtrBrady`**.

QRS Tone

The active alarm source is also used as a source for the QRS tone. You can change the tone volume in the **`Setup SpO2`** and **`Setup ECG`** menus and the QRS tone modulation in the **`Setup SpO2`** menu.

8

Monitoring Respiration Rate (Resp)

For the respiratory measurement (Resp), the monitor measures the thoracic impedance between two ECG electrodes on the patient's chest. Changes in the impedance due to thoracic movement produce the Resp waveform on the monitor screen. The monitor counts the waveform cycles to calculate the respiration rate (RR).

Lead Placement for Monitoring Resp

Correct patient skin preparation techniques for electrode placement are important for Resp measurement: you will find this information in the chapter on ECG.

The Resp measurement uses the standard ECG cable sets and lead placements. You can use any of the different types of ECG cable sets - 3-lead, 5-lead, or 10-lead, using either standard or EASI™ placement - to measure Resp, as long as you use ICU ECG cables.

The Resp signal is always measured between two of the ECG electrodes. If you are using standard ECG electrode placement, Resp is measured between the RA and LL electrodes. If you are using EASI™ ECG electrode placement, Resp is measured between the I and A electrodes.

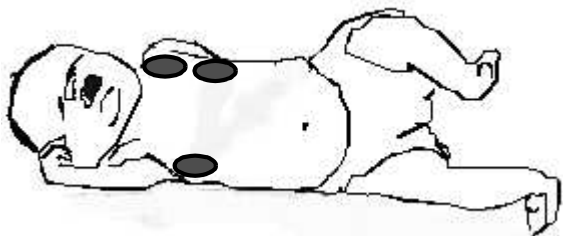
Optimizing Lead Placement for Resp

If you want to measure Resp and you are already measuring ECG, you may need to optimize placement of the two electrodes between which Resp will be measured for some patients. Repositioning ECG electrodes from standard positions, especially when you are using EASI™ ECG electrode placement, results in changes in the ECG waveform and may influence ST and arrhythmia interpretation.

Cardiac Overlay

Cardiac activity that affects the Resp waveform is called cardiac overlay. It happens when the Resp electrodes pick up impedance changes caused by the rhythmic blood flow. Correct electrode placement can help to reduce cardiac overlay: avoid the liver area and the ventricles of the heart in the line between the respiratory electrodes. This is particularly important for neonates.

Lateral Chest Expansion



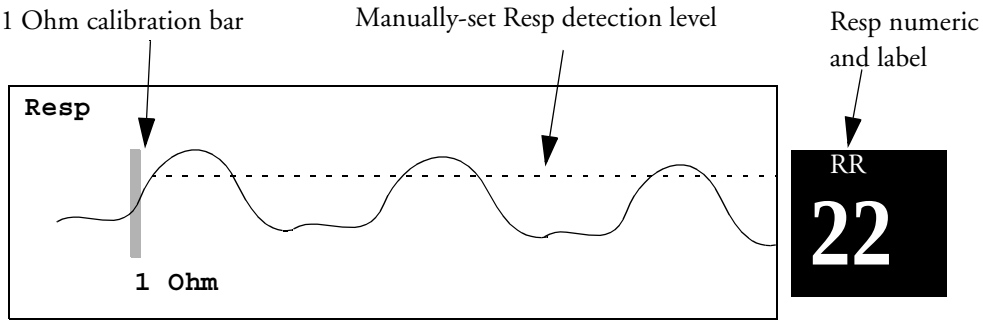
Some patients, especially neonates, expand their chests laterally. In these cases it is best to place the two respiratory electrodes in the right midaxillary and left lateral chest areas at the patient's maximum point of breathing movement to optimize the respiratory wave.

Abdominal Breathing

Some patients with restricted chest movement breathe mainly abdominally. In these cases, you may need to place the left leg electrode on the left abdomen at the point of maximum abdominal expansion to optimize the respiratory wave.

Understanding the Resp Display

The Resp measurement is displayed on the monitor as a continuous wave and a numeric respiration rate. If the detected respiration rate is close to the heart rate, this is indicated by the text **HR = RR** next to the respiration wave if you are in manual monitoring mode. Your monitor screen may look slightly different from the illustration.



Changing Resp Detection Modes

The Resp detection level can be set either automatically or manually.

♦ To change the resp detection mode, in the **Setup Resp** menu, select **Auto/Man** to toggle between the settings.

Auto Detection Mode

In Auto Detection Mode, the monitor adjusts the detection level automatically, depending on the wave height and the presence of cardiac artifact. Note that in Auto Detection Mode, the detection level (a dotted line) is not displayed on the waveform.

Use Auto Detection Mode for situations where:

- the respiration rate is not close to the heart rate

- breathing is spontaneous, with or without continuous positive airway pressure (CPAP)
- patients are ventilated, except patients with Intermittent Mandatory Ventilation (IMV).

Manual Detection Mode

In Manual Detection Mode you must set the Resp detection level.

♦ In the **Setup Resp** menu, select **Manual Up** or **Manual Down**. Use the dotted detection level line in the Resp waveform to determine when the desired level is reached.

Once set, the detection level will not adapt automatically to different respiration depths. It is important to remember that if the depth of breathing changes, you may need to change the detection level.

Use Manual Detection Mode for situations where:

- the respiration rate and the heart rate are close.
- patients have Intermittent Mandatory Ventilation.
- respiration is weak. Try repositioning the electrodes to improve the signal.

Resp Detection Modes and Cardiac Overlay

In Auto Detection Mode: If you are monitoring Resp and the ECG is switched off, the monitor cannot compare the ECG and Resp rates to detect cardiac overlay. The respiration detection level is automatically set higher to prevent the detection of cardiac overlay as respiration.

In Manual Detection Mode: Cardiac overlay can in certain situations trigger the respiration counter. This may lead to a false indication of a high respiration rate or an undetected apnea condition. If you suspect that cardiac overlay is being registered as breathing activity, raise the detection level above the zone of cardiac overlay. If the Resp wave is so small that raising the detection level is not possible, you may need to optimize the electrode placement as described in the section ”Lateral Chest Expansion”.

Changing the Size of the Respiration Wave

WARNING When monitoring in Manual Detection Mode, make sure to check the respiration detection level after you have increased or decreased the size of the respiration wave.

♦ In the **Setup Resp** menu, select **Size Up** to increase the size of the wave or **Size Down** to decrease it.

Changing the Speed of the Respiration Wave

Resp waveforms are usually viewed at a slower speed than other waveforms. For this reason, the Resp measurement has its own speed control and is not affected by the wave speed settings of the other measurements.

♦ In the **Setup Resp** menu, select **Resp Speed**. Choose the required speed from the pop-up list. This defines the speed at which the wave is drawn across the screen in millimeters per second (mm/s).

Using Resp Alarms

Resp alarms can be switched on and off and the high and low alarm limits can be changed just like other measurement alarms, as described in the Alarms chapter.

Changing the Apnea Alarm Delay

The apnea alarm is a high priority red alarm used to detect apneas. The apnea alarm delay time defines the time period between the point where the monitor cannot detect any respiration activity and the indication of the apnea alarm.

1 In the **Setup Resp** menu, select **Apnea Time**.

2 Select the appropriate setting.

Resp Safety Information

WARNING **Respiration detection level** If you do not set the detection level for the respiration correctly in manual detection mode, it may not be possible for the monitor to detect apnea. If you set the detection level too low, the monitor is more likely to detect cardiac activity, and to falsely interpret cardiac activity as respiratory activity in the case of apnea.

Apnea The respiration measurement does not recognize obstructive and mixed apneas — it only indicates an alarm when a pre-adjusted time has elapsed since the last detected breath.

The safety and effectiveness of the respiration measurement method in the detection of apnea, particularly the apnea of prematurity and apnea of infancy, has not been established.

Interference If operating under conditions according to the EMC Standard EN 60601-1-2 (Radiated Immunity 3V/m), field strengths above 1V/m may cause erroneous measurements at various frequencies. Therefore it is recommended to avoid the use of electrically radiating equipment in close proximity to the respiration measurement unit.

Resp Accessories To monitor respiration, use only the non-OR ECG accessories listed in the Resp section of the accessories chapter. You cannot measure respiration if you are using an orange OR ECG cable set. This is because of the higher internal impedance of the OR cable set, required for use if electro-surgery is being performed.

Rate adaptive pacemakers: Implanted pacemakers which can adapt to the Minute Volume may occasionally react on the Impedance measurement used by patient monitors for the determination of the Resp value and execute pacing with the maximum programmed rate. Switching off the Resp measurement can prevent this.

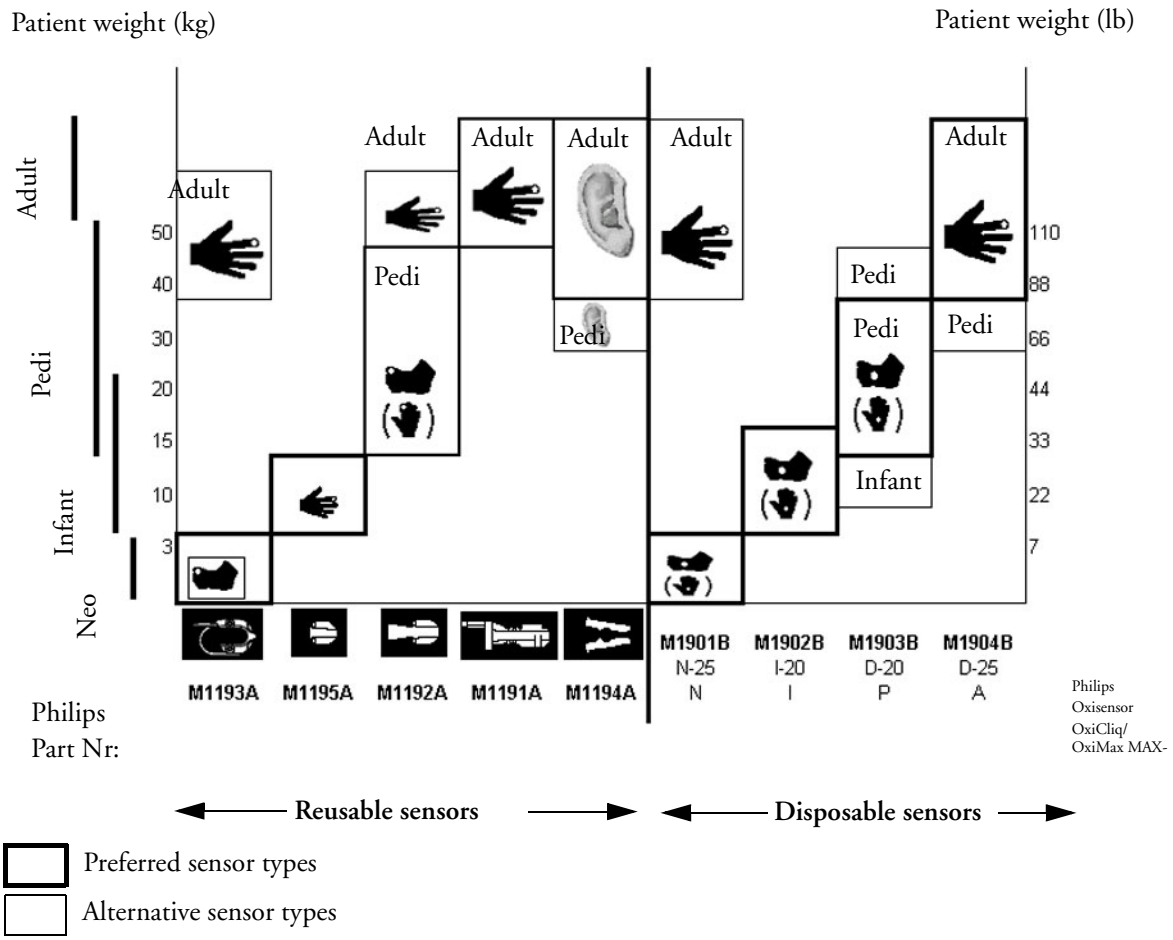
9

Monitoring SpO_2

Philips pulse oximetry uses a motion-tolerant signal processing algorithm, based on Fourier artefact suppression technology (FAST). It provides four 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).
- Pleth waveform - visual indication of patient's pulse.
- Pulse rate (derived from pleth wave) - detected pulsations per minute.
- Perfusion indicator - numerical value for the pulsatile portion of the measured signal caused by arterial pulsation.

Selecting an SpO_2 Sensor



This chart guides you in selecting the correct sensor type. Find the patient's weight on the vertical axes. The heavy-bordered areas at this weight indicate that the sensor on the horizontal axis is a "best choice" for this patient. The areas with light borders indicate a "good choice". The recommended application site is shown as a white dot in the picture.

For example, the best reusable sensor for a 35kg pediatric is the M1192A, applied to the toe or finger. Alternatively, you could use M1194A applied to the ear.

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

If you are measuring SpO_2 with the M3001A Multi-Measurement Server or the SpO_2 measurement module M1020B, Option A01, use Philips reusable and disposable sensors and Nellcor "R-Cal" disposable sensors. If you are measuring SpO_2 with the SpO_2 measurement module M1020B Option A02, use Nellcor OxiMax sensors.

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 on patients who have allergic reactions 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. When using the M1195A Infant Finger Sensor, select a finger or toe with a diameter of between 7 and 8 mm (0.27" and 0.31"). When applying a M1193A neonatal sensor do not overtighten the strap.

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 **Loose Sensor**: 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 at least every four hours.

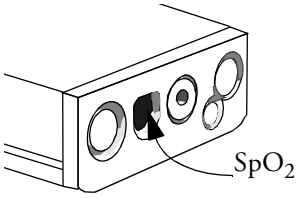
Venous Pulsation: Do not apply sensor too tightly as this results in venous pulsation which may severely obstruct circulation and lead to inaccurate measurements.

Ambient Temperature: Never apply an SpO_2 sensor at ambient temperatures from above 37 °C because this can cause severe burns after prolonged application.

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

Connecting SpO_2 Cables

♦ Connect the sensor cable to the MMS. If you are using a disposable sensor, plug the sensor into the adapter cable and plug this cable into the MMS. Plug reusable sensors directly into the MMS.



CAUTION **Extension cables**: Do not use more than one extension cable (M1941A).

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

Humidity: For neonatal patients, make sure that all sensor connectors and adapter cable connectors are outside the incubator. The humid atmosphere inside can cause inaccurate measurements.

Measuring SpO_2

1 Select the correct patient category setting (adult/pediatric and neonatal), as this is used to optimize the calculation of the SpO_2 and pulse numerics.

2 During measurement, ensure that the application site:

- has a pulsatile flow, ideally with a perfusion indicator value above 1.0.
- has not changed in its thickness (for example, due to edema), causing an improper fit of the sensor.

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

Using an SpO_2 sensor during MR imaging can cause severe burns. Minimize this risk by positioning the cable so that no inductive loops are formed. If the sensor does not appear to be operating properly, remove it immediately from the patient.

CAUTION Injected dyes such as methylene blue, or intravascular dyshemoglobins such as methemoglobin and carboxyhemoglobin may lead to inaccurate measurements.

Interference can be caused by:

- High levels of ambient light. (Hint: cover application site with opaque material.)
- Electromagnetic interference.
- Excessive patient movement and vibration.

Assessing a Suspicious SpO_2 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/Pleth pulse rate may differ from the heart rate calculated from ECG but this does not indicate an inaccurate SpO_2 value.

If you doubt the measured SpO_2, use the pleth wave and perfusion indicator instead to assess the signal quality.

Understanding SpO_2 Alarms

This refers to SpO_2 specific alarms. See the Alarms section 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 NBP cuff, a non-pulsatile SpO_2 INOP can occur. If the monitor is configured to suppress this alarm there may be a delay of up to 60 seconds in indicating critical patient status, such as sudden pulse loss or hypoxia.

Adjusting the Alarm Limits

In the **Setup SpO_2** menu:

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

WARNING High oxygen levels may predispose a premature infant to retrolental fibroplasia. If this is a consideration do NOT set the high alarm limit to 100%, which is equivalent to switching the alarm off. Transcutaneous pO_2 monitoring is recommended for premature infants receiving supplemental oxygen.

Adjusting the Desat Limit Alarm

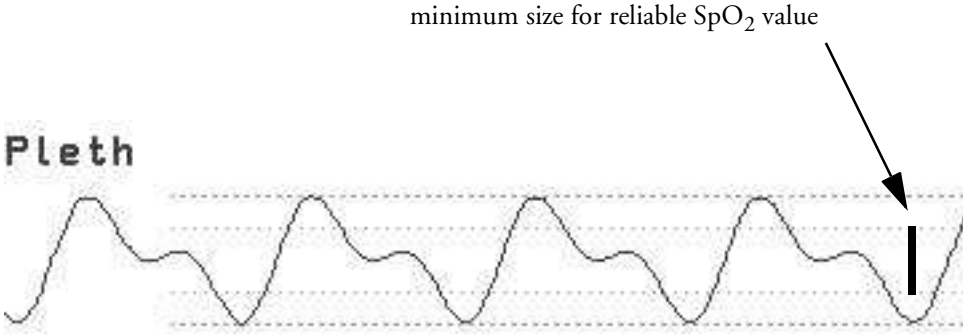
The Desat alarm is a high priority (red) alarm notifying you of potentially life threatening drops in oxygen saturation.

1 In the **Setup SpO_2** menu, select **Desat Limit**.

2 Adjust the limit.

Pleth Wave

The Pleth wave is autoscaled to maximum display size. It decreases only when the signal quality becomes marginal. It is NOT directly proportional to the pulse volume. If you need an indication of change in pulse volume, use the perfusion indicator.



Perfusion (Pleth) Indicator

The perfusion indicator gives a numerical value for the pulsatile portion of the measured signal caused by the pulsating arterial blood flow.

As pulse oximetry is based on the pulsatile nature of the signal, you can also use the perfusion indicator as a quality indicator for the SpO_2 measurement. Above 1 is optimal, between 0.3-1 is acceptable. Below 0.3 is marginal; reposition the sensor or find a better site.

Setting SpO_2/Pleth as Pulse Source

1 In the **Setup SpO2** menu, select **Pulse (SpO_2)** to enter the **Setup Pulse** menu.

2 In the **Setup Pulse** menu, select **System Pulse** and select **SpO_2** from the pop-up list.

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 or pulse depending on which is currently selected as the active alarm source.

♦ In the **Setup SpO_2** menu, select **Tone Modulation** to toggle between **Yes** (for on) and **No** (for off).

Setting the QRS Volume

♦ In the **Setup SpO_2** menu, select **QRS Volume** and set the appropriate QRS tone volume.

Calculating SpO_2 Difference

When a second SpO_2 measurement is present (either through the SpO_2 module or through VueLink), the monitor displays both SpO_2 values, and calculates the difference between them. The second value is subtracted from the first.

1 From the **Main Setup** menu, select **Measurements**.

2 From the **ΔSpO_2 Setup** menu, select **First SpO_2**.

3 Choose the first measurement source.

4 Select **Second SpO_2**.

5 Choose the second measurement source.

10

Monitoring NBP

This monitor uses the oscillometric method for measuring NBP. In adult and pediatric 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 patient population. For the auscultatory reference, the fifth Korotkoff sound was used to determine the diastolic pressure.

In neonatal 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 measurements in a representative patient population.

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

Introducing the Oscillometric NBP 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 **Patient Category**: Select the correct patient category setting for your patient. Do not apply the higher adult inflation, overpressure limits and measurement duration to neonatal patients.

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 on patients with 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 on patients with 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 MMS, 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:

- if a regular arterial pressure pulse is hard to detect
- with cardiac arrhythmias
- with excessive and continuous patient movement such as shivering or convulsions
- 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

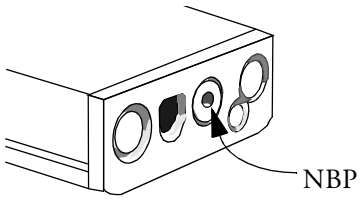
There are three methods of measuring NBP:

- **Manual** - measurement on demand.
- **Auto** - continually repeated measurements (between one and 120 minute adjustable interval).
- **STAT** - rapid series of measurements over a five minute period, then the monitor returns to the previous mode. Use only on supervised patients.

Preparing to Measure NBP

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 patient's heart. If it is not, you must use the measurement correction formula to correct the measurement.

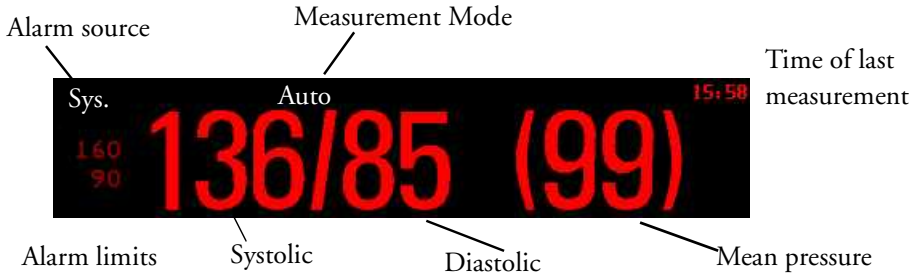
The marking on the cuff must match the artery location. Do not wrap the cuff too tightly around the limb. It may cause discoloration, and ischemia of the extremities. Inspect the application site regularly to ensure skin quality and inspect the extremity of the cuffed limb for normal color, warmth and 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 0.75mmHg (0.10kPa) for each centimeter higher or	deduct 0.75mmHg (0.10kPa) for each centimeter lower or
add 1.9mmHg (0.25kPa) for each inch higher.	deduct 1.9mmHg (0.25kPa) for each inch lower.

Understanding the NBP Numerics



Depending on the NBP numeric size, not all elements may be visible. If you have parallel alarm sources, the sources are displayed instead of the alarm limits. During measurement, 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. The NBP measurement is suitable for use in the presence of electrosurgery and during the discharge of a cardiac defibrillator according to IEC 601-2-30/EN 60601-2-30.

Starting and Stopping Measurements

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

Action to be performed	NBP Setup menu	SmartKeys	MMS hardkey
Start/Stop manual measurement **Start Auto series** **Stop current automatic measurement**	**Start/Stop**		Start/Stop
Stop Automatic, Manual or STAT measurement AND series	**Stop All**		---
Start STAT measurement	**NBP STAT**		STAT (for MMS without Pressure/Temp measurement)
Stop current STAT measurement and end series	**Start/Stop**		Start/Stop
	NBP STAT		STAT (for MMS without Pressure/Temp measurement)

CAUTION Use clinical judgement to decide whether to perform repeated series of STAT measurements because of the risk of purpura, ischemia and neuropathy in the limb with the cuff.

Enabling Automatic Mode and Setting Repetition Time

1 In the **Setup NBP** menu, select **Auto/Man**.

2 Toggle between **Auto/Man**, if necessary, to pick the measurement method.

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

If you change the Profile or patient category, any currently active automatic NBP measurement and automatic measurement cycle stops and the NBP numeric clears.

Choosing NBP 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. In the **Setup NBP** menu, select **Alarms from** and choose from:

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
S&D&M	all three pressures in parallel

Assisting Venous Puncture

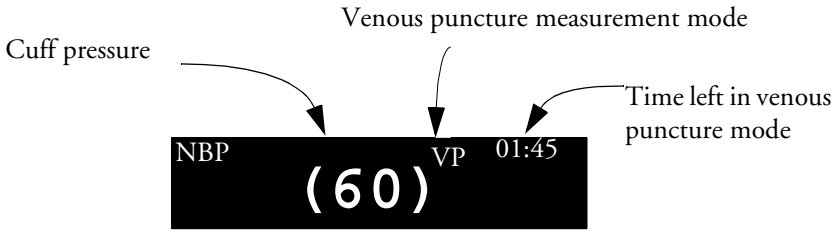
You can use the NBP cuff to cause sub-diastolic pressure. The cuff deflates automatically after a set time (adult/pediatric 170 seconds, neonatal 85 seconds) if you do not deflate it.

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

2 Puncture vein and draw blood sample.

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

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



Calibrating NBP

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

11

Monitoring Temperature

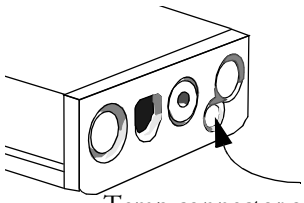
You can measure temperature using the MMS, one of the measurement server extensions, or the temperature plug-in module. You cannot measure invasive pressure and temperature simultaneously in one MMS or server extension. Temp measurement automatically switches on when you connect a probe. You can switch the measurement off manually.

Making a Temp Measurement

1 Select the correct type and size of probe for your patient.

2 If you are using a disposable probe, connect the probe to the temperature cable.

3 Plug the probe or temperature cable into the temperature connector socket.



Temp connector socket

4 Apply the probe to the patient. You are advised to use a protective rubber cover on rectal probes.

5 In the **Setup <Temp>** menu, select **Label** and choose a label to indicate temperature type. Choose from

Temp	non-specific temperature label.	Trect	rectal temperature
Tart	arterial temperature	Tskin	skin temperature
Tcore	core temperature	Tven	venous temperature
Tesoph	esophageal temperature	Tnaso	nasopharyngeal temperature

6 Check that the alarm settings (on or off, high and low limits) are appropriate for this patient and this type of temperature measurement.

Calculating Temp Difference

The monitor can calculate the difference between two temperature values by subtracting the second value from the first. The difference is labeled with the first letters of the first measurement and the first letters of the second. For example, Tco-sk indicates the value is the calculated difference between core temperature (Tcore) and skin temperature (Tskin).

1 In the **Setup Main** menu, select **Measurements**.

2 In the **Setup ΔTemp** menu, select **First Temp**.

3 Label the measurement source as appropriate.

4 Select **Second Temp**.

5 Label the measurement source as appropriate.

12

Monitoring Invasive Pressure

You can measure pressure using the Multi-Measurement Server (MMS), one of the measurement server extensions or the pressure plug-in module. You cannot measure invasive pressure and temperature simultaneously in one MMS or server extension.

WARNING Make sure that the applied parts never come into contact with other conductive parts, or with earth.

Setting up the Pressure Measurement

1 Plug in the pressure cable.

MMS

Module

2 Prepare the flush solution.

3 Flush the system to exhaust all air from the tubing. Ensure that the transducer and stopcocks are free of air bubbles.

WARNING If air bubbles appear in the tubing system, flush the system with the infusion solution again. Air bubbles may lead to a wrong pressure reading.

4 Connect the pressure line to the patient catheter.

5 If you are using an infusion pressure cuff with the pressure line, attach the pressure cuff to the fluid to be infused. Inflate it according to your standard hospital procedure, then start the infusion.

6 Position the transducer so that it is level with the heart, approximately at the level of the midaxillary line.

WARNING If measuring intracranial pressure (ICP) with a sitting patient, level the transducer with the top of the patient's ear. Incorrect leveling may give incorrect values.

Selecting a Pressure for Monitoring

Tell the monitor which pressure you want to monitor by selecting its pressure label. The label is a unique identifier for each type of pressure. When you chose a label, the monitor uses that label's stored color, wave scale and alarm settings.

1. In the **Setup** <**Press**> menu, select **Label**.
2. Select the appropriate label from the list.

Label	Description	Label	Description
ABP	Arterial blood pressure	**PAP**	Pulmonary artery pressure
ART	Arterial blood pressure (alternative)	**RAP**	Right atrial pressure
Ao	Aortic pressure	**UAP**	Umbilical arterial pressure
CVP	Central venous pressure	**UVP**	Umbilical venous pressure
ICP	Intracranial pressure	**P**	Non-specific pressure label
LAP	Left atrial pressure		

Zeroing the Pressure Transducer

To avoid inaccurate pressure readings, the monitor requires a valid zero. Zero the transducer in accordance with your hospital policy (at least once per day). You must perform a zero:

- when you use a new transducer or tubing
- every time you reconnect the transducer cable to the monitor
- if you think the monitor's pressure readings are not correct.

Zeroing ICP

Your hospital guidelines may require you to zero the ICP transducer less frequently than other transducers, due to the need for aseptic conditions. When you zero an ICP transducer, the zero values are automatically stored and you will not be prompted to repeat the zero procedure.

If you want to simultaneously zero all pressures except ICP, disconnect the ICP transducer from the measurement server or module while zeroing. Reconnecting the transducer recalls the stored values.

WARNING If you select the label ICP, the measurement device uses the most recently stored zero. Therefore, make sure you zeroed the transducer correctly in accordance with the transducer manufacturer's instructions and your hospital policy. When you use a transducer that you cannot rezero after placement, ensure that you keep the measuring device with the patient so that you are certain you have the correct zero data for this patient.

Determining a Pressure's Most Recent Zero

The monitor displays the most recent zero on the status line. If this has "timed-out" after you have performed a zero, redisplay the information by entering the pressure's setup menu.

Zeroing a Pressure Measurement

WARNING **Invasive pressure alarms** (and pulse alarms, if derived from invasive pressure) are temporarily suppressed until 30 seconds after the transducer finishes zeroing.

1 Turn off the stopcock to the patient.

2 Vent the transducer to atmospheric pressure, to compensate for the static and atmospheric pressure exerted on the transducer.

3 In the setup menu for the pressure, select **`Zero <Press>`**.

4 When you see the message **`<Press> zero done at <date and time>`** on the status line, (for example, **`ABP zero done at 13 Mar 02 23.35`**) close the stopcock to atmospheric pressure, and open the stopcock to the patient.

Using the Zero Hardkey

Selecting the Zero hardkey on the M1006B Pressure module starts a zero for the pressure currently measured with the module.

Selecting the Zero hardkey on the M3001A Multi-Measurement Server starts zeros the pressure being measured by the measurement server and any connected measurement extensions.

Zeroing All Pressures Simultaneously

WARNING **Before** zeroing all pressures, make sure that **all** pressure transducers are vented to atmospheric pressure.

If you are measuring pressures with more than one measuring device, using the **`Zero`** SmartKey to initiate the zeroing calls up a list of all active pressures. Select the pressure you want to zero or select **`All Press`** to zero all pressures simultaneously.

Troubleshooting the Zero

The status line lists the probable cause of an unsuccessful zero:

Message	Corrective Action
unable to zero - equipment malfunction	The hardware is faulty. Contact your service personnel.
unable to zero - excessive offset	Make sure the transducer is vented to air and try again. If this fails, the hardware may be faulty. Replace the adapter cable and try again. If it fails, replace the transducer and try again. If it still fails, contact your service personnel.
unable to zero - unstable signal	
unable to zero - no transducer	Make sure that the transducer is connected and try again. If this fails, exchange the adapter cable and try again. If this fails, exchange the transducer.
unable to zero - pulsatile pressure	Make sure that the transducer is vented to air, not to the patient, and try again.
unable to zero - timed out	Try pressing the Zero key again. If this fails, replace the transducer and adapter cable and contact your service personnel.
switch <Press> on first	Pressure measurement is switched off. To switch it on, in the Setup Pressure menu, select the pressure's label.

Adjusting the Calibration Factor

Each time you use a reusable transducer, compare the calibration factor written on your transducer with the calibration factor shown on the monitor. To ensure accurate measurement, they must be the same.

1 In the **Setup <Press>** menu, select **Cal. Factor**.
If the value here does **not** match that on the transducer, select the corresponding value from the list now in accordance with your hospital's procedure.

2 To confirm you want to use the new calibration factor, select the Confirm popup.

Displaying a Mean Pressure Value Only

Use this when you want to see only the mean pressure.

♦ In the pressure's setup menu, select **Mean Only**. Toggle between **On** to display mean pressure value only, and **Off** to display all pressure values (systolic, diastolic and mean).

Changing the Pressure Wave Scale

1 Select the label of the pressure wave whose scale you want to set to enter the **Setup** menu.

2 In the **Setup <Press>** menu, (for example **ABP**) select **Scale**.

3 Select a value from the pop-up list:
– a positive value sets the top gridline. The bottom gridline is set at zero.
– a negative value sets the bottom gridline. The middle gridline is set at zero.

Optimizing the Waveform

- In the **Setup <Press>** menu, select **Optimum Scale** to let the monitor select the best minimum and maximum scales for the current wave.

Non-Physiological Artifact Suppression

Some clinical procedures may affect blood pressure, for example, a flush procedure or a blood sample. Your monitor may be configured to suppress these non-physiological artifacts for a specified duration (**Artifact Suppression** is configured to 30, 60, or 90 seconds). During artifact suppression, the monitor shows the INOP message **<Pressure label> ARTIFACT**, and a question mark is shown beside the pressure numerics. Pressure alarms and the **Pulse Non-Pulsatile** INOP are suppressed during the configured period. The CPP high alarm is not suppressed.

Choosing the Pressure Alarm Source

WARNING Make sure you set alarm limits for the correct label. The alarm limits you set are stored for that particular label only. Changing the label may change the alarm limits.

You can monitor for alarm conditions in systolic, diastolic and mean pressure, either singly or in parallel. Only one alarm is given at a time, in this order of priority: mean, systolic, diastolic.

- In the **Setup <Press>** menu, select **Alarms from** and choose the source.

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

- Select and set the **High Limit** and **Low Limit** for the pressure(s) you have selected.

WARNING If you are using an intra-aortic balloon pump connected to the M1006B #C01 module, do not defibrillate unless the pump cable is disconnected.

Calibrating Reusable Transducer CPJ840J6

Depending on your monitor's configuration, you may be able to perform a calibration in monitoring mode. Perform a mercury calibration when you use a new transducer, and at regular intervals according to your hospital policy. You require:

- standard sphygmomanometer.
- sterile 10cc syringe with heparinised solution.
- 3-way stopcock.
- approximately 25cm of tubing.

Making the Pressure Calibration

WARNING Never perform the invasive pressure calibration while a patient is being monitored.

1 Zero the transducer.

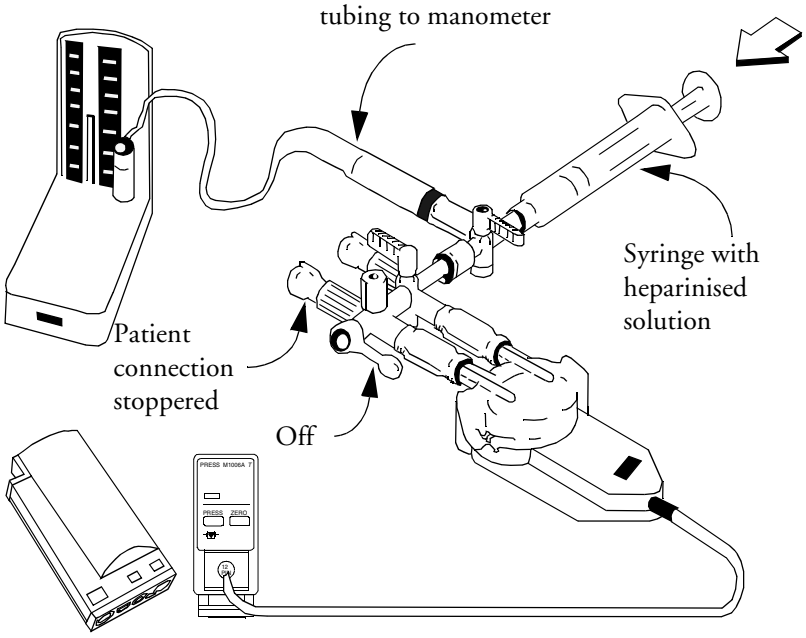
2 Connect the syringe and manometer.

a. Attach the tubing to the manometer.

b. Connect the 3-way stopcock to the stopcock that is not connected to the patient catheter when you measure a patient.

c. Attach the syringe to one port and the manometer tubing to the other port.

d. Open the port to the manometer.



3 Move the syringe barrel in and raise the mercury to 200mmHg (30kPa). 200mmHg is the recommended calibration pressure.

4 In the **Setup Pressure** menu, select **Cal. Press**.

5 Select the calibration pressure from the list, for example 200 mmHg.

6 Select **Confirm** to recalculate the calibration factor using the applied pressure.

7 When the monitor displays **<Press> calibration done at <date and time>**, remove the manometer tubing, syringe and extra stopcock. We recommend you replace the transducer dome and tubing with sterile ones.

8 Label the transducer with the calibration factor shown in the **Cal. Factor** field in the pressure's setup menu.

9 Reconnect the patient and start measuring again.

Troubleshooting the Pressure Calibration

The status line lists the probable cause of an unsuccessful calibration.

Message	Corrective Action
unable to calibrate - equipment malfunction	Contact your service department. The pressure hardware is faulty.
unable to calibrate - out of range	Make sure that you have selected the value for **Cal. Press** that you are applying to the transducer, and repeat the calibration.
unable to calibrate - no transducer	Make sure that the transducer is connected and try again.
unable to calibrate - unstable signal	Make sure there are no disturbances to the transducer, and repeat the calibration.
unable to calibrate - perform zero first	No valid zero. Zero the transducer.

Calculating Cerebral Perfusion

The monitor can calculate the difference between mean arterial pressure and the intracranial pressure. The difference is labeled CPP.

1 In the **Main Setup** menu, select **Measurements**.

2 In the **Setup CPP** menu, select **ABP, ART** or **Ao** as the arterial pressure source.

Measuring Pulmonary Artery Wedge Pressure

Pulmonary Artery Wedge Pressure (PAWP) values, used to assess cardiac function, are affected by:

- Fluid status
- Myocardial contractility
- Valve and pulmonary circulation integrity

Obtain the measurement by introducing a balloon-tipped pulmonary artery flotation catheter into the pulmonary artery. When the catheter is in one of the smaller pulmonary arteries, the inflated balloon occludes the artery allowing the monitor to record changes in the intrathoraic pressures that occur throughout the respiration cycle. The pulmonary wedge pressure is the left ventricular end diastolic pressure (preload).

The most accurate PAWP values are obtained at the end of the respiration cycle when the intrathoraic pressure is fairly constant. Use the ECG waveform to determine the waveform of the wedge pressure. You can use the respiration waveform as a reference when assessing the PAWP waveform, to ensure constant measurement timing relative to the respiratory cycle. The monitor displays the PAWP value for up to 24 hours or until you admit a new patient.

WARNING **The pressure receptor** in the catheter records pressure changes that occur only in front of the occlusion. Even though the catheter tip is in the pulmonary artery, the receptor records pressure changes transmitted back through the pulmonary circulation from the left side of the heart.

While performing the wedge procedure, the monitor switches off the pressure alarms for pulmonary artery pressure (PAP).

Due to a slight measurement delay, you should not use Microstream (sidestream) CO_2 as a direct reference for determining the end expiratory point in the pressure curve.

To start the Wedge procedure,

1 In the **`Main Setup`** menu, select **`Wedge`** to display the wedge procedures window.

2 Prepare and check the pressure line according to your hospital policy. If the PAP waveform scale is set to **`Optimum`** prior to the wedge procedure, it is possible that after wedging the catheter, the resulting pressure waveform will fall below the lower scale. In this case, the wedge waveform will not be displayed or recorded properly. To avoid this, switch out of optimum scale before performing a wedge procedure.

3 Use the **`Reference Wave 1`** and **`2`** popup keys to select any ECG or respiratory wave as reference waves.

4 Select **`Wave Speed`** if you want to synchronize all displayed waves to your preferred speed.

5 Inflate the balloon when the monitor prompts you: **`Ready for balloon inflation`**. The waveform changes from the PAP to the PAWP wave. The measurement takes approximately 12 seconds. On completion, the monitor stores the PAWP waveform display and prompts you to deflate the balloon. If the monitor cannot detect a wedging waveform you must use **`Store Trace`** to store the wedge and two reference waves manually.

6 Deflate the balloon when the monitor prompts you: **`Ready for balloon deflation`** and verify that the waveform returns to pulmonary artery shape.

7 If you need to start a new measurement, select **`Restart Wedge`**.

Editing the Wedge

1 Select the **Edit Wedge** pop-up key to see the stored waveforms.

2 The monitor displays a cursor in the waveform at the PAWP mean value. It also displays any previously stored value and the time it was stored.

3 Move the cursors up, down, right and left to set them on the correct wedge position.

4 Select **Store Wedge** to store the PAWP value.

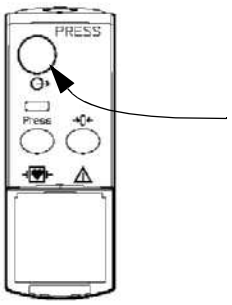
5 Select **Print Wedge** to print the PAWP waveform and any reference waves or **Record Wedge** to record them. While recording or printing, you cannot perform any more Wedge tasks.

WARNING **Prolonged inflation** can cause pulmonary hemorrhage, infarction or both. Inflate the balloon for the minimum time necessary to get an accurate measurement.

If the pulmonary artery flotation catheter drifts into the wedge position without inflation of the balloon, the pulmonary artery pressure waveform assumes a wedged appearance. Take appropriate action, in accordance with standard procedures, to correct the situation.

If the PAWP (mean) is greater than the PAP (systolic), deflate the balloon and report the incident in accordance with hospital policy, because the pulmonary artery could be accidently ruptured, and the wedge value derived will not reflect the patient's hemodynamic state, but will merely reflect the pressure in the catheter or balloon.

Identifying the Pressure Analog Output Connector



analog output
(module M1006B,
option C01 only)

13

Monitoring Cardiac Output

The Cardiac Output (C.O.) measurement invasively measures cardiac output and other hemodynamic parameters using a technique called thermodilution. This can be used to determine the flow rate of a system by introducing a cold solution into the system and measuring the resulting drop in temperature at a downstream site. The temperature change is displayed as a curve in the C.O. procedure window, and the monitor calculates the C.O. value from this curve. The C.O. value is inversely proportional to the area under the curve. As cardiac output varies continuously, a series of measurements must be carried out to achieve a reliable C.O. average value. Always use the average of multiple thermodilution measurements for therapy decisions.

The measurements can be carried out using the right heart thermodilution method or the PiCCO method (transpulmonary thermodilution).

- The right heart method is available with
  - C.O. module M1012A, standard and option #C10
  - M3012A Hemodynamic Measurement Server Extension, options #C05 and #C10
- The PiCCO method is available with
  - C.O. module M1012A, option #C10
  - M3012A Hemodynamic Measurement Server Extension. option #C10

The PiCCO method additionally lets you measure Continuous Cardiac Output (CCO) by performing pulse contour analysis on the blood pressure waveform.

Hemodynamic Parameters

This table illustrates the hemodynamic parameters available with each method, whether they are measured continuously, and whether they can be shown on the monitor's resting display or in the HemoCalc Window.

Measured and Calculated Hemodynamic Parameters and Indexes	PiCCO Method (Transpulmonary Thermodilution)			Right Heart Thermodilution		
	Continuous?	Resting Display	HemoCalc Window	Continuous?	Resting Display	HemoCalc Window
Blood Temperature (Tblood)	Y	Y	N	Y	Y	N
C.O./C.I.: Cardiac Output	N	Y	Y	N	Y	Y
CCO/CCI: Continuous Cardiac Output	Y	Y	Y (in the C.O. field)	Not available		
SVR/SVRI: Systemic Vascular Resistance	N and Y	Y	Y	N	N	Y
SV/SI: Stroke Volume/SV Index	N and Y	Y	Y	N	N	Y
***dPmax**: Left Ventricular Contractility Index	Y	Y	N	Not available		
CFI: Cardiac Function Index	N	Y	N	Not available		
ITBV/ITBVI: Intrathoracic Blood Volume	N	Y	Y	Not available		
***EVLW/EVLWI**: Extravascular Lung Water	N	Y	Y	Not available		
***GEDV/GEDVI**: Global End-Diastolic Volume	N	Y	Y	Not available		
PVR/PVRI: Pulmonary Vascular Resistance	Not available			N	N	Y
LCW/LCWI: Left Cardiac Work	N	N	Y	N	N	Y
RCW/RCWI: Right Cardiac Work	Not available			N	N	Y
RVSW/RVSWI: Right Ventricular Stroke Work	Not available			N	N	Y

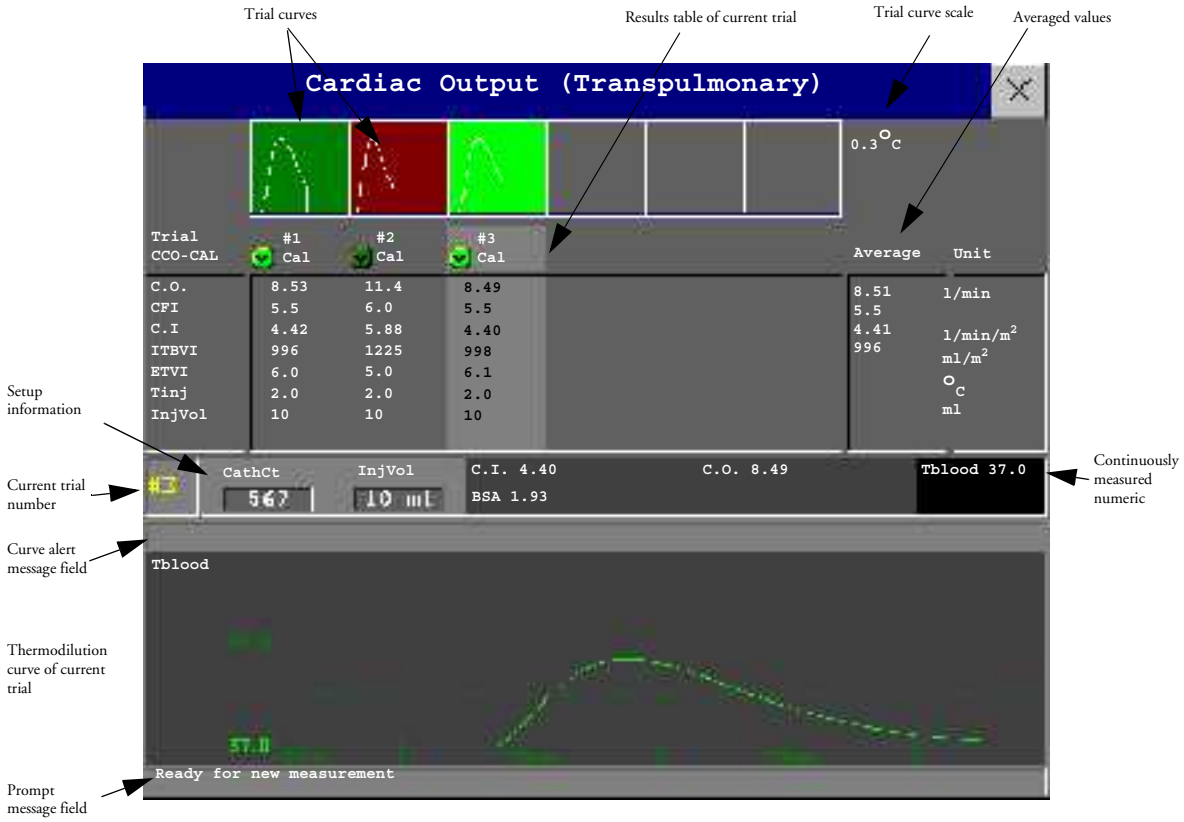
* currently not available in the U.S.A or in clinical environments under FDA control.

Using the C.O. Procedure Window

The C.O. procedure window displays up to six trials (measurement curves) with the trial number and the C.O. value under the thermodilution curve. When you open the window, a line of pop-up keys automatically appears to let you carry out C.O.-related tasks. This example shows the procedure window for the transpulmonary (PiCCO) Method. The window may be configured to look slightly different on your monitor.

To open the C.O. procedure window,

- Select **Cardiac Output** in the **Setup C.O.** or **Setup CCO** menu, or
- Select the **Cardiac Output** SmartKey on the screen, or
- Press the **START** hardkey on the front of the C.O. plug-in module, or
- Press a remote start switch, if you are using one.



Start C.O.	Stop C.O.	Select Trial	Accept/ Reject	Save C.O.& Cal CCO	Print/ Record	Table Contents	Hemo Calc	Change Scale	Setup C.O.

Accessing the Setup C.O. and Setup CCO Menus

C.O. settings can be changed in the **Setup C.O.** menu. To access this menu,

- press the C.O. hard key on the C.O. module
- select any of the discontinuous C.O. numerics (for example, C.O., C.I.) on the screen.

CCO/CCI settings can be changed in the **Setup CCO** menu. To access this menu,

- select any of the continuously measured hemodynamic numerics (CCO, CCI.) on the screen.

Changing the C.O. Results Table Contents

To change the measurement parameters shown in the results table of the C.O. procedure window,

- select the **Table Contents** pop-up key and choose from the list of available parameters.

Entering the HemoCalc Window

- From the C.O. procedure window, select the pop-up key **HemoCalc** to open the HemoCalc window.

Viewing the Temperature Unit

The temperature unit is visible in the **Setup C.O.** menu in Monitoring Mode, but inactive ("grayed out"). It can be changed in Configuration Mode.

Measuring C. O. Using the PiCCO Method

The PiCCO method combines transpulmonary thermodilution and pulse contour analysis on the blood pressure waveform. A fluid with a known volume and temperature is injected into the right atrium through a CVP catheter. The injectate bolus mixes with the blood in the heart and the change in blood temperature is measured with a thermistor at the distal end of an arterial catheter placed in one of the bigger systemic arteries, for example, the femoral or the axillary artery.

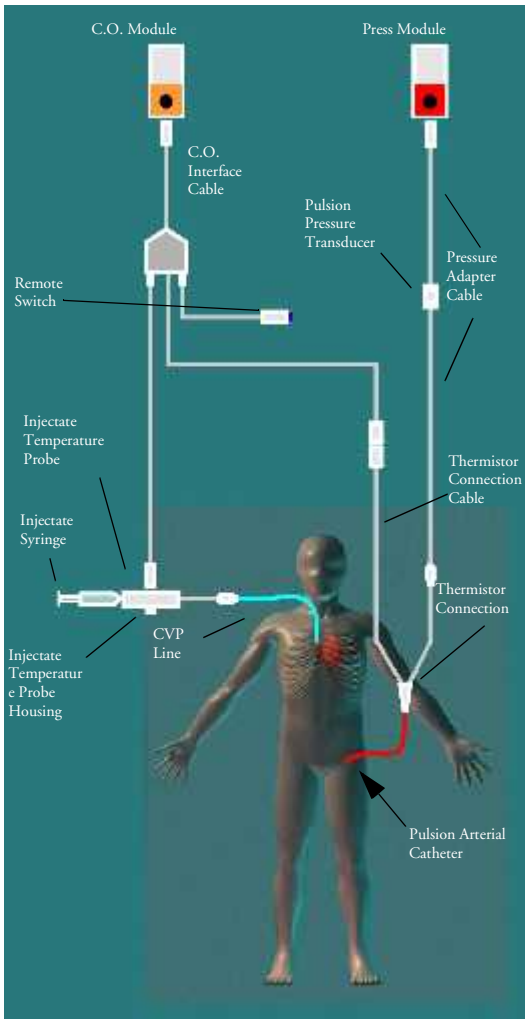
If CVP is not measured continuously, the monitor uses a preset, static CVP value to calculate the SVR/SVRI (you will see the INOP message **SVR SET CVP USED**).

The PiCCO Method requires a pressure measurement made using either the M1006B Pressure module, or a M3001A MMS, or a measurement server extension M3015A, M3016A, or M3012A. (A VueLink pressure may not be used.) You will also need a conventional central venous (CVP) line and an arterial catheter from Pulsion Medical Systems. You must use the approved catheters and puncture locations.

Measuring Continuous Cardiac Output

Every time C.O. is measured with the PiCCO method, the monitor uses this C.O. value and the result of the pulse contour analysis to calculate a patient-specific calibration factor. The monitor uses this value to compute CCO and the other continuous hemodynamic parameters. CCO values are calculated on a beat-to-beat basis and then averaged over a 12-second time frame. The calculated values are displayed as numerics on the monitor screen.

Setting Up the PiCCO C.O. Measurement



1 Set up the arterial line using the arterial catheter (transpulmonary catheter) and the transducer kit from Pulsion Medical Systems. It must be placed in one of the bigger systemic arteries, for example, the femoral or the axillary artery. You must use the approved catheters and puncture locations.

2 Set up the central venous line.

3 Connect the injectate temperature probe housing to the venous line.

4 Plug the C.O. interface cable into the C.O. module or measurement server extension and connect the following devices to the C.O. interface cable:

- Injectate temperature probe
- Thermistor connector
- Remote start switch (if used).

Follow your hospital standards to avoid unintentional extraction of the C.O. catheter. Secure the cable using the mounting clip shipped with each C.O. interface cable. You may also find it helpful to loop the C.O. interface cable, tape the loop, and attach it to the undersheet of the patient's bed using a safety pin.

5 If you are measuring CCO, set up the pressure measurement now. The CCO measurement requires a minimally dampened invasive pressure setup. You must ensure that there are no air bubbles in the pressure line or dome and use only specified accessories.

6 Check that the correct measurement method is selected.

If a catheter is already connected to the Cardiac Output Interface Cable, the monitor automatically recognizes the method used. If not, in the **Setup C.O.** menu, select **Method** and then select **Transpulmonary**.

7 Check that the **Tinj Probe Type** setting in the **Setup C.O.** menu matches the type of injectate temperature probe used. The probe type is usually printed on the plug of the probe.

To change the probe type, in the **Setup C.O.** menu, select **Tinj Probe Type** to call up a list of available probes.

- **23001:** it is recommended to use this probe with cold injectate
- **M1646:** this probe can be used with room temperature injectate or with cold injectate.

8 Check that the correct arterial catheter constant is selected.

If the catheter is recognized by the monitor, the catheter constant is automatically displayed and cannot be changed manually. If it is not recognized, in the C.O. procedure window, select **CathCt** and use the pop-up keypad to enter the correct value. The catheter constant is usually written either on the catheter or on the catheter packaging.

9 Make sure that the injectate volume setting matches the injectate volume you will use. To change the volume, in the C.O. procedure window, select **InjVol** and select the correct injectate volume from the pop-up list.

If there is a problem with the volume or temperature you have chosen, the monitor will issue a curve alert message to inform you of this.

10 If you are measuring CCO or CCI, check that the correct pressure source is selected in the **Setup CCO** menu. The pressure label under **CCO from** must match the pressure measured with the arterial catheter. To change the pressure source, select **CCO from** to call up a list of available pressure labels and select the correct label.

11 If you are measuring CCO or CCI, verify that the correct alarm source is selected in the menu item **Alarms From**. To change the alarm source, select **Alarms From** and choose either **CCO** or **CCI**.

Performing PiCCO C.O. Measurements

If you are measuring CCO, all measurements should be conducted within 15 minutes. Older measurements "expire" for CCO calibration.

1 Enter the C.O. procedure window.

2 When you see the message **...Ready for new measurement**, start the measurement by selecting the pop-up key **Start C.O.** or pressing the Start hardkey on the C.O. module, or pressing the remote start switch.

3 When you hear the ready tone and see the message **...Stable baseline, inject now!**, inject the solution into the CVP catheter.

At the end of the measurement the thermodilution curve, cardiac output, index values, ITBV and EVLW values and any curve alerts are displayed and a message will appear "**...Wait before starting new measurement**".

4 When you see the **...Ready for new measurement** message, repeat the procedure until you have completed the measurements you want to perform. You can perform a maximum of 6 measurements before editing. If you perform more than 6 measurements without rejecting any, the oldest will automatically be deleted when a 7th curve is stored.

Editing PiCCO C.O. Measurements

It is important to identify and reject erroneous trials, as the monitor uses all the measurement trial values you do not reject to calculate the averaged cardiac output.

1 Review the trials. Irregular trials or trials marked with a "?" should be reviewed carefully. Consider the similarity of the values and the shape of the C.O. curve. A normal C.O. curve has one smooth peak and returns to the temperature baseline level after the peak.

2 Reject unsatisfactory trials by selecting the trial curve. Discard conspicuously different values. If all values are different from each other, there may be true hemodynamic instability caused, for example, by severe cardiac arrhythmia. To reject a trial, select its trial curve to toggle between

accepted and rejected. The background of rejected trials is red and the background of accepted trials is green. The monitor recalculates the average values after you reject trials.

Saving and Calibrating PiCCO C.O. Measurements

When you have finished editing the trials, you must save the results. This closes the measurement series, sends the average C.O. numeric to be displayed on the main screen, and stores the averaged values in the trends and calculations databases.

Before the monitor can calculate CCO, you must calibrate the measurement. You should also calibrate CCO every eight hours, or if the hemodynamic condition of the patient changes consistently in the same direction over 15 minutes, or if there are large or sudden changes in the patient's condition.

The monitor only uses C.O. measurements from within the last 15 minutes for calibrating CCO.

To save and calibrate,

- In the C.O. procedure window, select the pop-up key **Save C.O. & Cal CCO** to use the averaged C.O. value to calibrate Continuous Cardiac Output (CCO).

Your monitor may be configured to have two separate pop-up keys, **Save C.O.** and **Cal CCO**, instead of the combined **Save C.O. & Cal CCO.**

WARNING CCO calibration is patient-specific. When the C.O. module or measurement server extension is plugged in after the patient has changed, make sure that the correct CCO calibration is used. When in doubt perform a new CCO calibration first.

CCO Calibration Status Indicators

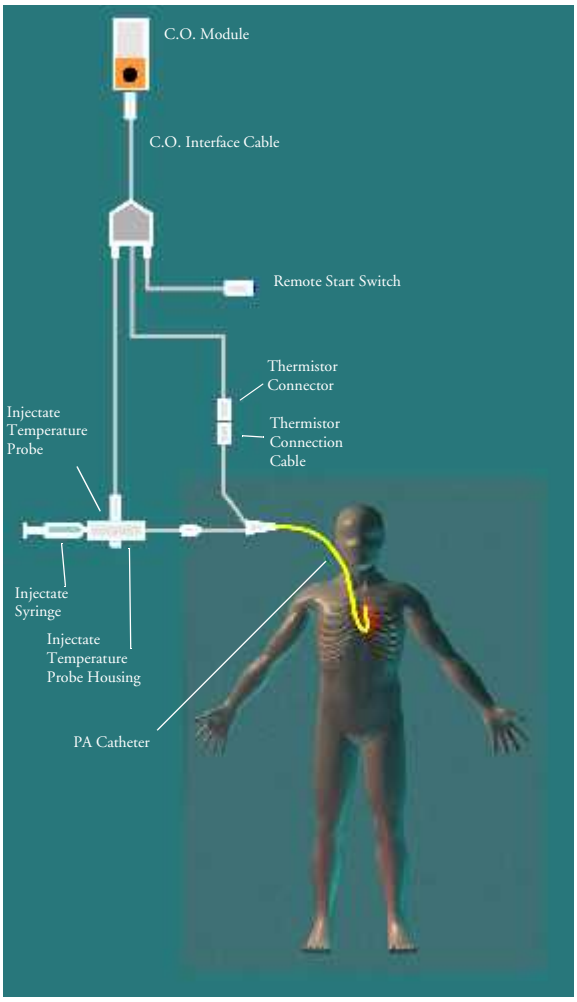
Each measurement trial is tagged with a calibration status indicator next to its trial number. Reflecting the quality of the pressure signal during the thermodilution measurement, this tag indicates each trial's validity to be used in a CCO calibration.

CAL	A pressure signal for CCO was available during the measurement (valid for calibration)
?CAL	A disturbed pressure signal for CCO was available during the measurement (valid for calibration)
N/A	No adequate pressure signal for CCO was available during the measurement (no valid calibration data)
EXP	This trial is more than 15 minutes older than the most recent trial and has expired for CCO calibration (no valid calibration data)

Measuring C.O. Using the Right Heart Thermodilution Method

In the right heart thermodilution method, a fluid of known volume and temperature is injected into the right atrium through the proximal port of a pulmonary artery (PA) (Swan-Ganz) catheter. The injectate bolus mixes with the blood in the right ventricle and the change in blood temperature is measured with a thermistor at the distal end of the catheter in the pulmonary artery.

Setting up RH C.O. Measurements



1 Set up the PA line using a PA catheter.

2 Attach the injectate temperature probe housing to the PA line.

3 Plug the C.O. interface cable into the C.O. module or measurement server extension and connect the following devices into the C.O. interface cable:

– injectate temperature probe

– remote start switch (if used).

Follow your hospital standards to avoid unintentional extraction of the C.O. catheter. Secure the cable using the mounting clip shipped with each C.O. interface cable. You may also find it helpful to loop the C.O. interface cable, tape the loop, and attach it to the undersheet of the patient's bed using a safety pin.

4 Plug the thermistor connection cable of the PA catheter into the thermistor connector.

5 Connect the injectate temperature probe to the injectate temperature probe housing.

6 Check that the correct measurement method is selected.

If a catheter is already connected to the Cardiac Output Interface Cable, the monitor automatically recognizes the method used. If not, in the **`Setup C.O.`** menu, select **`Method`** and then select **`Right Heart`**.

Ice-Bath Setup for RH Thermodilution C.O. Measurements

If you are using the flow-through method illustrated above, the injectate temperature is measured at the time of injection by the temperature probe in the injectate temperature probe housing.

If you are using the ice-bath setup, the injectate temperature probe and the injectate are both placed in an ice-bath and the probe measures the temperature of the contents of the ice bucket.

Setting the Computation Constant

Check that the correct **`Computation Constant`** is entered in the C.O. procedure window. This can be found in the documentation supplied with the catheter and is based on the injectate volume, injectate temperature and catheter type. To change the value, in the C.O. procedure window, select **`Computation Constant`** and use the pop-up keypad to enter the correct value.

Performing RH C.O. Measurements

1 Enter the C.O. procedure window.

2 When you see the message **...Ready for new measurement**, select the pop-up key **Start C.O.**

3 When you hear a ready tone and see the message **...Inject now!**, inject the solution into the right atrial port of the Swan-Ganz catheter. The optimal injection rate is 2.5 ml/second.

At the end of the measurement the thermodilution curve, cardiac output, index values and curve alerts (if necessary) are displayed and a message will appear **...Wait before starting new measurement**.

4 When you see the **...Ready for new measurement** message, repeat the procedure until you have completed the measurements you want to perform. You can perform a maximum of six measurements before editing. If you perform more than six measurements without rejecting any, the oldest will automatically be deleted when a seventh curve is stored.

Editing and Saving RH C.O. Measurements

It is important to identify and reject erroneous measurements (called "trials"), as the monitor uses all the measurement trial values you do not reject to calculate the averaged cardiac output.

1 Review the trials. Irregular trials or trials marked with a "?" should be reviewed carefully. Consider the similarity of the values and the shape of the C.O. curve. A normal C.O. curve has one smooth peak and returns to the temperature baseline level after the peak.

2 Reject unsatisfactory trials by selecting the trial curve. Discard conspicuously different values. If all values are different from one other, there may be true hemodynamic instability caused, for example, by severe cardiac arrhythmia. To reject a trial, select its trial curve to toggle between accepted and rejected. The background of rejected trials is red and the background of accepted trials is green. The monitor will recalculate the average values after you reject trials.

3 Save average C.O. values. To close a measurement series, you must save the average values by selecting the pop-up key **Save C.O.** This sends the average C.O. numeric to be displayed on the main screen, and stores the averaged values in the trends and calculations databases.

Documenting C.O. Measurements

You can document C.O. measurements on the default printer or recorder.

1 In the C.O. procedure window, select the pop-up key **Print/Record.**

2 From the pop-up list, choose:

- **Print Results** to print the contents of the C.O. procedure window
- **Record Results** to record the contents of the C.O. procedure window
- **Record Trial** to send an individual trial curve to the recorder.

C.O. Injectate Guidelines

The greater the injectate volume and the colder the temperature, the more accurate the measurement. Reduced injectate volume or higher injectate temperature may reduce the specified accuracy.

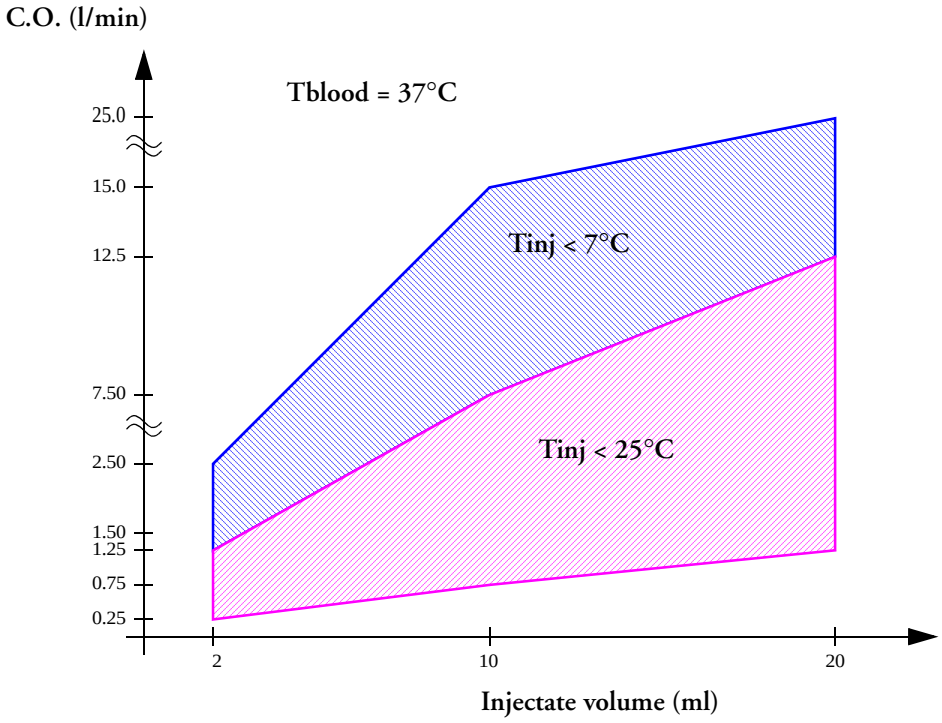
For adult patients, to ensure the greatest measurement accuracy, use a cold injectate of 10 ml volume, if not contra-indicated by the patient's condition. Your choice of injectate volume should be based on the injectate temperature and the patient's cardiac output.

Guidelines for Right Heart Thermodilution C.O. Injectate

If you are using the right heart thermodilution method, the use of injectate with a temperature less than 8°C lower than the blood temperature may cause incorrect values for the thermodilution.

Guidelines for PiCCO C.O. Injectate

If you are using the PiCCO method, the use of injectate with a temperature less than 12°C lower than the blood temperature may cause incorrect values for the thermodilution and CCO calibration.



Injectate for Patients with High ETVI Values (PiCCO Only)

The dilution of injectate is also influenced by the extravascular tissue. The accuracy of the PiCCO method may be reduced in patients with high extra-vascular thermal volume index (ETVI) values. You should use a higher injectate volume and/or colder injectate in these patients, based on this table.

Patient Weight	Cold Injectate		Room Temperature Injectate	
	ETVI < 10	ETVI ≥ 10	ETVI < 10	ETVI ≥ 10
< 3 kg	2 ml	2 ml	3 ml	Use cold injectate
< 10 kg	2 ml	3 ml	3 ml	
< 25 kg	3 ml	5 ml	5 ml	
< 50 kg	5 ml	10 ml	10 ml	
< 100 kg	10 ml	15 ml	15 ml	
≥ 100 kg	15 ml	20 ml	20 ml	

C.O./CCO Curve Alert Messages

After each measurement trial, the monitor analyzes the thermodilution curve. If the curve appears abnormal, a curve alert message appears in the C.O. procedure window. A question mark symbol ("**?**") appears next to the cardiac output numeric if any of these messages appear.

C.O./CCO Curve Alert Messages	Possible Causes
Tinj off scale	The Tinjectate is out of the range -1°C and 30°C. Cool down or heat up the injectate or change the injectate solution and repeat the measurement.
Noisy Baseline	A blood temperature baseline drift that could not be compensated was detected during the C.O. measurement. Interference may be caused if the patient is on a ventilator. Interference may also be caused by an infusion pump: infusions of significant volume should be paused 30 seconds before a thermodilution measurement and should not recommence until the measurement series is completed.
Temperature Baseline Drift	May occur if patient is recovering from open heart surgery, or if patient was cooled down for surgery and is in the process of regaining normal body temperature when the measurement is made.
Small signal, more indicator required	The peak of the transpulmonary thermodilution curve was below 0.1°C. Increase injectate volume and/or lower injectate temperature.
Injectate Temperature too High	The difference between the blood and injectate temperatures is too small. The calculated value for C.O. may not be accurate.
High ETVI, use cold injectate or greater inj. volume	The ETVI value is too high. The accuracy of the transpulmonary thermodilution measurement may be reduced. Increase injectate volume and/or lower injectate temperature following the guidelines given in the section "Guidelines for PiCCO C.O. Injectate" on page 148.

C.O./CCO Curve Alert Messages	Possible Causes
Disturbed Injection	The injection should be performed quickly and with a steady pressure. Shaking or unsteady pressure may cause this message to appear.
Check Injectate Temperature Probe Type	The recorded Tinj signal is uncharacteristic for the M1646 injectate temperature probe. The probe may be defective or an incorrect probe type may have been used.
Unsteady Baseline	There is a noisy baseline, and thermal baseline drift.
Multiple Peaks	Caused by faulty injection technique.
Abnormal Decay Time	May be caused by low cardiac output. Calculated value for C.O. may not be accurate.
Very Long Curve	The decay time of the curve is longer than 15 seconds.
Very Short Curve	Decay time of the curve is less than 0.5 seconds. If there is a noisy baseline, part of the baseline may have been mistaken for a thermodilution curve. Calculated value for C.O. may not be accurate.
Irregular Curve	Any combination of curve alert messages.
Delayed Injection	Injection is given more than 15 seconds after **Start C.O.** is selected. Calculated value for C.O. may not be accurate.

C.O./CCO Prompt Messages

Prompt messages appear in the C.O. procedure window if a C.O. measurement trial must be terminated.

C.O./CCO Prompt Messages	Possible Causes
Curve Below Baseline, measurement terminated	May be caused by thermal baseline drift. No C.O. value calculated.
Excessive Curve Height, measurement terminated	The curve exceeds the upper limit. This may be caused by an injectate that was too cold. No C.O. value calculated.
Unstable Baseline, injection not recommended	The baseline is unstable. Wait until the baseline is stable before injecting. If this does not occur within a reasonable time, injection is possible but the accuracy of the measured values may be reduced.
Excessive baseline drift, don't inject now	No measurement is possible. Measured values are incorrect.

C.O./CCO Warning Messages

Warning messages contain important information about the C.O. measurement.

C.O./CCO Warning Messages	Possible Causes
Next measurement erases older curve	Six curves are stored, this is the maximum possible. If another measurement is stored, the oldest thermodilution curve will be erased.
Previous C.O. Setup Data replaced	A C.O. module or measurement server extension has been plugged in with different C.O. setup data from the previous data. The new C.O. setup data is read from the new C.O. device, and replaces the current data. The message disappears when the **Start C.O.** pop-up key is pressed.
Verify the C.O. Setup Data	A new transpulmonary thermodilution catheter has been connected to the C.O. Interface Cable.
Check arterial pressure, CCO cal currently not possible	Poor or invalid pressure signal, for example if pressure was not zeroed.
Verify the Computation Constant	A new catheter has been plugged in, or the computation constant has been changed and **Start C.O.** has not been selected.
Previous Comp. Constant replaced	A new C.O. module or measurement server extension with a different computation constant from the current one has been connected. The new computation constant is read from the new C.O. device, and replaces the current one. The message disappears when **Start C.O.** is selected.

C.O./CCO Safety Information

WARNING **Catheter constant:** Make sure that the arterial catheter constant for the measurement is appropriate to the catheter used.

Computation Constant: Make sure that the computation constant for the measurement is appropriate to the injectate volume, injectate temperature and catheter type used.

IABP: Do not perform transpulmonary thermodilution measurements on patients undergoing IABP treatment.

CCO accuracy: Accuracy of the CCO measurement and all the derived values may be influenced by patients with valve diseases or artificial valves.

C.O. and MRI: Do not use the Cardiac Output Interface Cable in Magnetic Resonance Imaging (MRI) Applications.

Aortic graft patients: Do not use an arterial catheter in the arteria femoralis when it is contra indicated, for example, with patients who have an aortic graft.

CAUTION During the cardiac output measurement procedure the blood temperature alarms are inactive. This is indicated by a crossed-out alarm symbol next to the temperature numeric. Making alarms inactive during this procedure prevents false alarms. The alarms are automatically reactivated when you have completed the measurement procedure.

14

Monitoring Carbon Dioxide

Use the CO_2 measurement to monitor the patient's respiratory status and to control patient ventilation.

There are two methods for measuring carbon dioxide in the patient's airway:

- Mainstream measurement uses a CO_2 sensor attached to an airway adapter directly inserted into the patient's breathing system. This method is available with the M3016A Mainstream CO_2 Extension to the M3001A Multi-Measurement Server.
- Sidestream (Microstream) measurement samples a probe of the respiratory gas with a constant sample flow from the patient's airway and analyzes it with a remote CO_2 sensor built into the measurement system. Philips uses the advanced Microstream method of sidestream CO_2 measurement which is available in the M3015A Microstream CO_2 Extension to the M3001A Multi-Measurement Server.

In both cases, the measurement principle is infrared transmission, where the intensity of infrared light passing the respiratory gas is measured with a photo detector. As some of the infrared light is absorbed by the CO_2 molecules, the amount of light passing the gas probe depends on the concentration of the measured CO_2.

The partial pressure is calculated from the gas concentration by multiplying the concentration value with the ambient pressure.

The measurement provides:

- a CO_2 waveform.
- an end tidal CO_2 ($etCO_2$) value: the CO_2 value measured at the end of the expiration phase.
- an inspired minimum CO_2 ($imCO_2$): the smallest value measured during inspiration.
- an airway respiration rate (awRR): the number of breaths per minute, calculated from the CO_2 waveform.

Depending on the **Max Hold** setting configured for your monitor, the $etCO_2$ numeric shows either the highest CO_2 value measured within the configured time period (**Max Hold** set to **10 sec** or **20 sec**) or the $etCO_2$ numeric shows breath-to-breath value (**Max Hold** set to **Off**).

During calibration, the monitor measures and displays the instantaneous CO_2 concentration.

WARNING **Correlation**: The etCO_2 readings do not always correlate closely with blood gas values, especially in neonatal patients and patients with pulmonary disease, pulmonary embolism or inappropriate ventilation.

Pharmaceuticals in aerosols: Do not measure CO_2 in the presence of pharmaceuticals in aerosols.

Using the Mainstream CO_2 Extension (M3016A)

The M3016A Measurement Server Extension measures partial pressure of carbon dioxide in a patient's expired gas using the mainstream method. When using the appropriate accessories you can use the mainstream CO_2 measurement with ventilated adults, pediatric and neonatal patients.

WARNING **Infra-red radiation**: Do not expose the airway adapter or M1460A transducer to infra-red radiation during use. This may cause incorrect readings.

Preparing to Measure Mainstream CO_2

1 Attach the transducer connector to the CO_2 connector on the measurement extension.

2 Wait 20 minutes, allowing the transducer to reach its operating temperature and a stable thermal condition.

3 Perform an accuracy check and then, if necessary, calibrate the transducer.

Checking Transducer Accuracy

WARNING **Check transducer accuracy** at least once a week or if you doubt the CO_2 readings.

1 In **`Setup CO2`** menu, select **`Cal. Mode`** to switch on calibration mode.

2 Look at the calibration value displayed in the **`Setup CO2`** menu next to **`Start Cal 1:.`** Is it the same as the value on the calstick? If not, calibrate the transducer now.

3 Place the transducer on the low cell of the calstick (labelled 0.0 mmHg or "ZERO"). The reading on the screen should be zero within ±1 mmHg within one minute.

4 Place the transducer on the high cell of the calstick. The reading on the screen should be within ±1 mmHg of the value on the calstick within one minute.

5 If both readings are in range, you can leave calibration mode and begin monitoring. If either of the readings is out of range, calibrate the transducer.

Calibrating the Transducer

1 Check that the windows on the calstick are clean and clear.

2 Place the transducer on one of the calstick cells and select **`Start Cal 1`**.

3 Enter the calibration value printed on the calstick then press **`Confirm`** to start calibration.

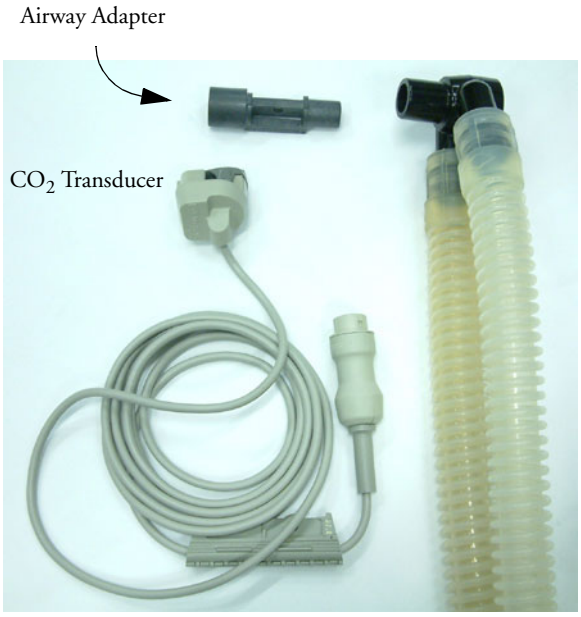
4 When the message **`CO2 CAL 1 calibration done - start CAL 2 calibration`** appears, put the transducer on the other cell and select **`Start Cal 2`** then press **`Confirm`**.

5 When you see the message **`CO2 calibration completed. Leave calibration mode.`**, calibration is complete.

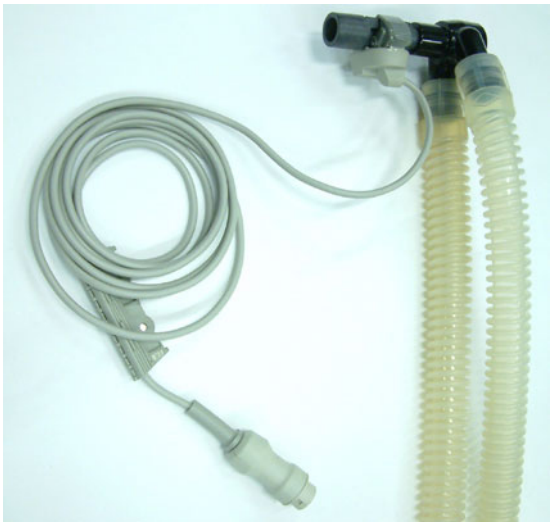
6 Select **`Cal Mode`** to switch calibration mode off. You cannot monitor in calibration mode.

Attaching and Removing the CO_2 Transducer

1 Open the latch and place the transducer onto the airway adapter. Place the airway adapter in the patient's breathing circuit between the endotracheal tube and the Y-piece. You may see the **`CO2 SENSOR WARM UP`** message until the transducer reaches operating temperature. Wait until this disappears before starting the measurement.



2 To remove the transducer from the airway adapter, open the latch and pull out the airway adapter.



WARNING **To prevent stress** on the endotrachial tube, support the transducer and airway adapter.

To avoid infection, use only sterilized airway adapters.

Using the Microstream CO_2 Extension (M3015A)

The M3015A Microstream CO_2 Extension measures the partial pressure of carbon dioxide in a patient's expired gas using Microstream technology.

In intubated patients, a sample of the respiratory gas is drawn from the patient's breathing circuit through an airway adapter and a gas sampling tube. In non-intubated patients, the gas sample is drawn through a nasal or oral-nasal cannula.

When using the appropriate accessories, you can use the Microstream CO_2 measurement with adult, pediatric, and neonatal patients.

Preparing to Measure Microstream CO_2

Use appropriate accessories for:

- the patient type (adult, pediatric or neonatal),
- the ventilation situation (including humidification)
- the duration - short term use, up to 24 hours (typically OR), or long term use (typically ICU).

All accessories are for single patient use only.

Setting up Microstream CO_2 Measurements

WARNING

- **Explosion hazard**: Do not use Microstream measurement in the presence of flammable anesthetic mixtures, such as flammable anesthetic mixture with air, oxygen or nitrous oxide.
- **Low etCO_2 values**: Leakages in the breathing system or sampling system may cause the displayed etCO_2 values to be significantly too low.

Using Microstream Accessories

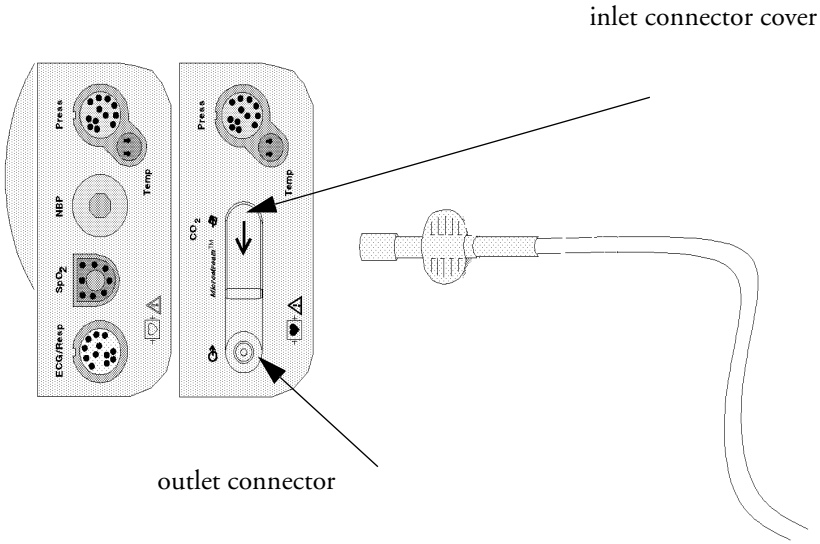
M3015A can be operated with the special Microstream accessories only. Refer to the instructions for use provided with the accessory.

For intubated patients, you can use a Microstream Airway Adapter and a FilterLine sample tube (or a FilterLine Set, which is a ready-made combination of the two) for non-humidified ventilation. Use the FilterLine H, or FilterLine H Set for humidified ventilation.

For non-intubated patients, the gas sample is taken through a Nasal FilterLine, or a Smart CapnoLine (which is a combined oral-nasal FilterLine). In parallel to the measurement of the CO_2, oxygen (O_2) may be delivered to the patient to support gas exchange. This is done by using an O_2/CO_2 FilterLine, or a Smart CapnoLine O_2 (a combined oral-nasal O_2/CO_2 FilterLine).

Using the FilterLine and Airway Adapter

1 Attach the female Luer connector to the CO_2 inlet connector on the measurement extension by pushing the socket cover down and screwing the connector into place.



2 Check that the FilterLine is not kinked.

3 Change the FilterLine if a "CO_2 OCCLUSION" INOP appears on the monitor or if the readings become extremely erratic.

Disconnect the FilterLine during suctioning and nebulizing therapies.

For best results change the FilterLines for non-humidified use (with orange connectors) after 24 hours of continuous use and the FilterLines H, for humidified use, (with yellow connectors) after 72 hours of continuous use.

CO_2 values for non-intubated patients using Microstream accessories will always tend to be lower than for intubated patients. If values appear extremely low, check whether the patient is breathing through the mouth or whether one nostril is blocked

Removing Exhaust Gases from the System

WARNING **Anesthetics**: When using the Microstream CO_2 measurement on patients who are receiving or have recently received anesthetics, connect the outlet to a scavenging system, or to the anesthesia machine/ ventilator, to avoid exposing medical staff to anesthetics.

Use an exhaust tube to remove the sample gas to a scavenging system. Attach it to the Measurement Server Extension at the outlet connector.

Setting up Mainstream and Microstream

These tasks are common to both mainstream and Microstream (sidestream) measurements.

Adjusting the CO_2 Wave Scale

1 In the **CO_2 Wave** menu or the **Setup CO_2** menu, select **Scale**.

2 Choose a suitable scale range from the pop-up list.

Setting up CO_2 Corrections

Temperature, water vapor in the patient's breath, barometric pressure, and the proportions of O_2 and N_2O in the mixture all influence CO_2 absorption. If values seem inaccurately high or low, check that the monitor is using the appropriate corrections.

Correction	
Altitude	Altitude is set during installation. The monitor automatically applies an appropriate correction.
O_2	The monitor automatically makes standard 45% correction (mainstream measurement only).
Humidity	At installation, the monitor is configured to automatically apply either Body Temperature Pressure Saturated (BTPS) or Standard Temperature Pressure Dry (STPD). To see which, go to the **Setup CO_2** menu, and scroll down to look at **HumidtyCorr.**
N_2O	In the **Setup CO_2** menu, select **N_2O Corr** and to toggle between on and off. If N_2O is present in the ventilation gas mixture, you must turn this on. If the N_2O correction is not available in the **Setup CO_2** menu, the CO_2 measurement in your Measurement Server Extension does not require N_2O correction.

Changing CO_2 Alarms

This refers to CO_2 specific alarms. See the Alarms section for general alarm information.

1 In the **Setup CO_2** menu, select **etCO_2 High** or **imCO_2 High** and choose the upper alarm limit.

2 Select **etCO_2 Low** and choose the lower alarm limit.

Changing the Apnea Alarm Delay

This determines the time limit after which the monitor alarms if the patient stops breathing.

1 In the **Setup CO_2** menu, select **awRR**.

2 In **Setup awRR** menu, select **Apnea Time**.

3 Choose the apnea alarm delay time.

WARNING **Safety and effectiveness** of the respiration measurement method in the detection of apnea, particularly the apnea of prematurity and apnea of infancy, has not been established.

Prolonged delay: The selected apnea alarm delay may be prolonged by up to 17 seconds, if an apnea occurs during the automatic zero process. This applies to the Microstream (M3015A) measurement only.

Deriving Alarms From awRR

1 In the **Setup CO_2** menu, select **awRR**.

2 In the **Setup awRR** menu, select **Alarms**.

3 Choose **On** to derive alarms from the airway respiration signal or **Off** to disable them.

Changing awRR Alarm Limits

1 In the **Setup CO_2** menu, select **awRR**.

2 Select **High Limit** to set the upper alarm limit.
Select **Low Limit** to set the lower alarm limit.

3 Select the appropriate setting.

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Monitoring tcGas

The tcGas module measures the partial pressure of the oxygen and carbon dioxide that diffuses through the skin, thereby providing a measure of these gases in the capillary blood.

The monitor's settings for altitude and barometric pressure influence the measurement. The $tcpO_2$/$tcpCO_2$ measurement is valid for an infant patient not under gas anesthesia. Anesthetic agents, such as halothane, can cause incorrect or drifting readings.

Transcutaneous measurements cannot replace arterial blood gas monitoring. However, you can use transcutaneous monitoring to reduce the frequency of arterial sampling. The values at tissue level will **not** be the same as those measured arterially because the measurement is transcutaneous. They correlate with (track closely) the arterial values. For example, a drop in transcutaneous values usually indicates a corresponding drop in arterial values.

Transcutaneous values will not always correlate with blood samples taken from the capillary blood of the heel (heelsticks or astrups).

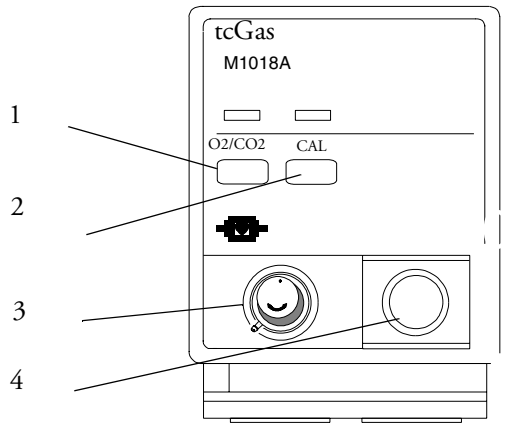
Identifying tcGas Module Components

1 press to enter **`Setup tcGas`** menu

2 press to start calibration

3 calibration chamber

4 transducer connector



Setting the tcGas Sensor Temperature

1 In the **Setup tcGas** menu, select **Transducer Temp**.

2 Choose a temperature value appropriate for your patient's age, weight and physical condition in accordance with your hospital policy.

Usually, a higher transducer temperature gives a better correlation and a quicker response time. However, higher temperatures also increase the risk of skin burns. Most physicians prefer a temperature between 42°C (107° F) and 44°C (111° F), and a site time of four hours or less. Usually, the higher the transducer temperature, the less the site time should be. Whenever you change the temperature setting, the monitor forces you to make a new calibration.

Using the tcGas Site Timer

Availability and behavior of the site timer depend on your monitor's configuration.

WARNING Prolonged continuous monitoring may increase the risk of undesirable changes in skin characteristics, such as irritation, reddening, blistering or burns. If the site timer is disabled, the transducer will heat indefinitely while on a patient. Change the site regularly, in accordance with medical procedures in your hospital.

Setting the tcGas Site Timer

The site timer helps reduce the risk of skin burn by ensuring that the transducer is used at one site for no longer than a predefined period. It reminds you when this period expires.

1 In the **Setup tcGas** menu, select **Site Time**.

2 Choose the time you want the transducer to remain on the measurement site. The optimum time depends on the transducer temperature and your patient's skin sensitivity.

The site timer starts automatically when you remove the calibrated transducer from the calibration chamber. If you return the transducer to the chamber and then remove it again, the site time continues to count down the remaining time; it does not start a new time period. The time remaining before the site timer expires appears in the status line which is visible as long as the **Setup tcGas** menu is open. When the time expires, the monitor sounds a tone and a displays a change site INOP. The monitor either switches off the transducer heating **or** continues monitoring, depending on its configuration. Although you can reuse the transducer for up to two hours after the heating is switched off, without making a new calibration, you are recommended to recalibrate before applying it to a patient. After two hours without heat, you must recalibrate.

During the initial few minutes of use, the monitor eliminates false alarms by temporarily suppressing tcGas alarms. It displays the "STABILIZING" INOP. After you apply the transducer to the skin, the instrument reading slowly assumes a steady value. The reading stabilizes when the measurement site is warm and local hyperemization is complete. This takes 10 to 20 minutes for the $tcpO_2$ reading and three to seven minutes for $tcpCO_2$.

Restarting the tcGas SiteTimer

To restart the site timer without recalibration (for example, after the site time has elapsed):

1 In the **Setup tcGas** menu, select **Site Time**.

2 Enter and confirm your desired time.

Disabling the tcGas Site Timer

Depending on your monitor's configuration, you might be able to disable the site timer. Remember, this means that the transducer heats indefinitely while on a patient.

1 In **Setup tcGas** menu, select **Site Timer** and switch this to **Disabled**.

2 Select the **Confirm** popup key.

Setting the tcGas Barometric Pressure

Altitude and barometric pressure affect tcGas values. The monitor derives barometric pressure from its altitude setting. If you want to set the true barometric pressure you must do this **before** starting a calibration - changes after calibration do not influence tcGas values. The monitor remembers this pressure setting until you enter a new one.

1 In the **Setup tcGas** menu, select **AmbientPress**.

2 Enter the current barometric pressure reading indicated by your barometer.

3 Select the **Confirm** popup key.

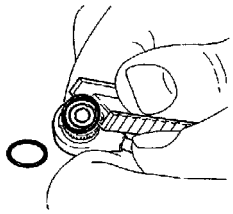
Remembraning the tcGas Transducer

CAUTION The tcGas transducer is thin and flexible. You must treat it with care. Avoid kinking, bending or pulling the cable.

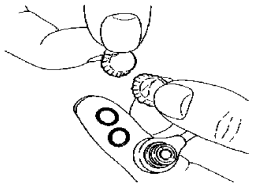
Remembrane the transducer if the electrolyte in your transducer has dried out or:

- if the transducer is new
- if you are using the transducer with a new patient
- if the membranes are damaged (scratched or wrinkled)
- after five days of continued use or 28 days of storage.

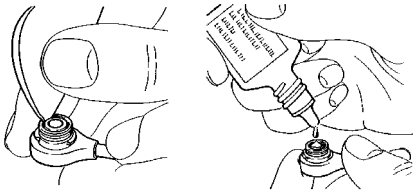
1 Unscrew the protection cap from the transducer and hook the O-ring remover under both O-rings to remove them.



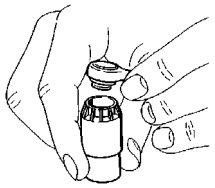
2 Remove **both** of the clear plastic membranes using your fingers.



3 Clean the transducer head, including the groove and rim, with absorbent paper to remove all old electrolyte (old electrolyte causes incorrect values) and apply approximately two drops of electrolyte solution to the transducer head.



4 Press the transducer head downwards into an unused membrane replacer until the replacer retracts as far as it can and you hear a click. Discard used replacer.



5 Remove any surplus electrolyte solution on the outside of the membranes with a soft tissue.

6 Make sure that the new membranes are secured by two O-rings on the transducer. If any air bubbles are visible under the membranes, repeat this procedure - air bubbles will cause incorrect readings.

7 After 24 hours you can calibrate the transducer. You must remembrane all new and dried out transducers twice before calibration.

New/Dried Out Transducers

Remembrane all new or dried out transducers twice before using. After the first remembraning, unplug the transducer from the module and leave it for 24 hours with the cap on. Remembrane again before calibrating.

Storing tcGas Transducers

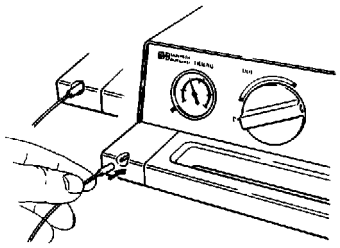
If you need to store a sensor for more than 24 hours, protect it for up to 28 days by putting two drops of electrolyte solution into the cap. Screw the cap on the sensor. Remembrane if it dries out or after 28 days.

Calibrating the tcGas Transducer

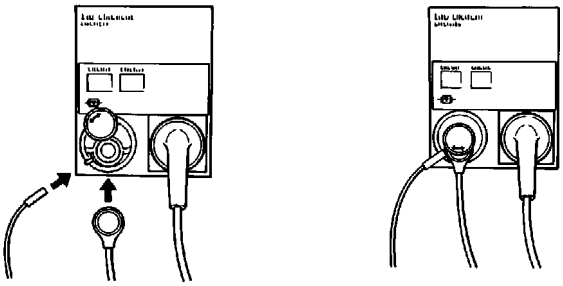
You can use either a Philips (15210B) or a Radiometer TCC3 calibration unit and a gas cylinder whose pressure indicator is above the 'out-of-gas' zone (black on 15210B, red on TCC3). To maintain accuracy, it is recommended to calibrate the transducer every four hours, even if the monitor does not prompt you to do so. You MUST calibrate when:

- you remembrane the transducer
- you change the transducer heat setting
- you doubt the measurement accuracy
- you start a new monitoring period or use a new site
- the monitor displays the "calibration required" INOP message.

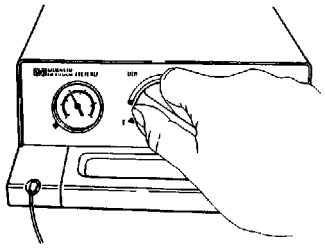
1 Connect the calibration unit to the inlet on the side of the module's calibration chamber using the recommended gas tubing. Different tubing will cause inaccurate measurements.



2 Plug the transducer cable into the module. Swing the calibration chamber cover open and insert the transducer into the chamber. Close the cover to secure the transducer. Set the transducer temperature at the monitor now.



3 On the 15210B calibration unit, turn the timer control clockwise as far as you can. On the Radiometer calibration unit, press the button with the green arrow once.



4 Press CAL on the module until the light above the key comes on and wait (three - 20 minutes) for the "calibration complete" message to appear on the monitor. Alternatively, in the **`Setup tcGas`** menu, select **`Start Calibration`**. To save gas on 15210B, if the timer control dial is not in the start position when the monitor displays the calibration complete message, turn the dial counter-clockwise to the start position. For TCC3, if the green light is still flashing when INOP "tcGas CalRunning" disappears, press the green arrow button again.

Calibration Failure

If calibration fails, the monitor displays "...**`tcGas transducer or Cal Unit malf`**" and the CAL FAILED INOP for the measurement.

Troubleshooting tcGas Calibration

Perform each of the following steps, in order, until calibration is successful.

1 Check the calibration unit, then recalibrate, remembering to turn on the gas supply on the calibration unit. If the pressure indicator reading is in the out of gas zone, there is insufficient gas in the cylinder. Connect the gas tubing firmly to the calibration unit and to the module's calibration chamber.

2 If Step 1 fails, check whether you need to **activate** the transducer (necessary if the electrolyte has dried out or if you have a new transducer). Remembrane the transducer, removing the old membranes, and cleaning the transducer head thoroughly.

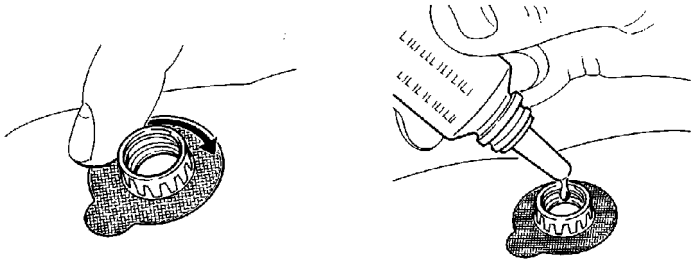
3 Calibrate a second time.

4 If Step 2 is unsuccessful, calibrate again. This calibration may be required to stabilize the electrochemical system in the transducer.

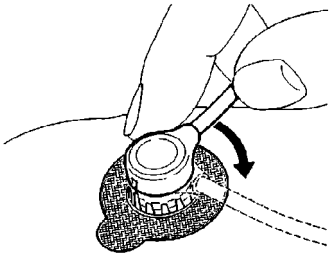
5 Only if the above steps are unsuccessful (you have activated and remembraned the transducer and calibration has still failed twice), replace the transducer.

Applying the tcGas Transducer

1 Peel protection film from fixation ring. Using a finger, press the sticky side of the ring on to clean, dry skin. Press around the outside to ensure a good seal. Apply three to five drops of contact fluid in the ring's center. Remove transducer from chamber.



2 Align the arrow on the transducer with the tab on the ring and fasten by turning turn a quarter-turn clockwise. Wait 10-20 minutes for readings to stabilize.



3 Apply the transducer as soon as possible after you see the "...calibration complete" message. If you wait longer than 30 minutes, the heat supply to the transducer switches off to prevent the electrolyte from drying out and a new calibration is necessary.

Optimize the measurement by selecting a site with high capillary density and blood flow, thin epidermis and no cardiovascular disorders. Most physicians use the abdomen, chest and back.

WARNING You must either remove the transducer before defibrillating, or remembrane and calibrate the transducer after defibrillating.

CAUTION To avoid transducer damage, remove it from the patient during high frequency surgical procedures.

Selecting the tcGas HeatPowerDisplay Mode

The heat power display gives an indication of the skin's perfusion below the transducer and of the transducer's contact with the skin. If the transducer loses contact, the heat power value drops significantly. When perfusion is poor you need less heat power to maintain the transducer temperature.

- In the **Setup tcGas** menu, select **HeatPowerDisplay** to toggle between **Relative** and **Absolute**. Choose **Relative** when the skin temperature is stable (the **STABILIZING** INOP disappears). This indicates subsequent changes in the relative heat power (and therefore changes in perfusion or transducer contact) since the last zeroing.

Zeroing the tcGas Relative Heat Power

When you start a calibration, the **HeatPowerDisplay** is set to **Absolute**. When you switch to **Relative**, it automatically zeros. Zero again if you change application site.

Finishing tcGas Monitoring

- Replace the transducer in the calibration chamber.

When changing the application site after a measuring period, some users leave the fixation rings in position to allow them to quickly move the transducer from site to site. Always unscrew the transducer from the fixation ring before removing the fixation ring from the skin.

TcGas Corrections

Transcutaneous pCO_2 values tend to be higher than arterial values due to the metabolic processes of the skin and the effect of heating on the blood under the transducer. Depending on your monitor's configuration, one or both of these corrections may automatically apply.

Temperature Correction for tcpCO_2

The transducer temperature causes an increase in partial CO_2 pressure. Your monitor may be configured to correct this.

- In the **Setup tcpGas** menu, look at the menu item **CO2 Correction**. If correction is enabled, it is set to **On**.

Metabolism Correction for tcpCO_2

CO_2 production in the epidermis increases the CO_2 value. Your monitor may be configured to automatically deduct a metabolism factor (only applies when **CO2 Correction** is on).

- In the **Setup tcGas** menu, look at the value shown for the menu item **MetabolismFactor**. This is deducted from the CO_2 value.

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Monitoring $S\bar{v}O_2$

MP60/70/90 monitors only

The $S\bar{v}O_2$ module measures the percentage of mixed venous oxygen saturation continuously and invasively using the Abbott Laboratories OptiCath family of catheters routed via the right side of the heart into the pulmonary artery. Can be used only with the MP60/MP70/MP90 monitors.

WARNING

Injected dyes, such as methylene blue, or intravascular dyshemoglobin may lead to inaccurate measurements.

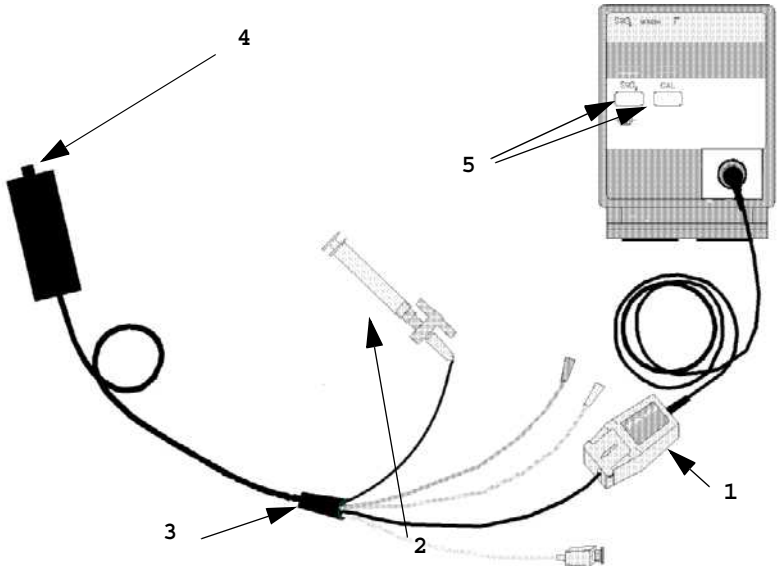
Do not monitor oxygen saturation during infusion of I.V. fat emulsion or other turbid substances through the distal lumen of the OptiCath catheter. These liquids might temporarily modify the blood scattering and absorption characteristics at the catheter tip. This interferes with the optical measurement of oxygen saturation. After infusion is complete, you can again monitor oxygen saturation accurately.

During injection of the bolus for thermodilution cardiac output measurements, the $S\bar{v}O_2$ measurement might be disturbed.

Preparing to Monitor $S\bar{v}O_2$

In addition to an $S\bar{v}O_2$ module, you need an Abbott Laboratories OptiCath catheter, and 50131-04 Optical Module. Use only the Abbott accessories listed in the Accessories section.

1 optical module
2 balloon inflation stopcock
3 Abbott fiber optic catheter
4 optical reference
5 enter setup/ calibration



Connect the optical module (Abbott 50131-04) to the $S\bar{v}O_2$ module. Allow the optical module to warm up before you perform a calibration. Although the warm up message disappears from the screen after one minute, Abbott recommends letting the optical module warm up for 15 minutes for best accuracy. Please refer to the instructions for the optical module.

To avoid false alarms during the pre-insertion calibration and insertion of the catheter into the patient, the monitor automatically suspends alarms during the pre-insertion calibration, for up to three minutes after you remove the catheter tip from the optical reference. After light intensity calibration, or after three minutes (whichever comes first), the monitor returns to the alarm state it was in prior to pre-insertion calibration.

Carrying out a Pre-insertion Calibration

WARNING It is strongly recommended to carry out a pre-insertion calibration prior to all insertions. If this is not possible, you must perform an in-vivo calibration after insertion.

Refer to the instructions for use that accompany the catheter. Do not use the catheter if the packaging is damaged. If you have to disconnect the monitor from the patient (for example, when transferring the patient from one location to another), you must disconnect at the $S\bar{v}O_2$ module. The catheter should remain in the optical module, otherwise you need to recalibrate.

1 Remove outer wrapping from catheter tray to uncover optical connector.

2 Place the optical module on the catheter tray in the space provided and open the lid.

3 Place the optical connector into the optical module (with the label "**TOP**" facing upwards) and close the lid.

4 In the **Setup SvO2** menu, select **Start Pre-InsCal**. Ensure that the tip of the catheter is still in the optical reference.

5 Insert the catheter when you see the message **SvO2 calibration completed - catheter ready for insertion**. If the calibration fails, repeat the calibration before inserting the catheter. If it fails a second time, replace the optical module.

Inserting the Catheter

1 Remove the inner cover of the catheter tray.

2 Remove the catheter tip from the optical reference. Check the catheter's proper operation (for example: the balloon tip).

3 Prepare and insert the catheter in accordance with standard hospital practice.

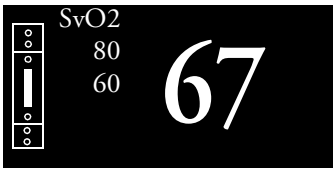
The $S\bar{v}O_2$ catheter is thin and flexible, treat it carefully. Avoid kinking, bending or grasping the catheter with forceps or a hemostat. Damage to the fiber results in low intensity light and sudden decrease in intensity readings. Refer to the documentation provided with the fibre-optic catheter, paying special attention to any precautions, warnings or contraindications.

Secure the optical module directly or in close proximity to the patient, to avoid placing excessive tension on the catheter, which would result in movement of the catheter tip from the optimal position in the patient. Position the optical module to avoid contact with liquids, because fluid entering the catheter-optical module connection may impair light transmission.

If you place the catheter in the patient without performing the pre-insertion calibration, you **must** perform an in-vivo calibration once the catheter is in place.

Performing a Light Intensity Calibration

Perform a light intensity calibration after the catheter is in its proper position. When the catheter is positioned properly, the light intensity indicator must cover at least two small divisions above the midpoint.



♦ In the **Setup SvO2** menu, select **Start Light Cal**.

Calibration is complete after a few seconds. If you doubt existing light intensity readings, recalibrate.

Performing In-Vivo Calibration

Perform an in-vivo calibration:

- if you place the catheter in a patient *without* performing a pre-insertion calibration.
- if the catheter was disconnected from the optical module.
- when the catheter has been in the patient for 24 hours.
- if any significant change in light intensity occurs that the monitor cannot correct automatically.

Setting Up the In-Vivo Calibration

Check for:

- proper positioning of the catheter in the patient.
- relatively stable oxygen saturation in patient.
- that the $S\bar{v}O_2$ light intensity indicator covers at least two divisions above the midpoint.

Making the In-Vivo Calibration

1 Be prepared to draw a blood sample from the patient.

2 In the **Setup SvO2** menu, select **Start In-VivoCal**.

3 To clear the distal lumen, draw off and discard at least 2 ml of blood before taking the sample.

4 Draw a blood sample from the distal port of the catheter and flush the line according to standard hospital practice.

5 Obtain laboratory analysis of the sample using direct measurements.

6 Compare the results with the stored calibration value displayed in the **Setup SvO2** menu. If the difference is less, or equal, to 4%, you can skip the next step.

7 If there is a difference of more than 4% between the stored value and the laboratory value, select **CalibrationValue** to adjust the stored value. Selecting **Recall PreviousC** recalls the previously stored calibration value.

8 Complete the calibration by selecting **Store In-VivoCal** (even if you did not adjust the calibration value). This updates the data stored in the optical module.

Calculating Oxygen Extraction

Oxygen extraction is the difference between the measured SpO_2 and $S\bar{v}O_2$ values. If you are monitoring SpO_2 and $S\bar{v}O_2$, the monitor can calculate this value and display it as a numeric.

♦ To switch oxygen extraction calculation on or off, in the **Setup Sp-vO2** menu, select **Sp-vO2** and toggle between **On** and **Off**.

♦ If more than one SpO_2 value is available, you must choose which value is used in the calculation. In the **Setup Sp-vO2** menu, select **SpO2 Source** and select the required source.

If one of the calculation sources becomes unavailable, the monitor displays the INOP **Sp-vO2 CHK SOURCES** for one minute. After this time, the calculation automatically switches off. If the missing source becomes available again, the calculation automatically switches on again.

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Using the AGM

The M1026A Anesthetic Gas Module (AGM) measures patients' anesthetic and respiratory gases. It can measure and display waves and numerics for 3 respiratory gases, and it can automatically identify 5 anesthetic agents and display waves and numerics for one of these.

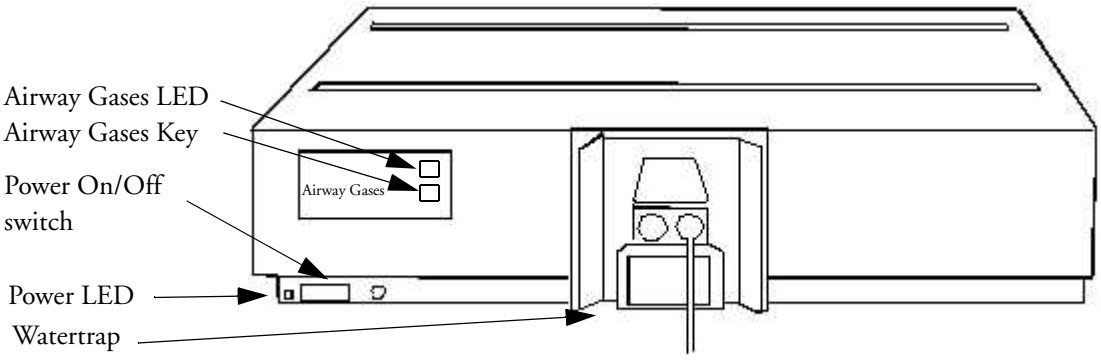
The module measures the Airway Respiration Rate (awRR) and provides end tidal (et) and inspired (in) values for the following gases:

Respiratory Gases	Anesthetic Agents
Carbon dioxide (CO_2)	Halothane
Nitrous oxide (N_2O)	Isoflurane
Oxygen (O_2)	Enflurane
	Sevoflurane
	Desflurane

Understanding the AGM Display

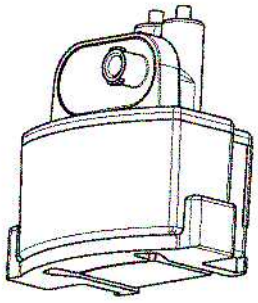
The AGM can send waves and numerics for all measured gases for display on the monitor screen. This example shows the CO_2, O_2, and N_2O waves and numerics. Your display may be configured to look different.

AGM Major Parts and Keys



The setup airway gases LED lights when the **`Setup Gas Analyzer`** menu is open, when the module is first switched on (for 5 - 10 seconds), and if there is a problem with the communication between the AGM and the monitor.

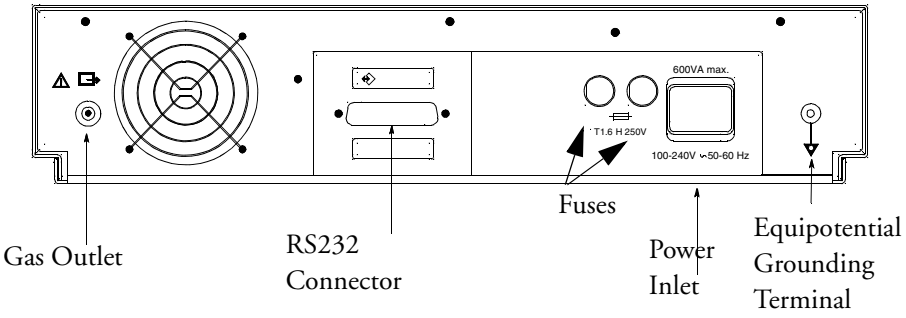
Watertrap



The watertrap prevents water and other fluids from passing into the AGM and causing contamination and/or internal occlusions. It has a water reservoir in which fluids are collected, two water separation filters, and two shut-off fuses as a backup mechanism for the water separation filters.

The watertrap is for multi-patient use. It must be exchanged at least every two weeks.

AGM Rear Panel



Make sure all devices connected to the RS232 connectors are isolated. Make sure that the anesthetic gas outlet at the rear of the module is connected to the gas scavenging system.

See the Service Documentation supplied with the device for further information on connecting devices.

Understanding the Gas Measurement

The AGM uses a technique called Non-Dispersive Infrared Gas Concentration Measurement (NDIR) to measure the concentration of certain gases.

The gases which can be measured by the AGM absorb infrared (IR) light. Each gas has its own absorption characteristic. The gas is transported into a sample cell, and an optical IR filter selects a specific band of IR light to pass through the gas. For multiple gas measurement, such as in the AGM, there are multiple IR filters. The higher the concentration of gas in a given volume the more IR light is absorbed. This means that higher concentrations of IR absorbing gas cause a lower transmission of IR light. The amount of IR light transmitted after it has been passed through an IR absorbing gas is measured. From the amount of IR light measured, the concentration of gas present can be calculated. This calculation provides the gas measurement value.

Connecting AGM Accessories

The AGM accessories and part numbers are listed in the accessories section.

1 Insert a watertrap by gently pushing it up and in, following the instructions supplied with the watertrap.

2 Switch on the AGM. This allows time for the module to warm up while connections to the patient are being made.

3 Connect the gas sample tubing to the Luer connector of the watertrap, following the instructions supplied with the tubing.

4 Connect the other end of the gas sample tubing to the patient via the airway adapter.

CAUTION **Airway Adapter:** Use a Philips Airway Adapter and position it so that the part connecting to the gas sample tube is pointing upwards. This prevents condensed water from passing into the gas sample tube and causing an occlusion. Philips airway adapters have a built-in port extending from the adapter wall, which reduces the risk of a blockage occurring.

Watertrap: To minimize the risk of internal contamination, never leave the AGM running without a watertrap attached (except during a watertrap exchange).

Gas Sample Tube: Do not use the gas sample tube if it is kinked, as it may cause an occlusion or leakage.

Room Ventilation Make sure that the room in which the AGM is used is well-ventilated with fresh air. Gases or fumes that mix with and contaminate the room air may degrade measurement accuracy.

WARNING Ensure that the connections are tight. Any leak in the system can result in erroneous readings due to ambient air mixing with patient gases.

Using the AGM Setup Menus

Many AGM settings can be changed just like other measurement settings. These are described in the chapter on Basic Operation, only AGM-specific settings are described here.

To change settings for individual gases, enter the setup menu for the individual gas:

- select the measurement numeric on the monitor screen, or
- select the required gas label in the **Setup Gas Analyzer** menu.

To change AGM settings, enter the **Setup Gas Analyzer** menu:

- select one of the AGM numerics on the monitor screen and then select the menu item **Gas Analyzer**, or press the Airway Gases hardkey on the AGM.

Choosing Numerics for Display

For each gas the AGM measures, you can choose which numerics are displayed with the waveform on the screen:

- **et** displays the endtidal numerics,
- **in** displays the inspiratory numerics,
- **et+in** displays both endtidal and inspiratory numerics.
- **Off** switches off measurement of that particular gas.

No waveforms or numerics will be shown for gases set to **Off**, and no alarms will be generated.

To change the displayed numeric, in the **Setup <Gas Label>** menu, select the label of the gas measured to call up a pop-up list of numerics available and then select the numeric you want to display.

As the inspired minimum is measured for CO_2 (imCO_2), the numeric label is **im** instead of **in**.

Humidity Correction for CO_2

The AGM is configured to correct the CO_2 measurement for either Body Temperature Pressure Saturated (BTPS), to account for humidity in the patient's breath, or Ambient Temperature Pressure Dry (ATPD).

- In the **Setup CO2** menu, see the menu item **Humidity Corr.** to see which correction applies. It is either **Wet** for BTPS or **Dry** for ATPD.

Adjusting Wave Scales

1 In the **Wave** menu or the **Setup** menu for the gas, select **Scale**.

2 Choose a suitable scale range from the pop-up list.

Changing the Apnea Alarm Delay

The apnea alarm delay time determines the time limit after which the monitor alarms if the patient stops breathing.

1 In the **Setup CO2** menu, select **awRR**.

2 In the **Setup awRR** menu, select **Apnea Time**.

3 Choose the apnea alarm delay time.

WARNING The safety and effectiveness of the respiration measurement method in the detection of apnea, particularly the apnea of prematurity and apnea of infancy, has not been established.

Deriving Limit Alarms from awRR

1 In the **Setup CO2** menu, select **awRR**.

2 In the **Setup awRR** menu, select **Alarms**.

3 Select **On** to derive alarms from the airway respiration signal or **Off** to disable them.

Alarms and Zero Calibration

When a zero calibration is in progress, the physiological alarm detection is suspended. When the calibration is finished, the AGM resumes alarm detection. If an alarm condition is present after the zero calibration, the alarm will be activated within the specified alarm delay time.

WARNING If an apnea occurs during a zero calibration, the time delay between the start of apnea and the activation of the apnea alarm could be up to 16 seconds plus the configured apnea delay time.

Automatic Alarm Suppression

Your monitor can be set to suppress alarms until it detects that a patient has been connected to the AGM (when a breath is detected). This feature is called **No Al til Breath** and can be set to **On** or **Off** in the monitor's Configuration Mode.

Agent Identification

Setting the agent identification mode to **Agent Id: Manual** lets you choose the anesthetic agent manually. If you choose the setting **Agent Id: Auto**, the AGM automatically identifies the predominant anesthetic agent in the breathing circuit.

- To change the agent identification mode, in the **Setup AGT** menu, select **Agent Id:** to toggle between the settings **Auto** and **Manual**.

If Agent ID is Set to Manual

To change the agent monitored, when **Agent Id** is set to **Manual**:

- In the **Setup <Agent label>** menu, select **Agent** to call up a pop-up list of available agents and select the agent you want to monitor. For example, **Setup HAL**.

If the manually selected agent does not match the agent detected, the INOP **CHECK AGENT** appears.

If Agent ID is Set to Auto

As soon as the AGM has detected the agent, a waveform and numerics for this agent appears on the monitor screen, if they are configured to be displayed. During the process of identification, the generic label **AGT** is shown as a placeholder.

For an anesthetic agent to be detected by automatic agent identification, its concentration must exceed the identification threshold. The presence of other substances in the patient such as methanol or acetone can influence the agent identification and lead to incorrect values and incorrect identification.

Exchanging Agents

If the anesthetic agent administered to the patient changes, a mixture of both gases is detected by the AGM during the transition. The time needed to complete the exchange depends on the type of anesthesia (low flow or high flow), and the characteristics of the agents administered (pharmacokinetics). During the exchange, you will see the INOP message **AGT MIXTURE** and **-?-** next to the affected numerics.

If you are using automatic agent identification, when one of the agents decreases below its threshold and the other agent predominates, the monitor will recognize the exchange.

If you are using manual agent identification, you must change the agent in the **Agent Setup** menu to match the administered agent.

Agent ID During Emergence from Anesthesia

If automatic agent identification is selected during emergence from anesthesia and the agent concentration falls below the identification threshold, the agent will no longer be identified. The agent label will remain on the display and the numeric will show **0.00 %** until the monitor detects that a patient is no longer connected. After this, the generic label **AGT** will be shown.

- To display the correct agent and value, change to manual identification and select the agent manually.

Removing Gas from the Circuit

If inhalation anesthetics are used during anesthesia, pollution of the operating room should be prevented by either returning the filtered gas sample to the breathing circuit or by disposing of the gas sample.

Your hospital policy may not permit the use of gas return systems.

Returning the Gas Sample

Use an M1656A Gas Exhaust Return Filter and M1655A Exhaust Return Tubing as instructed in the documentation supplied with the filter to return the gas sample to the patient's breathing circuit.

Removing the Gas Sample

To remove the gas sample from the breathing circuit, a scavenging system must be connected to the gas exhaust port. Use either:

- a gas exhaust scavenging tube
- a suction bottle reservoir, where the suction pressure does not exceed 0.3-0.4mm Hg
- a scavenging interface.

Entering AGM Standby Mode

During standby, the AGM gas sample intake pump is automatically switched off to increase the pump lifetime. The message **AGM STANDBY** is shown on the monitor. When you exit standby, you do not need to wait for the AGM to warm up to resume monitoring.

The AGM standby mode is linked to the monitor standby mode:

- If the monitor enters standby mode, the AGM also enters standby mode.
- If the monitor leaves standby mode, the AGM automatically also leaves standby mode.
- If the AGM enters or leaves standby mode, this does not affect the monitor.

The AGM enters standby mode automatically when no breath is detected for a configured period of time (if CO_2 is less than 4 mmHg).

To enter or leave standby mode manually:

- in the **Setup Gas Analyzer** menu, select **Set to Standby** or **Exit Standby**.

Zero Calibration

The AGM zero calibration maintains the accuracy of the AGM gas measurements by sampling and analyzing room air. It takes about 10 to 15 seconds to complete and may not be interrupted. If a zero calibration fails, a second zero calibration is performed automatically. During the zero calibration, the waveform is flat and numerics are not updated.

Automatic Zero Calibration

A zero calibration is carried out automatically after the module has been switched on, and then 8, 15, 30, 45, and 90 minutes after monitoring has been started. After that, a zero calibration is triggered every 8 hours or if a measurement drift is detected. If the AGM was in standby when one of the above triggers for zero calibration occurred, the zero calibration is carried out when the AGM leaves standby.

Carrying Out Manual Zero Calibration

♦ To manually start a zero calibration, in the **Setup Gas Analyzer** menu, select **Zero Cal**, then select the **Confirm** pop-up key.

Suppressing Zero Calibration

To temporarily prevent an automatic zero calibration from being started,

♦ in the **Setup Gas Analyzer** menu, select **No Zero for 5min**.

Selecting **No Zero for 5min** again before the timer has timed out resets the timer to five minutes.

Using the AGM During a Cardiopulmonary Bypass

During a cardiopulmonary bypass, the anesthesiologist may cease periodic mechanical ventilation. In these cases, it is important to note that an active AGM will continue to suck gases from the patient-ventilator circuit during that time. This will cause the airway pressure to drop if no active measures are taken to keep the patient-ventilator circuit stable. To stop the AGM from sucking gases out of the circuit, either:

- activate the AGM standby mode or
- disconnect the sample line from the AGM or from the patient-ventilator circuit.

AGM Safety Information

To avoid condensed water collecting in the gas sample tube, position the AGM at or above the patient level. Do not set up the AGM in a position where liquid could spill onto it.

WARNING **Detecting leaks:** Any leak in the tubing and connections from the patient to the AGM may result in dilution of the gas mixture with ambient air. If this leak exceeds a certain magnitude, the value of gases and anesthetic agents displayed on the monitor may differ significantly from the actual concentration in the patient's breathing circuit. Erroneous values may lead to inappropriate intervention and patient safety may be at risk.

Unexpected values: If an unexpected gas concentration value appears on the monitor, or if the waves appear to be flatter than normal, visually inspect the entire tubing and replace if necessary. If no occlusion or leakage can be found, replace the watertrap with a new one and check the values.

CAUTION **AGM ports:** Do not apply excessive pressure to the AGM inlet or outlet ports, for example from a syringe, as this may cause damage to the pneumatic and optical systems.

Cleaning: Switch off the AGM during cleaning, as an intake of cleaning fluids or fumes may damage the device.

18

Monitoring EEG

The Electroencephalograph (EEG) module monitors the patient's cerebral function by measuring the electrical activity of the brain. It provides the monitor with two channels of realtime EEG waves, EEG trend information in the form of Compressed Spectral Arrays (CSA), and up to eight of the following numerics:

Spectral Edge Frequency (SEF): The SEF is the frequency below which a defined percentage of the Total Power lies. The percentage is set in Configuration Mode.

Mean Dominant Frequency (MDF): The MDF is the mean value of the frequency which dominates the measured EEG.

Peak Power Frequency (PPF): The PPF is the frequency with the highest measured amplitude.

Total Power (TP): The TP numeric indicates the power in the measured frequency band.

Percentage of total power in each frequency band:

- **`Alpha`** waves (8 to 13 Hz)
- **`Beta`** waves (13 to 30 Hz)
- **`Theta`** waves (4 to 8 Hz)
- **`Delta`** waves (0.5 to 4 Hz).

EEG Monitoring Setup

1 Plug the trunk cable into the EEG module in the Flexible Module Server.

2 Prepare the patient's skin prior to placing the electrodes. Good electrode-to-skin contact is important for a good EEG signal, as the skin is a poor conductor of electricity.

– Shave hair from sites, if necessary.

– Wash sites thoroughly with soap and water. We do not recommend using ether or pure alcohol, because this dries the skin and increases the resistance.

– Use a skin preparation paste to remove skin cells and oil before placing the electrodes.

3 Select the desired electrode montage in the **Setup EEG** menu or in the **EEG Impedance/Montage** window.

4 Attach the reference electrode first.

5 Place the electrodes on the patient's head according to the selected montage. Use electrode gel if you are not using pre-gelled electrodes. Remember to select a site where the signal will not be interfered with by muscle artifacts.

6 Connect the electrode connector end to the trunk cable.

7 Check the electrode-to-skin impedance in the **EEG Impedance/Montage** window.

8 For good signal quality, keep all lead wires together and away from other electric devices and metallic bodies.

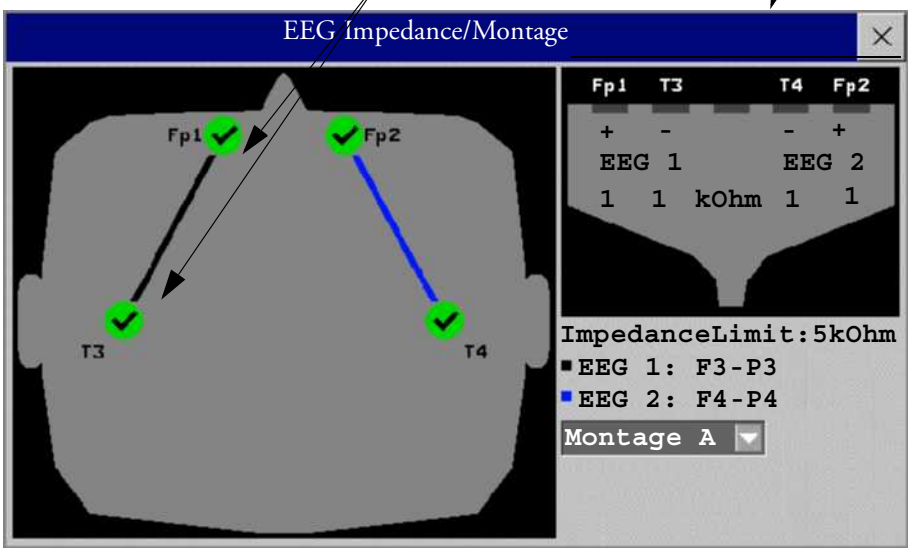
Using the EEG Impedance/Montage Window

♦ To open the window, in the **Setup EEG** menu, select **Show Montage**, or select the **Show Montage** pop-up key.

The window may be configured to look slightly different on your monitor.

Electrode locations on the patient's head. The symbols represent the electrode-to-skin impedance.

Wiring and impedance values for the selected montage



Choosing an EEG Electrode Montage

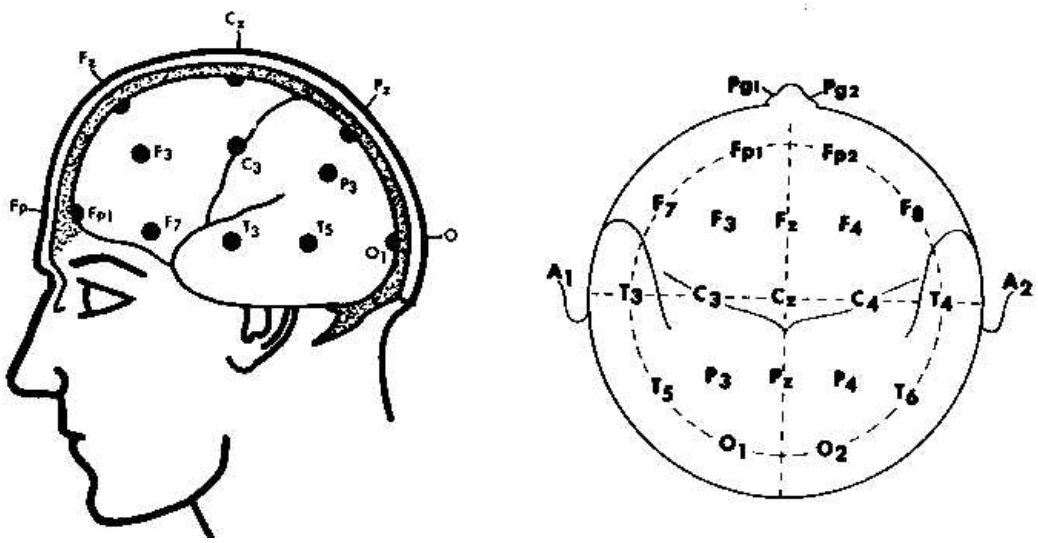
1 To activate one of the five pre-configured electrode montages, select the arrow beside the label in the **EEG Impedance/Montage** window and choose a montage from the list.

2 Attach the electrodes as illustrated in the **EEG Impedance/Montage** window.

The five default electrode montage configurations can be modified and renamed in Configuration Mode.

Montage Name	EEG1+	EEG1-	Label1	EEG2+	EEG2-	Label2
Mont.A	Fp1	T3	Fp1-T3	Fp2	T4	Fp2-T4
Mont.B	O1	T3	O1-T3	O2	T4	O2-T4
Mont.C	F3	C3	F3-C3	F4	C4	F4-C4
Mont.D	C3	P3	C3-P3	C4	P4	C4-P4
Mont.E	Fp1	T5	Fp1-T5	Fp2	T6	Fp2-T6

The electrode locations are labeled according to the international 10-20 electrode placement system.



Changing the Impedance Limit

The impedance limit can be set for all electrodes simultaneously in the **Setup EEG** menu, or in the **EEG Impedance/Montage** window using the pop-up keys. If the limit is exceeded during monitoring, an INOP will appear and the graphic impedance indicator will change.

To change the impedance limit, either

- use the pop-up keys that appear with the **EEG Impedance /Montage** window, or
- in the **Setup EEG** menu, select **Impedance Limit** to call up a list of selections between 1 and 30 kOhm, then select the required limit from this list.

About Electrode-to-Skin Impedance

Electrode-to-skin impedance is the main quality indicator for the measured EEG signal. During normal EEG monitoring, electrode-to-skin impedance is measured continuously and disconnected electrodes are detected. The impedance value for each single, independent signal electrode is displayed in the **EEG Impedance/Montage** window. If the measured electrode-to skin impedance of one or more electrodes is above the limit, an INOP will be issued.

For impedance measurement at least two electrodes, plus the reference electrode, must be connected.

Impedance Indicators

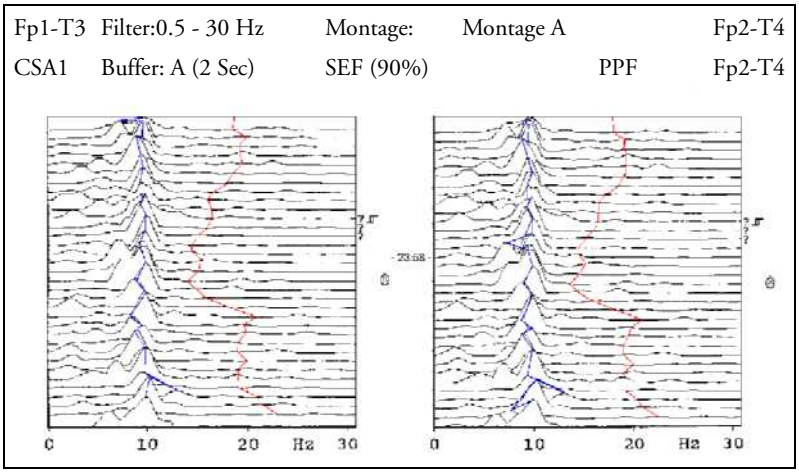
Electrode/Skin Impedance	Symbol	Color	Displayed Impedance Value	Action
Electrode not connected		red	no value	connect electrode
Noisy signal		gray	60 kΩ (fixed)	check electrode-to-skin connections
Electrode connected, impedance above limit		yellow	measured value (e.g 15 kΩ)	check limit, check electrode-to-skin contact
Electrode connected, impedance at or below limit		green	measured value (e.g. 3 kΩ)	no action necessary

About Compressed Spectral Arrays (CSA)

The continuous EEG signal is sampled periodically and this value is stored in a frame. Each frame is processed using Fast Fourier Transformation (FFT) to provide a frequency spectrum displayed as a compressed spectral array (CSA).

The CSAs provide an overview of the patient's EEG values over time. They can be configured to be shown on the resting display of your monitor. The CSAs may be configured to look slightly different on your monitor.

Selecting the CSA opens the EEG pop-up keys to let you carry out EEG monitoring tasks.



The CSA contains the following information		
Status line	Lead label	for example, Fp1-T3, Fp2-T4
	CSA label	CSA1 or CSA2 according to EEG channel
	Montage label	for example, Montage A
	Filter settings	for example, 1-30 Hz
	Buffer label and time	the buffer and interval between spectral lines on the CSA
	Current SEF Threshold	can only be changed in Configuration Mode
Spectral lines	The energy at each frequency is computed and displayed as a spectral line	
Trendlines	EEG values are sampled at configured time intervals and displayed as color-coded trendlines. Trendlines are available for the three frequency numerics (SEF, PPF, MDF)	
Annotations:	?	INOP marker
		Filter change marker
		Montage change marker

Displaying CSAs

To show the CSAs on the resting display (if your monitor has a Screen preconfigured to do this),

1 Select the **Change Screen** SmartKey to call up a list of available preconfigured screens.

2 From this list, select the screen configured by your unit to show CSAs.

3 In the **Setup EEG** menu, select **Setup CSA** to enter the **Setup CSA** submenu to define the appearance of the CSA on the monitor display(s).

Setup CSA	This menu entry lets you
Buffer	choose one of the three pre-configured buffers
Trend SEF/MDF/PPF	switch the trendline of the specific numeric on or off
Smoothing CSA	see whether smoothing of spectral lines is on or off. This can only be changed in Configuration Mode.

Changing EEG Settings

Be aware that any changes made to EEG settings apply to both EEG channels.

Switching EEG Numerics On and Off

Each EEG numeric can be individually switched on or off in the **Setup EEG** menu.

1 In the **Setup EEG** menu, select the numeric label.

2 Select **On/Off** to toggle between the settings.

Changing the Scale of the EEG Waves for Display

This only changes the visual appearance of the wave. It does not affect the signal analyzed by the monitor or printed in reports or recordings.

1 In the **Setup EEG** menu, select **Wave Scale** to call up a list of wave scales.

2 Select the required scale from this list.

Scaling information is displayed with each EEG wave.

- If **Show Gridlines** is set to **On** in Configuration Mode, gridlines and the current wave scale values are shown with the EEG wave.
- If **Show Gridlines** is set to **Off** in Configuration Mode, the current wave scale is indicated by a size bar beside the EEG wave.

Changing Filter Frequencies

The low and high pass filters screen out undesirable interference from the raw EEG wave display. The current EEG filter frequency settings are shown in the header of the CSA. Changing filter settings affects the EEG wave and all the EEG numerics. Whenever the filter setting is changed, a filter change marker appears next to the spectral lines.

To change the filter settings:

1 In the **Setup EEG** menu, select **Low Filter** or **High Filter** to call up a list of available frequencies.

2 Select the required frequency from this list.

Changing the Speed of the EEG Wave

The EEG measurement has its own speed control and is not affected by the wave speed settings of the other measurements.

- In the **Setup EEG** menu, select **EEG Wave Speed**. Choose the required speed from the pop-up list. This defines the speed at which the wave is drawn across the screen in millimeters per second (mm/s).

EEG Reports

The content of EEG Reports is always the same and does not need to be configured.

- To print an EEG Report, in the **Setup EEG** menu, select **Print Report**.

  Alternatively, you can select the CSA and use the **Print Report** pop-up key to start the report.

- To modify the buffer and trendline settings on the CSA Report, in the **Setup EEG** menu, select **Setup CSA** and then select **CSA on Report**. If you do not change these settings, the monitor will use the default settings SEF Trendlines: On, Buffer: C.

CSA on Report	This menu entry lets you
Buffer	choose one of the three pre-configured buffer times
Trend SEF/MDF/PPF	switch the trendline of the specific numeric on or off
Smoothing CSA	see whether smoothing of spectral lines is on or off. This can only be changed in Configuration Mode.

EEG Safety Information

EEG Configuration and Monitor Upgrades The A.2 monitor release (software revision A.20.xx) introduced a new feature that lets you rename EEG montages. It is not possible to clone EEG settings between montages with different names, therefore all EEG settings are reset to factory defaults during any upgrade/downgrade/cloning actions that mix releases/software revisions/configurations before A.2/A.20.xx with subsequent versions. You must check that all EEG settings are correct before resuming monitoring with a monitor that has been upgraded or cloned.

WARNING Do not touch the patient, or table, or instruments during defibrillation.

When connecting electrodes and/or patient cables, ensure that the EEG leads and connectors do not come into contact with other conductive parts or earth.

High-frequency Surgery To reduce the hazard of burns in the high-frequency surgical neutral electrode connection, the EEG electrodes should not be located between the surgical site and the electro-surgical unit return electrode.

EEG and Electrical Interference

CAUTION Interference from a non-grounded instrument near the patient and electrosurgery interference can cause problems with the waveform and the CSA.

Radiated field strengths above 1 V/m and patient signals ≤ 50 µV may cause noise on the EEG waves at various frequencies. Therefore, it is recommended to avoid the use of electrical radiating equipment in close proximity to the patient monitor. The noise does not influence the measurement accuracy.

Interference from ECG can be eliminated by adjusting the low filter settings.

19

Monitoring BIS

Bispectral Index monitoring helps to monitor the level of consciousness of a patient under general anesthesia or sedation in the OR and ICU. The BIS sensor is placed on the patient's forehead to capture electroencephalographic (EEG) signals from which several numerics are derived, including a single BIS value representing the level of consciousness. See the chapter on Specifications for the BIS intended use statement.

The BIS Module provides the monitor with an EEG wave and the following numerics:

Bispectral Index (BIS). The BIS numeric reflects the patient's level of consciousness. It ranges from 100 (fully awake) to 0 (suppression; no electrical brain activity).

Signal Quality Index (SQI). The SQI numeric reflects signal quality and provides information about the reliability of the BIS, SEF, TP, and SR numerics during the last minute.

It ranges from 0 to 100%:

SQI < 15%: the numerics cannot be derived

SQI 15% to 50%: the numerics cannot be reliably derived

SQI 50% to 100%: the numerics are reliable.

Electromyographic Activity (EMG). The EMG numeric reflects the electrical power of muscle activity and high frequency artifacts.

EMG < 55 dB: this is an acceptable EMG

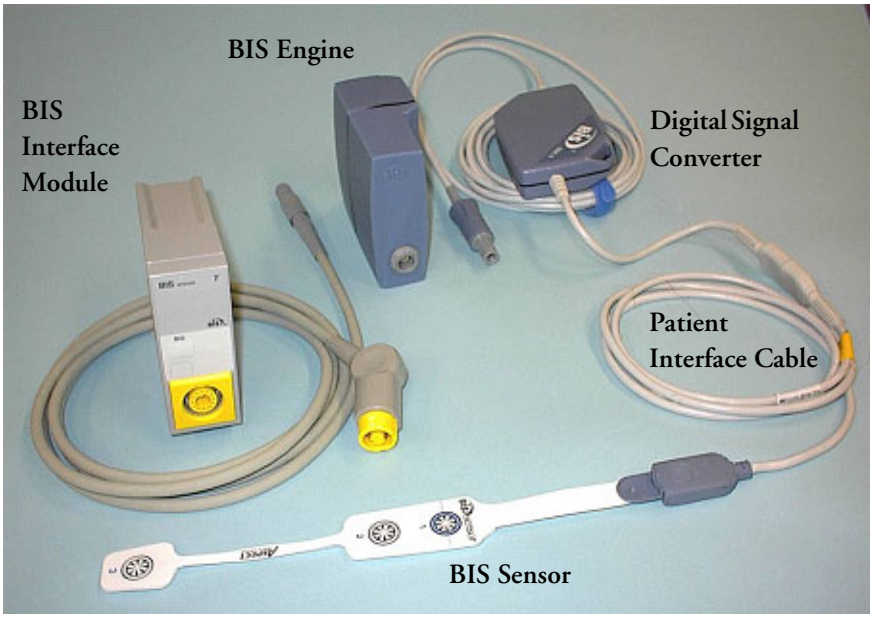
EMG ≤ 30 dB: this is an optimal EMG
(note that the minimum possible EMG is approximately 25 dB).

Suppression Ratio (SR). The SR is the percentage of time over the last 63-second period during which the EEG is considered to be in a suppressed state.

Spectral Edge Frequency (SEF). The SEF is the frequency below which 95% of the Total Power is measured.

Total Power (TP). The TP numeric indicates the power in the frequency band 0.5 to 30 Hz. The useful range is 30 - 100 dB.

BIS Monitoring Setup



1 Connect the BIS Engine to the BIS Interface Module using the BIS Engine Cable.

2 Connect the digital signal converter (DSC) to the digital signal converter port on the rear of the BIS Engine.

3 Attach the patient interface cable (PIC) to the digital signal converter.

4 Attach the BIS Sensor to the patient following the instructions supplied with the sensor.

Make sure that the patient's skin is dry. Be aware that a wet sensor or a salt bridge may cause erroneous BIS and impedance values.

A variety of sensors are available for use in the OR and ICU environments: see the chapter on accessories for information.

5 Connect the BIS Sensor to the patient interface cable.

As soon as a valid sensor is detected, the impedances of all electrodes are measured automatically and the impedance value for each electrode appears in the Impedance Check Window.

6 Use the attachment clip to secure the digital signal converter near, but not above the level of the patient's head.

BIS Continuous Impedance Check

This checks:

- the combined impedance of the signal electrodes plus the reference electrode.

  This is done continuously and does not affect the EEG wave. As long as the impedances are within the valid range, there is no notification of this check or its results.

- the impedance of the ground electrode.

  This is done every ten minutes and takes approximately 4 seconds. It causes an artifact in the EEG wave, and the message **Ground Check** is shown on the monitor screen during the check. If the ground electrode does not pass this check, another check is started. This continues until the ground electrode passes the check.

If the Continuous Impedance Check interferes with other measurements, it can be switched off. To do this:

1 In the **Setup BIS** menu, select **Cont.Imp.Check.**

2 Select **On/Off** to toggle between the settings.

CAUTION Switching the continuous impedance check off will disable automatic notification to the user of impedance value changes, which may lead to incorrect BIS values. Therefore, this should only be done if the check interferes with or disturbs other measurements.

BIS Cyclic Impedance Check

This measures the exact impedance of each individual electrode consecutively for approximately four seconds.

It causes a disturbed EEG wave, and the message **BIS IMPEDANCE CHCK** is shown on the monitor screen during the check.

Starting a Cyclic Impedance Check

The Cyclic Impedance Check is automatically started when a sensor is connected. To manually start a Cyclic Impedance Check:

- select **Cyclic Check** in the **BIS Setup** menu to toggle between On and Off, or
- select **Start Cyclic Check** in the BIS Impedance Check Window.

Stopping a Cyclic Impedance Check

The Cyclic Impedance Check stops automatically if the impedances of all electrodes are within the valid range. To manually stop a Cyclic Impedance Check:

- select **Cyclic Check** in the **BIS Setup menu** to toggle between On and Off, or
- select **Stop Cyclic Check** in the BIS Impedance Check Window.

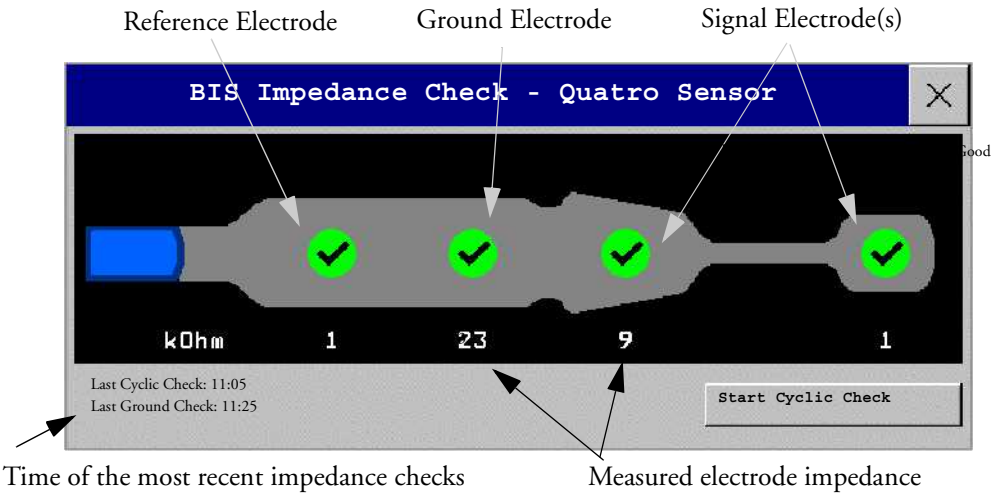
If you stop a Cyclic Impedance Check before the ground electrode has passed, a ground electrode impedance check will be started automatically. This cannot be switched off.

BIS Impedance Check Window

♦ To open the BIS Impedance Check Window, in the **Setup BIS** menu, select **Show Sensor.**

The graphic in the BIS Impedance Check Window automatically adapts to show the type of sensor you are using, showing three or four electrodes as required. Each symbol in the graphic represents an electrode and illustrates the most recently-measured impedance status of the electrodes. Although BIS may still be measured when the electrode status is red or yellow, for best performance, all electrodes should be green.

In addition, if the measured electrode-to skin impedance of any electrode or electrode combination is above the limit, or if disconnected electrodes are detected, an INOP will be issued, either **BIS HIGH IMPEDANCE** or **BIS LEAD OFF.**



BIS Impedance Indicators

Electrode-to-Skin Impedance	Message	Displayed Impedance Value	Symbol	Color	Action
Electrode has no skin contact	**Lead Off**	no value		red	Reconnect electrode, or check the sensor-to-skin contact. If necessary, clean and dry skin.
Too much signal noise, impedance cannot be measured	**Noise**	no value		gray	Check sensor-to-skin contact. Press sensor more firmly to skin. If necessary, clean and dry skin.
Impedance above limit	**High**	measured value in kOhm		yellow	Check sensor-to-skin contact. Press sensor more firmly to skin. If necessary, clean and dry skin.
Impedance within valid range	**Good**	measured value in kOhm		green	No action necessary

Changing the BIS Smoothing Rate

The smoothing rate defines how the monitor averages the BIS value.

♦ To change the smoothing rate, in the **Setup BIS** menu, select **BIS Smoothing Rate** then choose either:

– 15 seconds: this provides increased responsiveness to changes in the patient's state

– 30 seconds: this provides a smoother BIS trend with decreased variability and sensitivity to artifacts.

Switching BIS and Individual Numerics On and Off

To switch the BIS measurement on or off:

♦ In the **Setup BIS** menu, select **BIS** to toggle between On and Off.

To switch individual numerics provided by the BIS Module on or off:

♦ In the **Setup BIS** menu, select **SQI**, **TP**, **SEF**, **SR**, or **EMG** to toggle between **On** and **Off**.

Changing the Scale of the EEG Wave

Changing the scale only changes the visual appearance of the wave. It does not affect the signal analyzed by the monitor or printed in reports or recordings.

The scale information shown depends on whether gridlines are switched on or off for display. This is set in Configuration Mode.

1 In the **Setup BIS** menu, select **Change Scale** to call up a list of wave scales.

2 Select the required scale from this list.

- When gridlines are switched off, you can choose from the available scale values: 50 µV, 100 µV, 200 µV, and 500 µV. Scaling information is displayed as a vertical bar on the EEG wave together with its height equivalent in µV.
- When gridlines are switched on, scales are defined as a range, either ± 25 µV, ± 50 µV, ± 100 µV, or ± 250 µV. Scaling information is shown in the form of gridlines.

Switching BIS Filters On or Off

The low and high pass filters screen out undesirable interference from the raw EEG wave display. The notch filter removes line frequency interference. Filter settings affect the EEG wave and the SEF and TP values, but they do not affect the BIS, EMG, SR, and SQI values.

The filter settings are set in Configuration Mode. You can switch all the filters on or off together in Monitoring Mode.

1 In the **Setup BIS** menu, select **Filters**.

2 Select **On**/**Off** to toggle between all filters On or Off.

BIS Safety Information

Due to limited clinical experience in the following applications, BIS values should be interpreted cautiously in patients with know neurological disorders, those taking psychoactive medications, and in children below the age of 1.

WARNING **Conductive Parts** The conductive parts of sensors and connectors should not contact other conductive parts, including earth.

High-frequency Surgery To reduce the hazard of burns in the high-frequency surgical neutral electrode connection, the BIS sensor should not be located between the surgical site and the electro-surgical unit return electrode.

Defibrillation The BIS sensor must not be located between defibrillator pads when a defibrillator is used on a patient connected to the patient monitor.

Securing Cables To minimize the risk of patient strangulation, the patient interface cable (PIC) must be carefully placed and secured.

CAUTION **Revisions** The system will only function if all component revisions are compatible. Otherwise, an incompatibility INOP is displayed.

If the DSC has an older software revision than the BIS Engine, the DSC will automatically be upgraded by the BIS Engine. Do not disconnect the DSC from the BIS Engine, or disconnect the BIS Interface Module from the monitor, or switch the monitor power off within the first ten seconds after connection, as this will disrupt a possible software upgrade and cause damage to the DSC.

Impedance Checks Impedance checks may influence data acquisition of other electroencephalographic devices.

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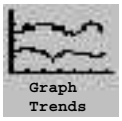
Trends

Trends are patient data collected over time and displayed in graphic or tabular form to give you a picture of how your patient's condition is developing.

Viewing Trends

- To open the tabular trends window, select the **Vitals Trend** SmartKey.
- To open the graphic trends window, select the **Graph Trends** SmartKey.

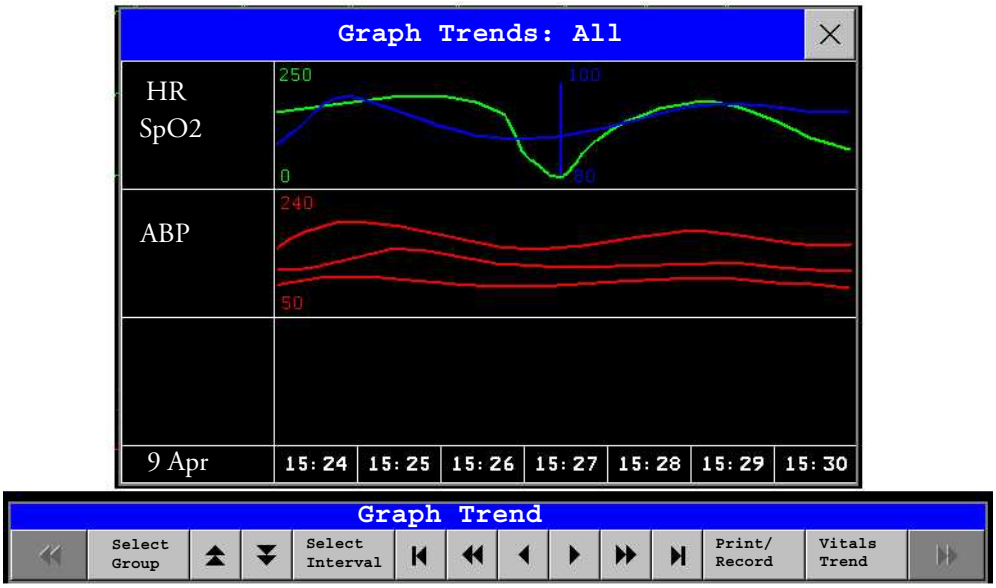


The trend windows open displaying the most recent data and are updated as new data is stored. A timescale along the bottom of the screen shows you where you are in the trends database. The choice of measurements is defined by the trend measurement group chosen; measurements cannot individually be chosen for inclusion.

Your monitor screen may look slightly different to the examples shown here.

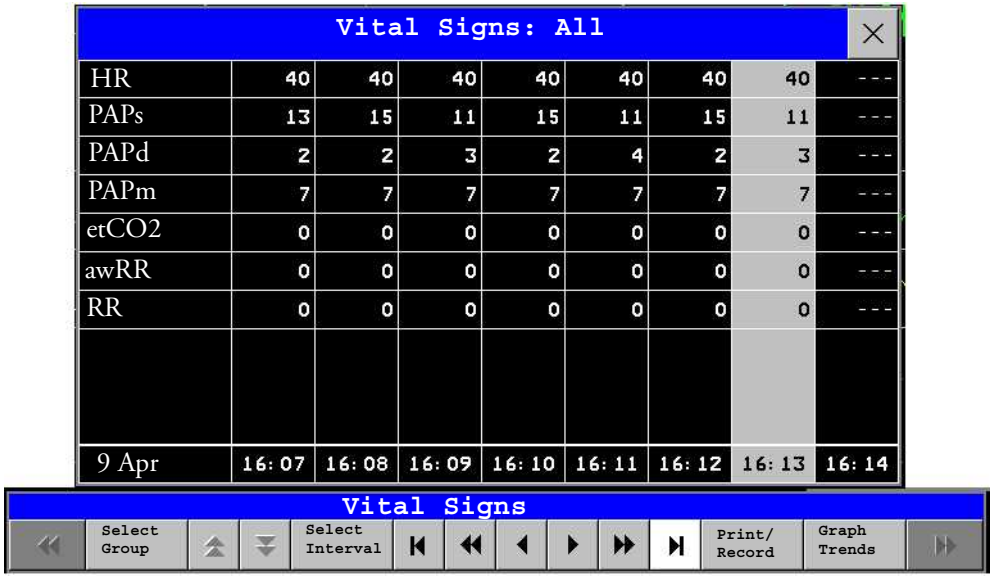
Viewing Graphic Trends

In the graphic trends view, the measured values are plotted on a graph along a time axis.



Viewing Vital Signs Trends

The Vital Signs window shows measurement values and the time of measurement in a table.



Multiple value measurements are split into the required number of lines. As you navigate through the trend database, the currently-selected column is highlighted.

A question mark (?) beside a value means that the data may not be reliable, due perhaps to an INOP condition in the measurement. If you see a "?", you should try to resolve the problem with the measurement signal.

Trends Pop-Up Keys

Depending on the trends view you choose, a selection of pop-up keys appears to let you navigate through the stored events and carry out trends-related tasks.

Pop-Up Keys	Selecting this pop-up key lets you....
Select Group	see a pop-up list of trend groups available and choose a group for viewing.
Select Interval	see a pop-up list of available data resolution settings to choose the level of detail shown in the trend view.
Print/ Record	print a tabular or graphic trends report, depending on the contents of the window currently open. The report will use the current trend interval settings.
	move the cursor one step to the left or right to navigate through the trends database timeline.
	move the cursor one page to the left or right to navigate through the trends database timeline.

Pop-Up Keys	Selecting this pop-up key lets you....
	jump to the beginning or the end of the trends database to see the most recent or oldest trend information stored.
	scroll up and down the screen to see measurement trends that do not fit in the current view.
Vitals Trend	open the current trend view in tabular form. The displayed time period and resolution stay the same.
Graph Trends	open the current trend view in graphic form. The displayed time period and resolution stay the same.

Setting Up Trends

Your monitor provides trends for continuously-monitored measurements, such as the ECG signal, as well as for aperiodically-measured parameters, such as Cardiac Output. Each measurement value counts as one measurement for the trend database. Some measurements can serve as a source for more than one measurement, for example you can choose up to three CO_2 measurements ($etCO_2$, $imCO_2$ and awRR) for trending.

Multi-value measurements will only be trended if a trend is available for each value within the measurement. For example, an ABP trend would require three components to be available for trending.

Choosing Which Measurements are Trended

The monitor stores trend information for all monitored measurements, if configured to do so. If your configuration restricts the number of trended measurements, you must choose which measurements will be included. A priority list, defined in the monitor's Configuration Mode, is used to select the trended measurements.

To see the measurement priority list for trending,

1 In the **Main Setup** menu, select **Trends**.

2 Select **Trend Priority**.

To add measurements to the priority list,

1 Select the pop-up key **Add** and choose from the pop-up list of available measurements.

2 Use the **Sort Up** and **Sort Down** pop-up keys to change the priority order.

3 Select the **Store** pop-up key to save your changes.

Choosing Trend Measurement Groups

The pop-up list of trend measurement groups that appears when you select the pop-up key **Select Group** lets you choose a defined group of measurements for displaying in the trends windows and printing in trends reports. The group settings define the list of measurements, the order of presentation, and whether the waveforms overlap on the display and on reports. The group **All** includes all the currently-monitored measurements. Trend measurement groups are defined in the monitor's Configuration Mode.

You can add groups to the list that appears when the **Select Group** pop-up key is selected. To do this,

1 In the **Main Setup** menu, select **Trends**.

2 Select **Trend Groups**.

3 Select the pop-up key **Add** and choose a group from the list of available groups that have been defined in Configuration Mode.

4 Select **Store** to save your changes.

Changing Parameter Scales

You can set separate scale settings for adult, pediatric, and neonatal patient trend information to define how the trend waveform will appear on the screen and in trend reports. To do this,

1 In the **Main Setup** menu, select **Trends**.

2 Select **Parameter Scales**.

3 Select the measurement or parameter you want to change from the list.

4 Select the pop-up key **Change** to call up the **Scale** menu.

5 In the **Scale** menu, select the parameter label you want to define settings for. Select **Adult**, **Pedi**, and **Neo** and use the pop-up keypad to enter new upper and lower scale definitions.

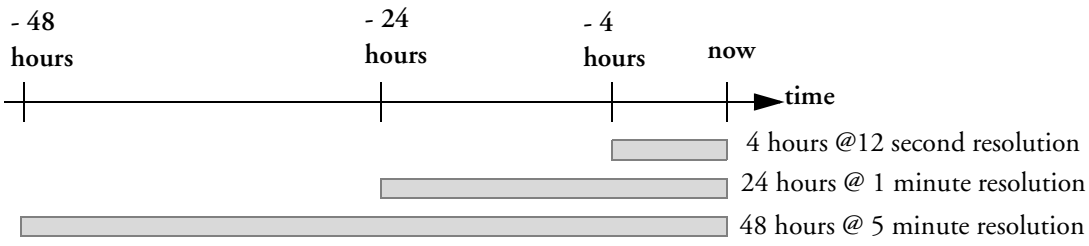
6 Select **Store** to save your changes.

Choosing Trend Resolution

Trend resolution is the frequency with which data is captured and stored in the trend database by the monitor. As the monitor has a fixed amount of memory space available for storing trend information, the higher the data resolution you choose, the shorter the period that can be stored. High-resolution data is especially suited for neonatal applications, where the clinical situation may change very quickly. In adult monitoring, where the patient's status typically changes more gradually, a longer trend may be more informative.

Example database configuration In this example, we see that the monitor stores the most recent data at the highest resolution, older data are stored at a lower resolution.

"2 hours @ 12 second resolution" means that the monitor stores trend data every 12 seconds, or five times a minute, for the most recent two hours.



The resolution, database period, and the number of measurements trended is set in Configuration Mode.

Documenting Trends

To print a Vital Signs or Graphical Trends report,

- in the **Vitals Trend** or **Graph Trends** window, select the pop-up key **Print** to print a report for the trend group currently on the monitor screen.

  Reports include the most recent information and extend backwards in time according to the configuration. Trends reports can be printed on central or local printers.

To make a Vital Signs recording,

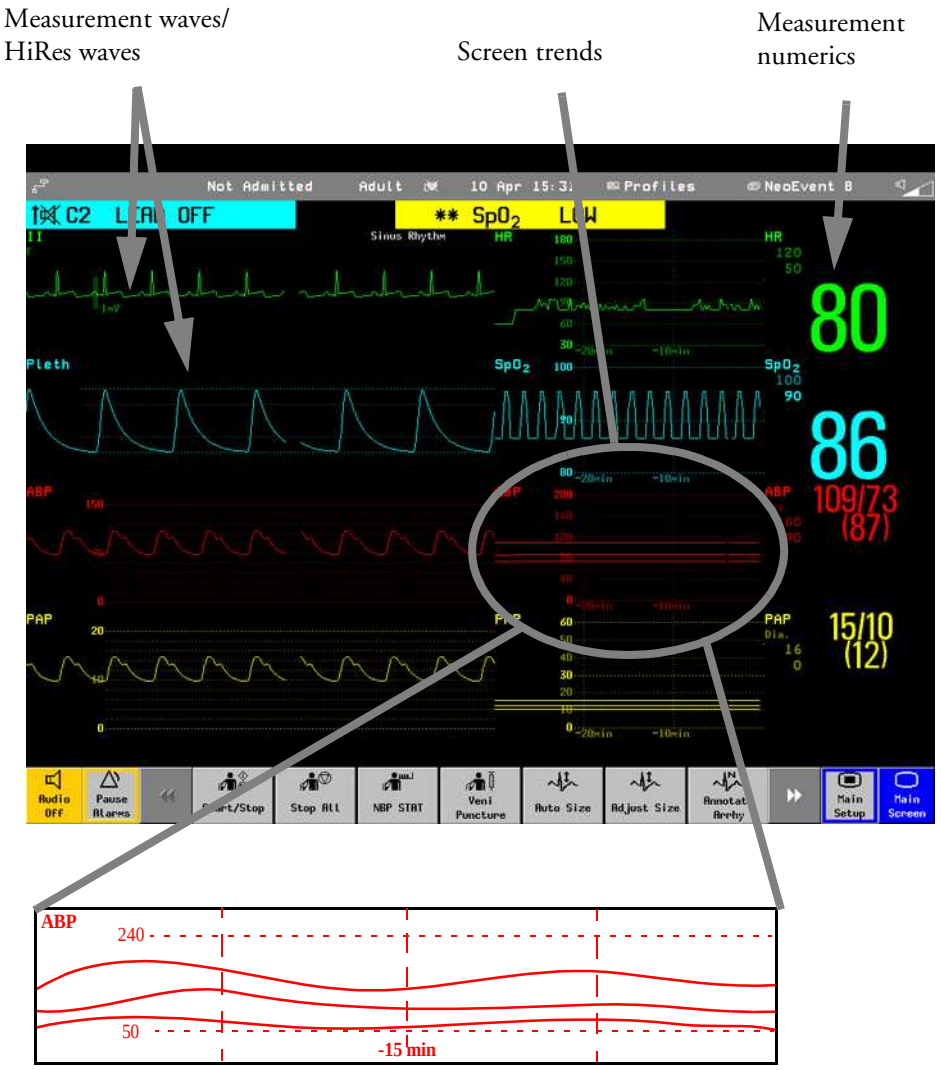
- in the **Vital Trend** window, select the **Print/Record** pop-up key, then select the **Record Vitals** pop-up key.

  Vital Signs recordings print patient demographic information and the content of the current **Vitals Trend** window on the recorder strip.

Screen Trends

Trends configured to display permanently on special monitor Screens are called screen trends. Each screen trend shows graphic trend information for one measurement, rather than for a trend group. All continuously-monitored measurements can be displayed as screen trends.

- If you do not see screen trends on the monitor Screen, select a different Screen, one that is configured to show screen trends.
- To view the information from a screen trend in more detail, select the screen trend to open the **<Measurement Label> Trend** menu, then select **Vitals Trend** or **Graph Trends** to open one of the trend windows.
- To switch between graphic and tabular views of aperiodic measurement Screen Trends (NBP, C.O., C.I. or Wedge), select the screen trend to open the **<Measurement Label> Trend** menu, then select **Change View**.



Changing the Selection of Screen Trends Displayed

Grouped screen trends If a measurement wave, numeric, and screen trend are configured to form a group, changing one automatically changes the others. Grouped elements often have the same color. To change the selection of grouped screen trends on the Screen,

- Select the measurement wave then select **Change Wave** in the wave menu. This automatically changes the wave, numeric, and screen trend simultaneously.

  If the wave has been replaced by the screen trend, select the screen trend then select **Change Trend** in the trend menu.

Independent screen trends To change a screen trend that is independent of any waves and numerics,

- select the screen trend to open the **<Measurement Label> Trend** menu, then select **Change Trend**. Select a different screen trend from the list of available screen trends.

  If the screen trend is grouped with a measurement wave and/or numeric, the menu entry **Change Trend** will not be visible.

Overlapping screen trends If you want to display two or more screen trends overlapping,

- select the screen trend to open the **<Measurement Label> Trend** menu, select **Change Trend**, then select **Add Trend** and select a screen trend from the pop-up list.

  If a screen trend is grouped with an overlapping wave, the screen trend will contain the same overlapping measurement trends. If a screen trend is grouped with a non-overlapping wave, you cannot display overlapping trends in that screen trends field.

As screen trends are only available on specially configured Screens, you cannot add screen trends to a Screen in Monitoring Mode.

Changing the Screen Trend Time

To change the period of measurement trend information displayed in a screen trend,

1 Select the screen trend to open the **<Measurement Label> Trend** menu

2 Select **Setup Trends**

3 In the **Setup Trends** menu, select **ScreenTrend Time** and select a time from the pop-up list. You can choose either 30 minutes, or one, two, four, or twelve hours.

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Calculations

Calculations are patient data that is not directly measured but calculated by the monitor when you provide it with the appropriate information.

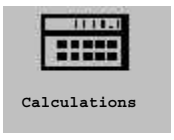
Your monitor can perform the following hemodynamic, oxygenation, and ventilation calculations.

Hemodynamic	Oxygenation	Ventilation
Cardiac Index (C.I.)	Arterial Oxygen Content (CaO_2)	Minute Volume (MINVOL)
Stroke Volume (SV)	Venous Oxygen Content (CvO_2)	Compliance (COMP)
Stroke Index (SI)	Arteriovenous Oxygen Content ($avDO_2$)	Dead Space (Vd)
Systemic Vascular Resistance (SVR)	Oxygen Availability Index (O_2AVI)	Dead Space/Tidal Volume Ratio (Vd/TV)
Systemic Vascular Resistance Index (SVRI)	Oxygen Consumption (VO_2)	Alveolar Ventilation (ALVENT)
Pulmonary Vascular Resistance (PVR)	Oxygen Consumption Index (VO_2I)	
Pulmonary Vascular Resistance Index (PVRI)	Oxygen Extraction Ratio (O_2ER)	
Left Cardiac Work (LCW)	Alveolar-Arterial Oxygen Difference ($AaDO_2$)	
Left Cardiac Work Index (LCWI)	Percent Arteriovenous Shunt (Qs/Qt)	
Left Ventricular Stroke Work (LVSW)		
Left Ventricular Stroke Work Index (LVSWI)		
Right Cardiac Work (RCW)		
Right Cardiac Work Index (RCWI)		
Right Ventricular Stroke Work (RVSW)		
Right Ventricular Stroke Work Index (RVSWI)		
Extra Vascular Lung Water Index (EVLWI)		
Intrathoracic Blood Volume Index (ITBVI)		
Global End Diastolic Volume Index (GEDVI)		

The hemodynamic calculations available depend on the Cardiac Output measurement method being used and the regulatory standards that apply for your hospital: see the C.O. chapter for availability details.

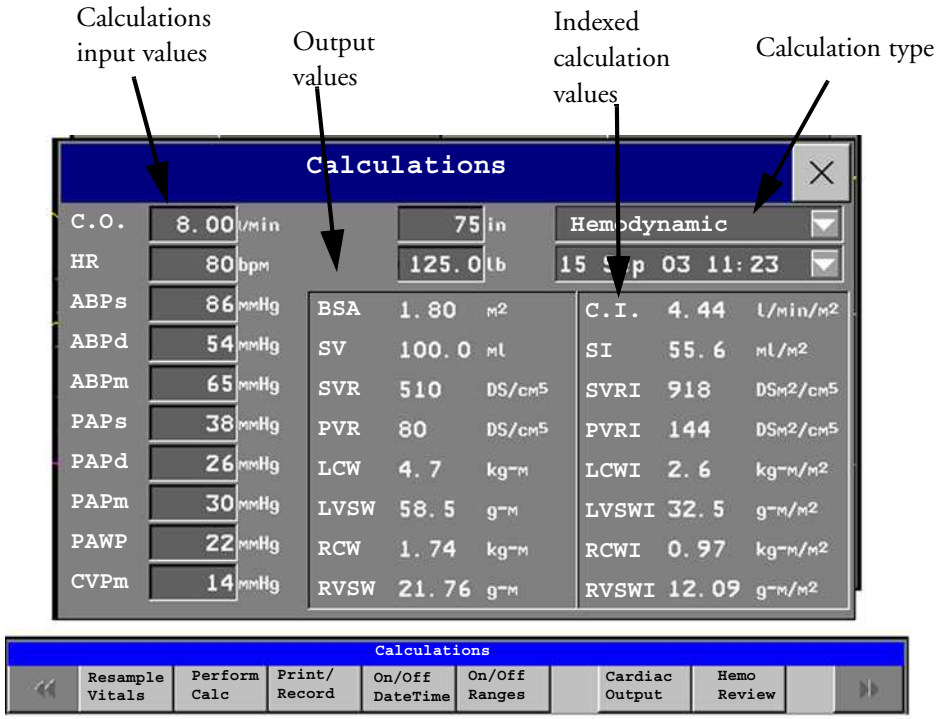
Viewing Calculations

- Select the **Calculations** SmartKey to open the Calculations window.
- Select the **Calc Type** field and select the required calculation type for display.



Calculations Windows

This example calculations window shows the hemodynamic calculations window. The ventilation and oxygenation windows are similar.



Calculations Pop-Up Keys

Depending on the calculations group you choose, a selection of pop-up keys will appear to let you navigate through the stored events and carry out calculations-related tasks.

Pop-Up Keys	Selecting this pop-up key lets you....
Resample Vitals	tell the monitor to override the values in the calculations database and use the most recent continuously monitored values. Resampling sets the calculation time to the current time, and displays the corresponding values for the previous second. Resampled values are indicated by a preceding asterisk (*) in Calculations, Graph Trends, and Vital Signs screens.
Perform Calc	perform the displayed calculation using the currently-input values.
Print/ Record	print or record the displayed calculation.
On/Off DateTime	toggle between showing the date and time or the units for the calculation input values.
On/Off Ranges	toggle between showing the normal ranges or the units for the calculation output values.
Cardiac Output	access the C.O. procedure window.

Pop-Up Keys	Selecting this pop-up key lets you....
Hemo Review	open the hemodynamic calculations review window.
Ventil Review	open the ventilation calculations review window.
Oxy Review	open the oxygenation calculations review window.
	access more calculations pop-up keys, if available.

Reviewing Calculations

- To enter the calculations review window, select the **Oxy Review**, **Ventil Review**, or **Hemo Review** pop-up key as required.

The review window lists all the input and output values for each measurement in the calculations group. The timeline in the review window lists the times the calculations were performed.

- To review individual calculations, select the calculation in the Calculation Review window and then select the **Original Calc** pop-up key.

Performing Calculations

You must check that all input values are appropriate for your patient before performing calculations.

1 Select the **Calculations** SmartKey to open the Calculations window.

2 Select the **Calc Type** field and select the required calculation type for display.

3 Check the calculation time in the **Calc Time** field.

When you enter the calculation window, this field will show either the current time or the time of the most recent available C.O. measurement, depending on your monitor configuration.

– To choose a different calculation time, select the **Calc Time** field. This calls up a list showing the timestamps of calculations performed earlier. Select a time from this list, or select **Select Time** to enter a time of your choice.

– To enter the current time, select the **Resample Vitals** pop-up key. If you choose the current time, the monitor will resample all the required values that are continuously monitored.

4 Enter any values that must be entered or edited manually. Select the value field and then use the pop-up keypad to enter the required values. Select **Enter** to confirm each entered value.

Entering Values for Calculations

The monitor automatically enters any available values for calculations. For aperiodically-measured values such as NBP or C.O., the monitor will re-use the most recent value in the calculation database until a new value becomes available.

- To enter calculations values manually or edit automatically-entered values, select the value field to open the on-screen keyboard and use this to enter the correct value. Values edited manually are marked with an asterisk symbol (*).

If you enter a value that has more decimal places than allowed for a particular input, the value you enter will be rounded off after you select **Enter**. If you enter a value which cannot be stored, the message **Warning: Value out of range** will appear. Enter a new value.

In hemodynamic calculations, if the systolic and diastolic pressures are manually entered, the mean pressure is calculated and marked with an asterisk. The formula used to estimate the mean pressure is [systolic + (diastolic x 2)] / 3.

Automatic Value Substitution

If the monitor cannot find a value required for calculation, it automatically tries to find an equivalent source for this value. For example, if C.O. is required but unavailable, the monitor automatically looks for CCO as a alternative source of C.O. values.

Automatic Unit Conversion

The monitor needs consistent units for performing calculations. It automatically converts units where necessary before it performs the calculation, for example, pressures sourced in kPa, cmH_2O, or mbar are automatically converted to mmHg, or to cmH_2O for ventilation calculations.

BSA Formula

Your monitor provides both the Boyd and Dubois formulas for the calculation of body surface area (BSA). For calculations, the monitor uses the setting defined in the Patient Demographics menu. All calculation results that use BSA are indexed to the selected formula.

- To check the current setting, select the patient name to enter the Patient Demographics menu. **BSA(B)** indicates that the Boyd formula is used; **BSA(D)** indicates that the Dubois formula is used.

Documenting Calculations

- To send a Calculations recording to a connected recorder, in the **Calculations** window, select the **Print/Record** pop-up key, then select the **Record Calc** pop-up key.

  Calculations recordings print the patient demographic information and the content of the current **Calculations** window on the recorder strip.

- To print a report for the calculation group currently on the monitor screen, select the pop-up key **Print Calc**. To print the Calculations Review window, select the pop-up key **Print** in the Calculations Review window. All the calculations in the current group will be printed in the report.

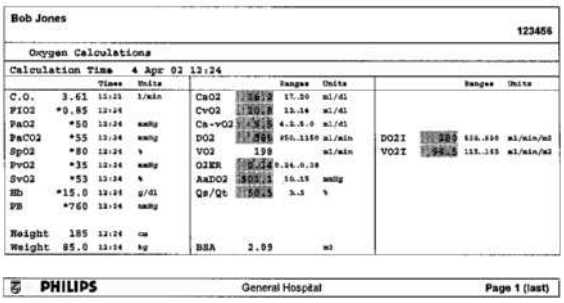
  Calculation Reports can be printed on central or local printers.

This example report shows the oxygen calculation group. Ventilation and hemodynamic calculation reports are similar.

Patient information

Calculation group

Three columns of calculations input and output values, with times, units and ranges, where appropriate



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Event Surveillance

Events are electronic records of episodes in your patient's condition. You can trigger them manually, or set them to trigger automatically during pre-defined clinical situations. The information the monitor stores for each event episode includes:

- waveforms for up to four measurements of your choice
- numeric vital signs for all the measurements monitored
- any alarm conditions active when the event episode was triggered
- any annotations connected with the event.

The event group you select defines which measurement waveforms are recorded during the event episode. You can navigate through the event database to view events retrospectively, and you can document events on a recording or report marked with the patient name, bed label, and the data and time.

There are two levels of event surveillance. To determine which level of surveillance you have, check the Event Surveillance Setup menu. Basic offers only one event group, whilst advanced offers up to six event groups. This section documents advanced surveillance. Basic event surveillance functions as a subset of advanced.

Event Groups

The active event group

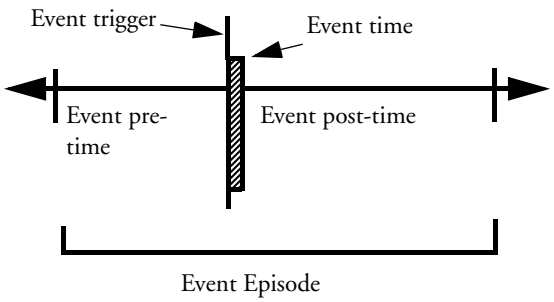
- monitors the patient's signals to detect event triggers
- defines which waveforms are recorded in the event data

Only one event group can be active at a time. Any other defined event groups do not monitor for event triggers. Event groups are defined in Configuration Mode.

Event Episode

When an event occurs, information for a predefined duration is stored. This is the event episode. It can start from the trigger moment or include information from a defined period before the trigger, called the event pre-time. The episode time after the event is called the event post-time. The event time is the period after the trigger during which a further event can change a single event to a combined event (combi-event).

Manually-triggered event episodes document patient information from the time leading up to the event trigger; they do not have a post-time.



Episode Types

The episode type defines the level of detail captured in an event episode. The higher the data resolution, the shorter the period that the monitor can store in its memory. High-resolution data is suited for neonatal applications, where the clinical situation may change very quickly. In adult monitoring, where the patient's status typically changes more gradually, a longer trend may be more informative.

Event Episode Types	**Pre-time**	**Post-time**	**Event time**
Average trend 20 minutes, five samples per minute	5 minutes	15 minutes	2 minutes
	10 minutes	10 minutes	
	15 minutes	5 minutes	
HiResTrnd Four minutes, four samples per second. Neonatal Event Review (NER) is a subset of HiResTrnd	1 minute	3 minutes	= post-time
	2 minutes	2 minutes	
	3 minutes	1 minute	
Realtime Wave Snapshot 15 seconds	5 seconds	10 seconds	= post-time
	10 seconds	5 seconds	

Event Triggers

You can trigger event capture manually, for example, if you want to record a patient's condition before a procedure. You can also set events to trigger automatically, when the patient's values cross a predefined threshold value, or when a particular measurement or procedure is carried out, for example, when an NBP measurement or a Cardiac Output or Wedge procedure is carried out.

If you use alarm limits as event triggers, the event capture is triggered automatically when your patient's values violate set alarm limits, or when a specified alarm condition, such as apnea, occurs.

If you set user-defined event triggers, you can define event triggers that are independent of alarm limits. You must set a threshold value and a threshold time for the trigger. If you set the trigger threshold to 12 seconds, the monitor triggers an event if the threshold is violated for more than 12 seconds.

If more than one trigger is available for the measurements in the active event group, the trigger condition may be **AtLeast1Par**, **AtLeast2Par**, **AtLeast3Par**, or **All4Par**. If the trigger is **AtLeast1Par** (this is short for 'at least one measurement parameter'), the monitor starts an event capture if a trigger occurs in any of the active event group's measurements. If the trigger is **AtLeast3Par**, the monitor captures events when three or more trigger thresholds from the active event group measurements are violated. The trigger condition for event groups is set in the monitor's Configuration Mode.

Viewing Events

- To see a summary of all the events in every group in the event database, use the Event Summary.
- To review all the events in a particular event group, use the **Event Review** window.
- To review individual event episodes in detail, use the **Event Episode** window.

To start viewing events, either:

- in the **Main Setup** menu, select **Event Surveillance** and then select the event view you require from the list, or
- select the **Event Surveillance** SmartKey and then select the event view you require from the list.

Events Pop-Up Keys

Depending on the events view you choose, a selection of the events pop-up keys let you navigate through the stored events and carry out events-related tasks.

Pop-Up Keys	Selecting this pop-up key lets you....
Event Setup	open the **Event Surveillance Setup** menu.
Show Episode	open the **Event Episode** window to review the selected event in detail.
Show Review	open the **Event Review** window.
Review Group	choose a different event group for reviewing in the **Event Review** window.
Trigger Group	simultaneously change the Review and Trigger groups.
Manual Event	start a manually-triggered event capture.
	move the cursor left or right to the next event to navigate through the events database. Placing the cursor over an event highlights it and shows the event values for the selected event.

Pop-Up Keys		Selecting this pop-up key lets you....
		jump to the first or last event in the event database.
Vitals View	**Graphic View**	toggle between a tabular and graphic version of the **Event Episode** window currently viewed.
Table Review	**Graphic Review**	toggle between a tabular and graphic version of the **Event Review** window currently viewed.
Delete Event		delete the currently-selected event from the database. The monitor asks you to confirm this deletion. You cannot retrieve deleted events.
Select Annot.		access the list of available annotations to add a nursing note for the current event episode.
Print/ Record		access the printing and recording pop-up keys to document events.

Event Counter

Event Counter

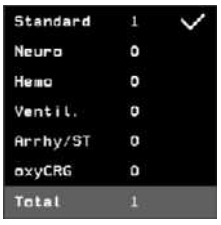
Event Counter (Graphic)

Vertical bars mark events in the graphic Event Summary view. The timeline shows the position of the stored events in the event database. Selecting this view activates a cursor that lets you navigate across the timeline and select individual events for review in the **Episode Review** window. It also calls up the events pop-up keys.

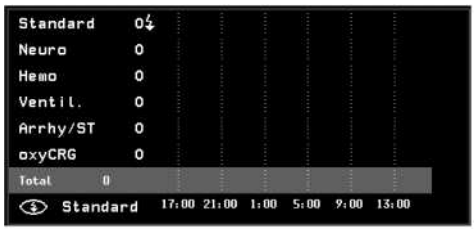
Event Summary View

The Event Summary view shows the number of stored events in each event group and the total number of events in the database. The trigger symbol indicates the active trigger group.

Selecting the Event Summary calls up the events pop-up keys.



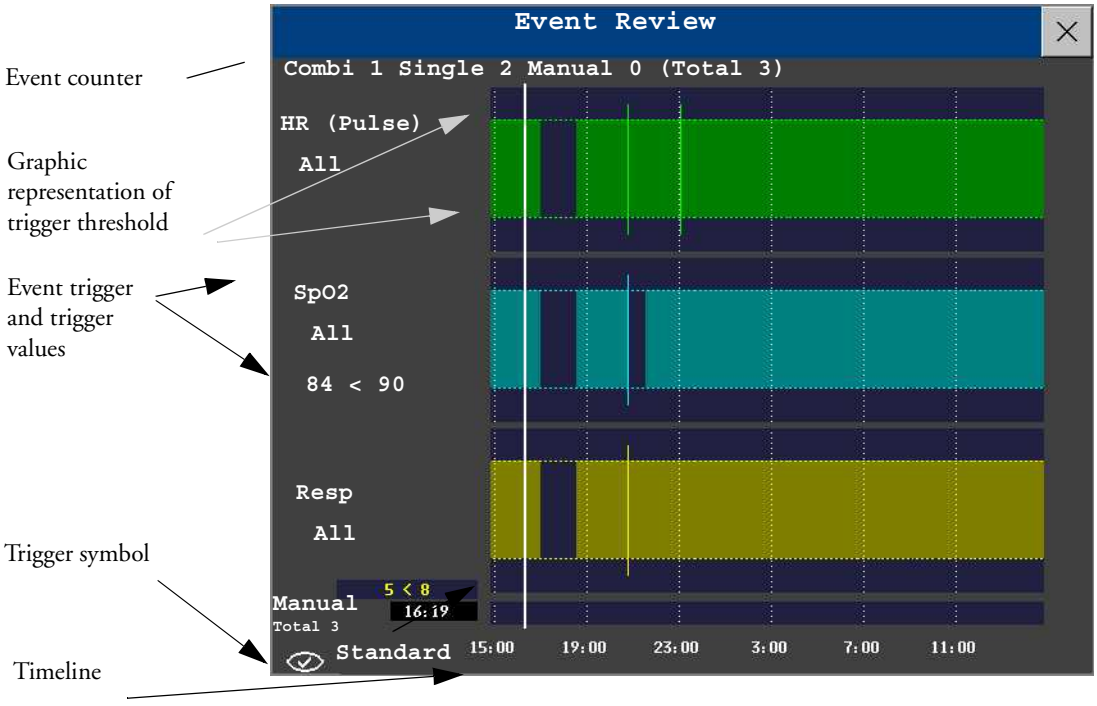
Event Summary



Event Summary (Graphic)

Event Review Window

- To enter the **Event Review** window, select the graphic event summary, if available, or select the events pop-up key **Show Review.**
- When you open the **Event Review** window, it automatically shows the event group with the most recent event. To view other event groups, select the pop-up key **Review Group** and select the group from the list.



Event bars: Each event bar represents one event. The height indicates the event severity. Bars that extend over more than one channel represent combi-events. Manually-captured events are marked with a bar above the timeline instead of in the measurement channels.

Event values: Event information for the currently-selected event is shown on the left of the review window. The trigger measurement is highlighted.

- If an alarm triggers the event, the monitor shows the alarm conditions that triggered the event.
- If the event trigger was user-defined, instead of an alarm condition the monitor shows for example **SpO2 94<96**, where the second number is the current event trigger threshold and the first number is the maximum deviation from the set limit.

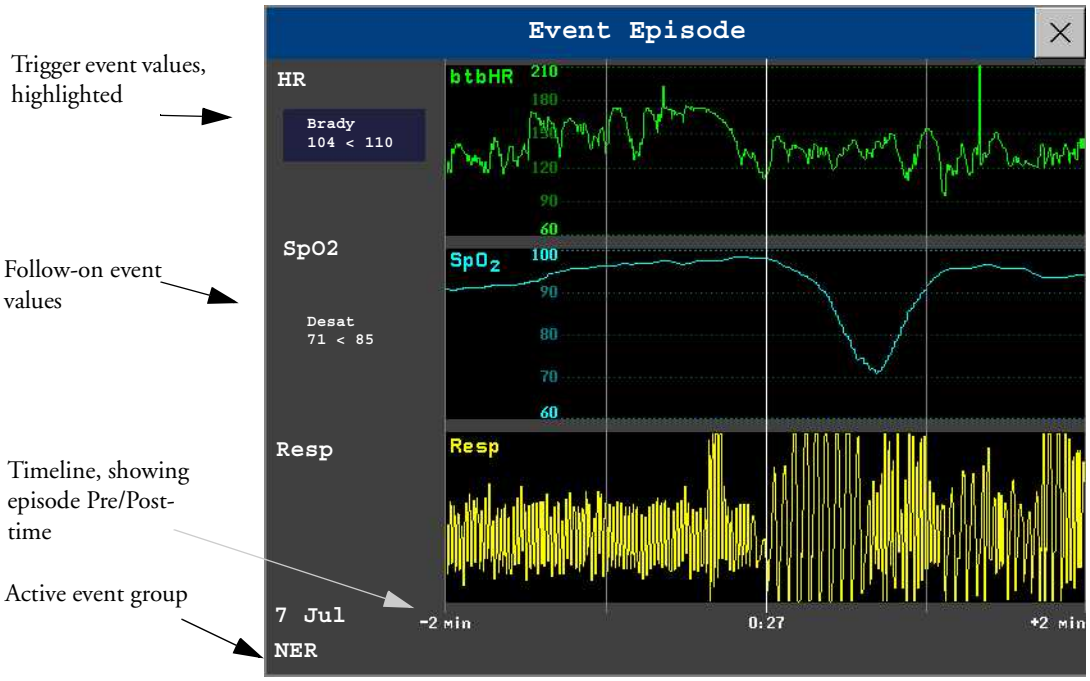
Trigger threshold: The horizontal lines show the trigger thresholds. Gaps in the line indicate that the trigger was inactive for a while, possibly because alarms were switched off or because there was an INOP condition in the group measurements.

Timeline: The timeline at the bottom indicates the period currently stored in the event database.

Event Episode Window

♦ To enter the **Event Episode** window, select the pop-up key **Show Episode**.

Depending on the event group settings, the **Event Episode** window shows either 20 minutes of average trend event information, four minutes of high-resolution event information, or 15 seconds of realtime wave information.



The event values to the left of the measurement channels show the trigger threshold set and the maximum amount by which this limit was exceeded. In this example, **ABP Sys HIGH 120 > 90** tells you that 120 was the highest ABP value measured during the event time and that the ABP trigger threshold was set to 90 when the event was triggered. If the event was manually-triggered, the event value boxes display “manual”.

The Event Counter

The event counter in the Event Summary view and in the Event Review window counts the total number of events in the database. If more than one event group was set as trigger group within the event history, the event counter also counts the event group totals.

Counting Combi-Events

If one or more events occur during the same Event Time, the monitor combines them and displays them as distinct events in one event episode, called a combi-event. The first event is the trigger event, and the others are follow-up events. For example, if an apnea event is followed 40 seconds later by a brady event, the brady event is not counted as a single event but as part of the apnea event.

Counting Neonatal Event Review (NER) Events

For neonatal events (NER; formerly "OxyCRG"), apnea events (**A**), bradycardia events (**B**), and combinations of these events are counted and classified by the event counter in the Event Summary. If they are associated with a Desaturation (**D**), this is also marked. Manual events (**M**) are counted separately. In the example below, **A(D):2(1)** indicates that two apnea events occurred and one of them was associated with a desaturation.

```
16 Stored Events:      A(D):2(1) B(D):7(1) AB (D): 1(1) D:6 M:0
```

Levels of Event Surveillance

You should be aware which level of event surveillance is used in your hospital, basic, advanced, or NER. This table lists the differences.

Event Functionality	Option C06, Basic Event Surveillance	Option C07, Advanced Event Surveillance	Option C04, Neonatal Event Review (NER)
Event groups	1	5 + NER	NER
Measurements per group	3	4	3
Triggers per measurement	1	2	1
Trigger types	Simple	Combined	Simple
Types of event episode	Average trend	Average trend High resolution trend Snapshot events	High Resolution Trend
Event views	Summary view, graphic Event Review window, graphic Event Episode window	Summary view, graphic and tabular Event Review window, graphic and tabular Event Episode window	Graphic and tabular Event Review window, graphic and tabular Event Episode window
Database capability	25 events for 24 hours	25 events for 24 hours 25 events for 8 hours 50 events for 8 hours 50 events for 24 hours	25 events for 24 hours 25 events for 8 hours 50 events for 8 hours 50 events for 24 hours

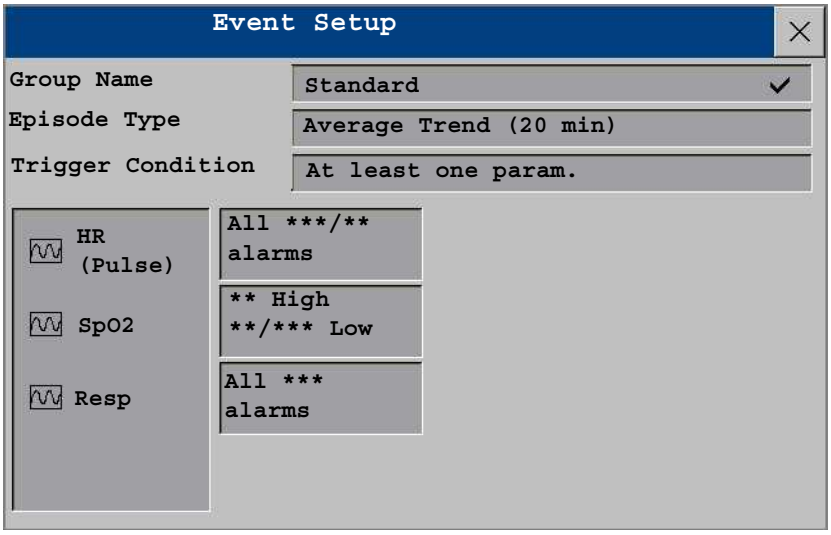
Setting Up and Using Event Surveillance

Before you can use event surveillance, you must choose the active event group and the event triggers.

Setting Up Events

1 Set the active event group. In the **Event Setup** menu, select the name of the Trigger Group and then select the required group from the pop-up list. The trigger symbol marks the active group.
The measurements and trigger condition for the group automatically change to reflect the new event group. These settings can be changed in the monitor's Configuration Mode.

2 Select the name of the trigger group to enter the **Event Setup <Group Name>** window.



3 Set the episode type.
Select the name of the current episode type and select an episode type from the pop-up list. The pre/post episode time for the selected episode type is displayed.

4 Set the trigger for each measurement.
Select each trigger name and select either an alarm trigger or a user-defined trigger from the pop-up trigger list.
The asterisk symbols beside the trigger tell you that the event trigger uses alarm triggers:
*** indicates a high priority (red) alarm,
** indicates a lower priority (yellow) alarm.
Triggers without asterisk symbols are user-defined triggers.

– If an alarm is an event trigger, no events of this kind are triggered if alarms are switched off. Changing alarm limits changes the event trigger definitions.
– If you choose a user-defined trigger, you must set a trigger threshold and trigger threshold time. Select each trigger threshold time box to call up a list of available threshold times and select the required time from this list.

5 Select **OK** to confirm your changes.

Triggering Events Manually

♦ To manually trigger an event in the currently active event group, select the SmartKey **Manual Event**.

The event data documents patient information for the time leading up to the trigger moment and uses the settings of the active event group.

Annotating Events

1 To annotate an event, in the Event Episode window, select the pop-up key **Select Annotation**.

2 Select the required annotation from the pop-up list of available annotations for the currently active event group.

Up to 20 annotations can be configured to let you add commonly-used clinical notes to event episodes for documentation purposes. To see the complete list of available annotations, in the **Event Setup** menu, select **Event Annotation**.

The Event Database

The maximum number of events that can be stored in the event database depends on the database configuration and the level of event surveillance used. The event database is set up in the monitor's Configuration Mode. Events are stored in the monitor's event database for the configured lifetime, either 8 hours or 24 hours. Deleted events cannot be retrieved. Events are automatically deleted when:

- their configured lifetime is over
- the storage capacity of the database is exceeded (storing a further event deletes the oldest event in the memory)
- a patient is discharged.

As the event database is cleared when you discharge a patient, you should ensure that you have documented any events you require for the patient records before you confirm the discharge.

Documenting Events

You can print a report or make a recording of the events history stored in the database or of individual event episodes.

Documenting Event Review

1 In the **Event Review** window, select the pop-up key **Print/Record**. This calls up the event documentation pop-up keys.

2 For a graphic **Event Review** recording, select the **Record Graphic** pop-up key.

For a tabular **Event Review** recording, select the **Record Tabular** pop-up key.

To print an Event Report, select the **Print Review** pop-up key.

Documenting an Event Episode

1 In the **Event Episode** window, select the pop-up key **Print/Record**. This calls up the event documentation pop-up keys.

2 To make an **Event Episode** recording, select the **Record** pop-up key.

To print an **Event Episode**, select the **Print Episode** pop-up key.

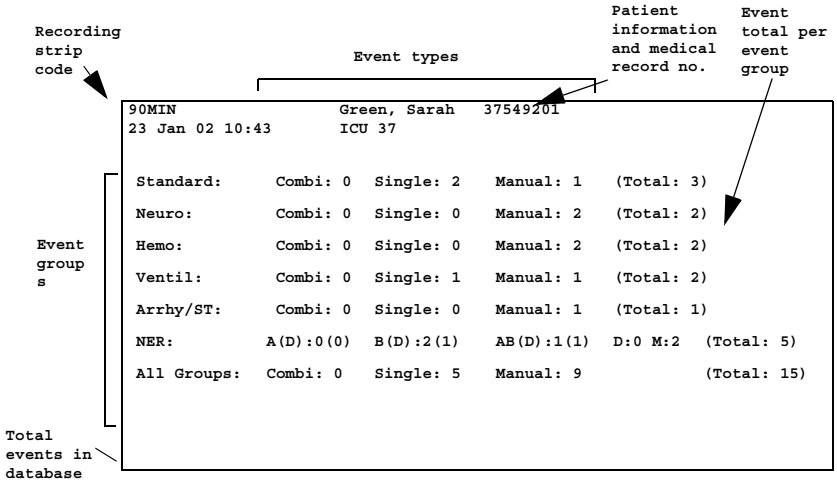
Event Recordings

Event recordings can be sent to a locally-connected M1116B recorder module.

Event Review Recordings

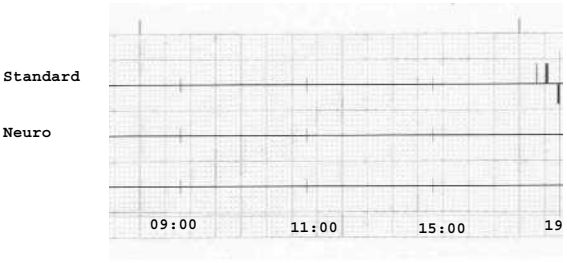
Each event review recording strip begins with a summary of the events stored in the event database.

Recording strip annotation is explained in the Recording chapter.



In graphic event review recordings, events are represented by bars, and each event group is printed on a separate channel.

The timeline reflects the period stored in the database, either 24 hours (divided into 4 hour sections) or 8 hours (divided into one-hour sections).



In tabular event review recordings, the events stored in the event database are shown in chronological order, with a number and time-stamp.

#	Time	Group	Parameter 1	Parameter 2	Parmeter 3
1	23 Jan 02 07:56	Neuro	Resp	BIS LOW 51<60	ABP
2	23 Jan 02 07:59	Standard	HR(Pulse) TACHY 201>180	ST-II	SpO2
3	23 Jan 02 08:02	Neuro	Resp HIGH 76>60	BIS	ABP
4	23 Jan 02 08:12	Standard	HR(Pulse)	ST-II Manual	SpO2
5	23 Jan 02 08:32	Standard	HR(Pulse)	ST-II	SpO2 LOW 95<96
...					

The measurements in the event group are shown in the next columns, marked “Parameter 1, Parameter 2...”, along with the event values measured at the time of the event. For each event, the trigger values are shown.

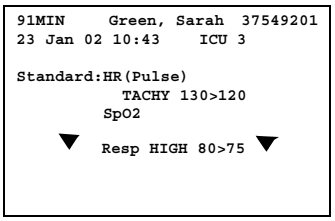
This section of the recording is A4 or letter size, so that it fits in a patient file.

Event Episode Recordings

Event episode recordings are divided into four sections.

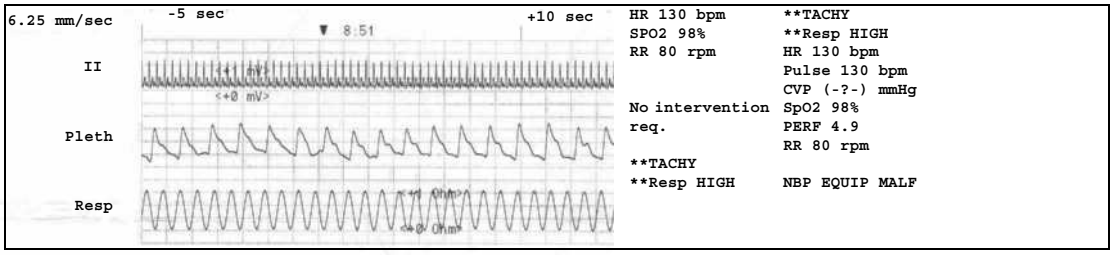
1. The first section shows the patient information and the event group of the episode with the event values for the group measurements. The trigger symbol marks the event trigger.
2. The second section shows the waveforms recorded during the episode. The trigger moment is marked with a triangle and divides the episode into the pre/post time. Any calibration marks and grid marks on the screen are automatically printed on the recording.

1.



If there are four measurements in the event group being recorded, two waveforms will be recorded in two separate waveforms segments.

2. 3. 4.



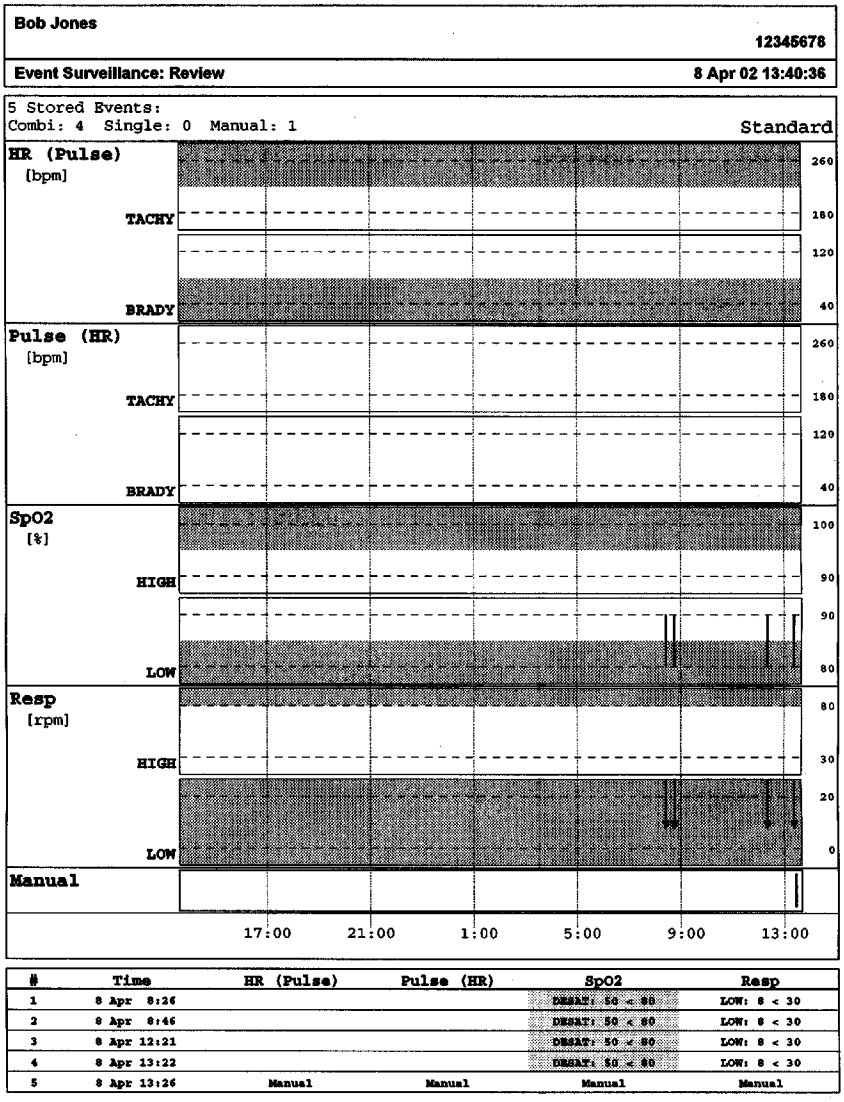
3. The third section shows the most important vital signs information, including numerics, active alarms, and any annotations made on the event episode.
4. The fourth section shows the numerics for all the currently monitored vital signs and any alarm conditions or INOPs active at the time the event was triggered.

Event Reports

Event reports can be printed on A4 and letter size paper on a printer connected locally or centrally to your monitor.

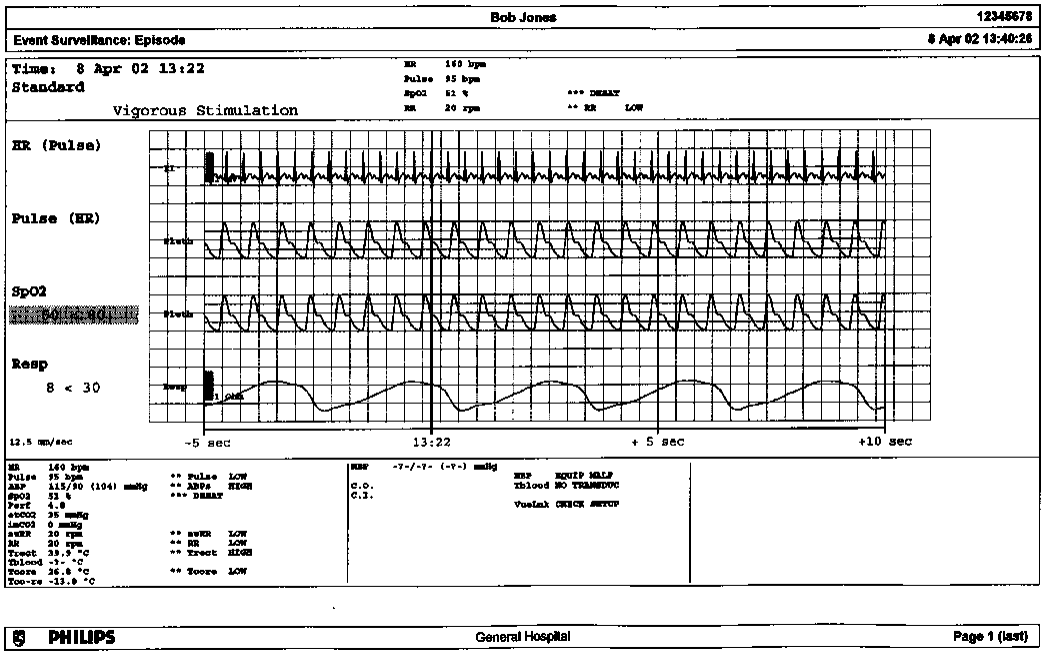
Event Review Reports

The event review report documents all the events stored in the event database.



Event Episode Reports

The event episode report documents the patient information from the currently-selected event. See the section on event recordings for an explanation of the report elements.



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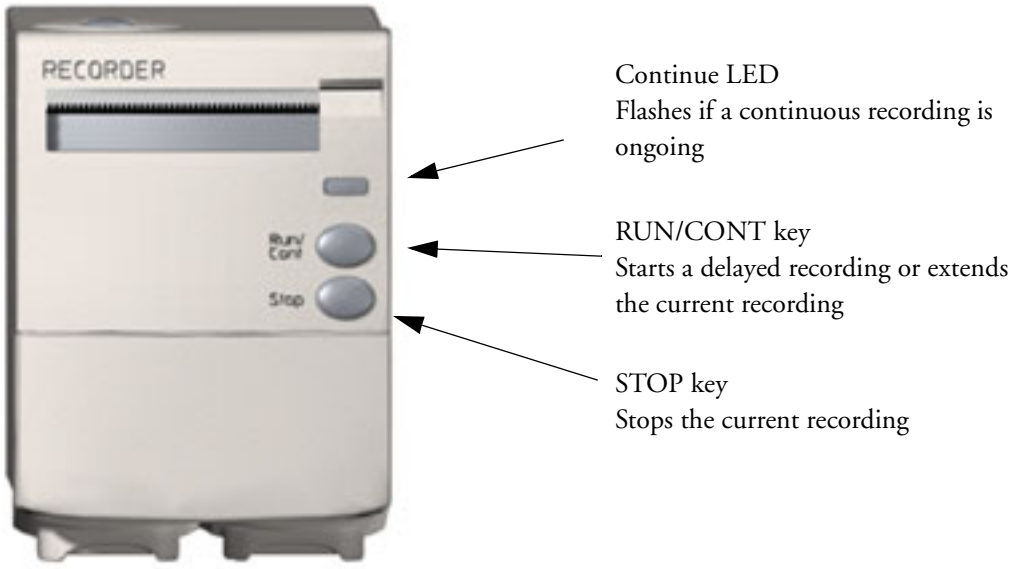
Recording

The M1116B plug-in recorder records numerics for all active measurements and up to three waveforms. You can use it for local recording mounted either in the monitor's FMS or in the Integrated Module Slot.

For central recording from the bedside, your monitor must be connected via a network to an Information Center. You can use either the M1116B recorder or the standalone M3160A 4-Channel Recorder. Recordings made on the M3160A may look slightly different to those described here. See the documentation supplied with the Information Center for information on the 4-Channel Recorder.



Starting and Stopping Recordings

The recordings pop-up keys let you start and stop recordings. Select the **Realtime Record** SmartKey to call up the line of pop-up keys. Scroll right or left to see any pop-up keys not displayed.

Start Delayed	Start RT A	Start RT B	Start RT C	Start HiResTrd	Start ECG Capt	Select Waves	Setup Recording	Stop all Recordng

Starting Recordings

To start any type of recording, select the **Realtime Record** SmartKey and then select the pop-up key of the recording type you want to start. Alternatively, you can select the **Main Setup** SmartKey, select **Recordings**, then select the recording type.

Select the SmartKey **Delayed Record** to immediately start a delayed recording. You can also start a delayed recording by pressing the RUN/CONT key on the recorder module.

Extending Recordings

Timed (non-continuous) recordings stop when their runtime is over. Continuous recordings continue until stopped manually or by an INOP condition.

- To make an ongoing recording continuous, press the RUN/CONT key on the recorder module.
- To extend an ongoing recording by its runtime, reselect its **Start** pop-up key.

Stopping Recordings

Recordings stop automatically when the preset runtime is over, when the recorder runs out of paper, or when the recorder has an INOP condition.

To manually stop a recording,

- Press the STOP key on the recorder module, or
- Select the **Realtime Record** SmartKey and then select the pop-up key **Stop all Recordng**.

Quickstarting Realtime Recordings

You can start realtime recordings on a locally-connected recorder without using a preconfigured template by defining the most important recording settings.

1 Select the **Realtime Record** SmartKey.

2 Select the pop-up key **Select Waves** and use the pop-up keys to choose up to three measurement waves to be printed on the recording. If you want fewer than three waves on the recording, select the pop-up key **Blank** for an empty wave channel.

3 When you have finished selecting waves, recording speed pop-up keys will appear. Use these keys to set the recording speed.

4 Select the **Start** pop-up key.

Quickstart recordings use default values for any recorder settings not defined: runtime is continuous, overlapping is set to non-overlapping, default recording speed is 25 mm/sec.

Overview of Recording Types

The **Recording Type** is always shown "grayed out" in the **Setup Recording** menu. This table details settings for local recordings.

	Delayed	Alarm	Realtime (RT)	ECG Capt	HiResTrnd	Procedure or Context
Type of recording	manual	automatic, triggered by defined alarm conditions	manual	manual	manual	manual, use the context window's pop-up keys to start
M1116B or M3160A	M1116B and M3160A	M1116B	M1116B and M3160A	M1116B	M1116B	M1116B
Information recorded	from the start trigger minus the delay time	from the start trigger minus the delay time	from the start trigger	from the start trigger, in realtime	from the start trigger minus delay time	defined by the context
Number of waves	up to 3	up to 3	up to 3	all ECG waves currently monitored and available	up to 3 high-resolution trends (beat-to-beat) waves	up to 3 waves, or specific to the context, e.g. a C.O. trial curve or a wedge procedure
Speed	50, 25, 12.5, 6.25, 2.5 mm/sec	50, 25, 12.5, 6.25, 2.5 mm/sec	50, 25, 12.5, 6.25, 2.5 mm/sec	25 mm/sec	1, 2, 2.5, 3, 6 cm/min	defined by the context
Runtime	15, 20, 25, or 30 seconds	15, 20, 25, or 30 seconds	15 seconds or continuously	4 seconds per wave	10 minutes, or continuously	defined by the context
Stops	automatically	automatically	automatically if limited, manually if continuous	automatically	automatically if limited, manually if continuous	defined by the context
Delay Time	10, 15 seconds	10, 15 seconds	none	none	6, 5, 4, 3, 2, 1 minutes	defined by the context
Overlap	up to 3 waves	up to 3 waves	up to 3 waves	none	up to 3 waves	defined by the context

ECG Capture Recordings

An ECG Capture recording shows a 4 second recording of each lead with a calibration bar preceding each ECG lead. All available leads are recorded sequentially in the standardized lead order. The recording is realtime, that is, the information recorded is not simultaneous.

Creating and Changing Recordings Templates

To save you defining recording settings each time you start a recording, you can create templates for commonly-used types of recordings in the **Setup Recording** menu. You can create templates for one delayed recording, one alarm recording, three realtime recordings, and one high resolution recording. ECG Capture recordings do not need to be configured, they always use the same format.

Changing recordings templates changes the settings that will be used each time a recording of this name is triggered.

1 Select the **Realtime Recordings** SmartKey to call up a line of recordings pop-up keys.

2 Select the pop-up key **Setup Recording** to enter the **Setup Recordings** menu.

3 Select **Name** to call up a pop-up list of available templates. Select the name of the template you want to create or change. Each recording name is linked to a recording type, either delayed, alarm, realtime, and high res trends, which is shown grayed out underneath the recording name. Recording names can be changed in the monitor's Configuration Mode.

4 Design the template by selecting each menu item and entering the information for the template.

- **Recorder**: choose which recorder the recording will print to (Local, Central 2-Ch. or Central 4-Ch.).
- **Channels 1 - 3**: choose which waveform to record in each channel. If the wave assigned to a recording channel in a particular template is not available when a recording is triggered, the channel is left blank on the recording strip. The pop-up list of available (currently monitored) waves differs according to the recording type:
  - Realtime and delayed recordings: the list shows all the currently available waves.
  - Alarm recordings: in addition to all the currently available waves, you can choose **Alarm Par** to always record the measurement in alarm in the chosen recorder channel
  - High-resolution recordings: the list shows all the available beat-to-beat waves.
- **Overlap**: define whether the recorded waveforms will be printed overlapping or beside each other.
- **Speed**: choose the recording print speed.
- **Delay Time**: Delayed recordings start documenting on the recorder strip from a pre-set time before the recording is started. This interval is called the "Delay Time" and can be set to 10 or 15 seconds.
- **Runtime**: see how long this type of recording is configured to run. This can only be changed in the monitor's Configuration Mode. Continuous recordings run indefinitely.

Changing ECG Wave Gain

The **ECG Gain** setting in the **Setup Recording** menu defines how every recorded ECG wave, irrespective of template or recording type, will appear on the recorder strip. This does not affect the displayed ECG wave, or printed ECG reports. To change the ECG gain setting for recordings,

1 In the **Setup Recording** menu select **ECG Gain**

2 Select the required setting:
  - **Auto**: the wave recording will use the same scale as the ECG wave on the monitor screen
  - **5 mm/mV, 10 mm/mv, 20 mm/mV**: the wave recording will use a scale of 5, 10, or 20 millimeters per millivolt.

Recording Priorities

Manually-started recordings have priority over automatically-started recordings. If an automatically- triggered alarm recording is running, and a realtime or delayed recording is manually started, the alarm recording is stopped and the manually-requested recording is started.

More recent manually-started recordings have priority over older manually-started recordings. If a manually-started recording is running, and another manually-started recording is triggered, then the older recording is stopped and the more recent manually-started recording is started.

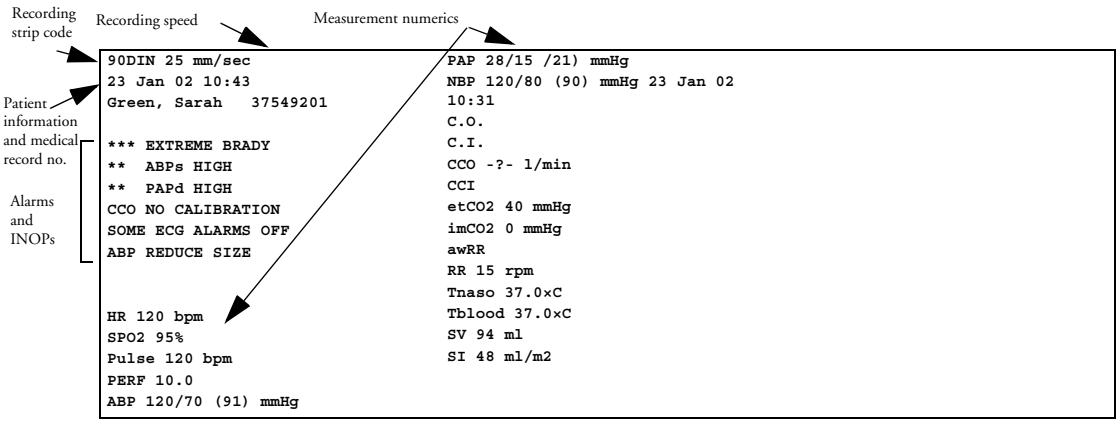
Alarm recordings are prioritized according to alarm priority. If an alarm recording triggered by a yellow alarm is running and a new alarm recording is triggered by a red alarm, the yellow alarm recording is stopped and the red alarm recording is started.

Sample Recording Strip

The information printed on the recording strip includes the patient name and MRN, bed number, date and time of recording, recording speed, and recording code. Active alarm and INOP messages as well as numerics for all currently monitored measurements are also printed.

Recording strip annotations are printed at the beginning of the recording strip and updated at regular intervals, every 15 minutes for recordings made at speeds lower than 6.25 mm/s, and every 60 seconds for recordings made at speeds greater or equal to 6.25 mm/s.

This sample recording strip shows a typical initial annotation:



Recording Strip Code

The recording strip code printed in the first line of the initial annotation has up to seven characters, specifying recording type, operating mode, application area, patient category, and delay time, if applicable.

	Code	Meaning
Recording type	90	Realtime
	8A	Delayed
	0B	Alarm
	91	Context (Procedures)
Operating mode	M	Monitoring
	D	Demo
	C	Configuration
	S	Service
Application area	I	ICU
	O	OR
	C	CCU
	N	NICU
Patient category	A	Adult
	P	Pediatric
	N	Neonatal

Recorded Waveforms

A selection of up to three waveforms is recorded, marked with wave labels and wave scale information. Wave scale information can be in the form of a calibration bar, like the 1 mV calibration bar for ECG, or calibration steps before the waveform starts.

Maintaining Recording Strips

Recording ink sometimes fades when covered with transparent tape. Avoid covering any part of a recording that is clinically relevant (annotation or waveforms) when taping a recording strip to a patient record or other patient documentation.

Reloading Paper

1 Use the latch on the right side of the recorder door to pull the door open.

2 Remove the empty core.

3 Insert a new roll so that it fits snugly into its housing and the paper end is feeding from the top.

4 Pull out some paper and fold along the front edge at a 45° angle. This makes it easier to feed the paper under the roller as shown.

5 Feed the paper through and pull some paper out from the top of the roller.

6 Close the recorder door.

7 To test if paper is loaded correctly, start a recording. If no printing appears, paper may be loaded backwards. Try reloading the paper.

CAUTION When the recorder is disabled (by removal from the FMS, door open, or out of paper), any alarm recordings will be sent to the central station recorder, if there is one. If no recorder is available, alarm recordings may be lost during the time the recorder is disabled. The message **`no alarm recording available`** will be displayed.

Recorder Status Messages

Recorder Status Messages	Explanation
`<Recording name> running`	The named recording is currently running.
`No <alarm recording name> available`	No alarm recording can be made on the selected recorder. If available, try selecting another recorder. Alarm recordings will be lost.
`<Recorder name> out of paper`	The named recorder is out of paper.
`<Recorder name> door open`	The door of the specified recorder is open.
`<Recorder name> not supported`	The M1116A recorder is not supported. Connect a M1116B plug-in recorder.

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Printing Patient Reports

Starting Reports Printouts

Most patient reports can be printed by selecting **Main Setup** - > **Reports** (or the **Reports** SmartKey) and then selecting the report name in the top half of the **Reports** menu. Report names are shown only for reports that have been correctly set up.

Data from the time of the print request is printed, even if the print job is delayed in the printer queue.

Report types	Report contents	How to start printing reports
Vital Signs Report	depends on selected trend group, data resolution, and period.	In the Vital Signs window, select **Print/Record**, then select **Print**
Graphic Trends Report		In the Graphic Trends window, select **Print**
Events Reports	Event Episode with up to 5 episodes	In the Events window, select the pop-up key **Print/Record**, then select the pop-up key **Print Review** or **Print Episode**
	Graphic or tabular Event Review	
EEG Report	EEG Waves, numerics, CSAs, and current settings	In the **Setup EEG** menu, select **Print Report**
ECG Reports	Depends on format selected	Select the **ECG Report** SmartKeys, if configured
Cardiac Output Report	Trial curves and numerics	In the **Cardiac Output** window, select the pop-up key **Print/Record**
Wedge Report	Wedge numerics and reference wave	In the **Wedge** window, select the **Print Wedge** pop-up key
Calculations Report	Hemodynamic, Oxygenation, or Ventilation Review	In the **Calculations** windows, select the **Print/Record** pop-up key
Drug Calculator Report	Titration Table	In the **Titration Table** window, select the **Print Titr.Tbl** pop-up key
	Drip Table	In the **Drip Table** window, select the **Print Drip Tbl** pop-up key
Alarm Limits Report	Graphic and numeric report of all current alarm limits	In the **Alarm Limits** window, select **Print Limits**
Realtime Reports, including oxyCRG Reports (Neonatal Event Review)	patient data and numerics, and either: all displayed waves OR all measured waves OR all measured RT waves Or all measured HiRes waves, OR oxyCRG waves (RT waves: ECG Primary lead, Pleth, Resp; HiRes waves: btbHR, HiRes SpO_2, HiRes Resp)	Select the **Realtime Reports** SmartKey, if configured

Stopping Reports Printouts

- To stop Reports printing, in the **Reports** menu, select
  - **Stop Report** to stop the current print job
  - **Stop All Reports** to cancel all queued report printouts
  - **Scheduled Rep.** to toggle to **Off** and switch off scheduled reports.

Setting Up Reports

Before you can print ECG, Vital Signs, Graphic Trends, or Auto Reports, you must define the report content. Typically, report content will be defined once for your monitor. As the content of context-linked reports, such as Cardiac Output, Calculations, and Wedge, is defined by the content of the procedure window, these reports do not need to be set up.

To set up reports:

1 In the **Reports** menu, select the name of the report you want to set up in the lower half of the reports menu to enter its individual setup menu.

2 Select each entry in the individual reports setup menus and choose the required setting as described in the individual sections.

The content you define in the individual **Setup Reports** menus will be used in all reports of this type: for example, if you set a print speed of 50 mm/sec in the **ECG Reports** menu, every ECG report will be printed at this speed, irrespective of format.

Setting Up ECG Reports

The settings you choose in the **ECG Reports** menu apply for all ECG reports printed.

ECG Reports	This menu entry lets you...
ReportLeadLayout	see which report layout has been configured for your monitor, **Internat.** or **Cabrera**. This setting can only be changed in Configuration Mode.
ECG Gain	set the required ECG Gain. This defines how ECG waves will appear on the ECG report printouts. Choose **5 mm/mV**, **10 mm/mV**, or **20 mm/mV.**
Speed	set the report print speed. Select either **25 mm/sec** or **50 mm/sec**.
Annotation	toggle between the settings **On** and **Off** to choose whether the printed ECG wave should be annotated with beat labels or not. See the chapter on ECG for a list of beat labels. Pace pulse marks are automatically printed beside the wave for paced patients.

Setting Up Vital Signs and Graphic Trend Reports

The procedure for setting up Vital Signs and Graphic Trend reports is identical. The settings you choose in the **Setup Vital Signs Report** and **Graphical Trend Report** menus apply for all Vital Signs and Graphic Trend reports printed.

Vital Signs Report/ Graphic Trend Report	**This menu entry lets you...**
Trend Group	choose from a list of available trends to define which will be printed on the report. The available choices depend on your monitor configuration; possible choices include **All**, **Cardiac**, **Hemo**, **Resp**, **Neuro**, **Temp**, **Gases**, or trend information from a **VueLink** device.
Period	choose the period of time for which trend data should be printed on the report. Choose either **1**, **2**, **3**, **6**, **12**, **24**, **48** hours. If **Automatic Period** is set to **On**, all trend data for the current patient will be printed, irrespective which trend period is selected.
Interval	(Vital Signs Reports only) choose the resolution of the trend data printed on the report. Choose either **12 seconds**, **1 minute**, **5 minutes**, **15 minutes, 30 minutes**, or **1 hour**.

Setting Up Auto Reports

Using Auto Reports you can set up to four individual reports to print automatically when a specified trigger occurs. There are two types of Auto Report:

- **Scheduled reports** can be set up to print at predefined intervals, starting at a predefined time of day. The start time you set applies for every following day. For example, if you set a start time of 07:00 and a repeat time of six hours, the first report will print at 07:00 every day, the next at 13:00 and so on.
- **End case reports** print automatically when you select **End Case** to discharge a patient.

Auto Reports	This menu entry lets you...
Auto Report	select the name for the Auto Report you want to set up. The default names are A, B, C, and D.
Report	assign a report type to the Auto Report name. The available reports are **Vital Signs**, **Graphic Trends**, **Events**, **ECG A**, **ECG B**, **EEG**, **Realtime Report**, **User A**, or **User B**.
End Case Report	toggle to **On** if you want the Auto Report you are setting up to print as an End Case Report, toggle to **Off** if the Report is a Scheduled Report only.
Scheduled Rep.	toggle to **On** if you want the Auto Report you are setting up to print as a Scheduled Report, toggle to **Off** if the Report is an End Case Report only.
Start Hour Start Minute Rep. Freq.(Hr) Rep. Freq.(Min)	set a time of day or a time interval as a print trigger for a scheduled report. – to set the time of day at which you want the report to print every day: select **Start Hour** and **Start Minute** and select the required time from the pop-up list – to set the time interval in minutes between two scheduled reports: select **Rep. Freq. (Hr)** and **Rep. Freq. (Min)** and select the time interval from the pop-up list. If you are setting up an end case report, these settings will be inactive (“grayed-out”).

Be aware that the monitor’s memory for reports is limited. If the memory is full, Auto Reports cannot be printed and the information may be lost.

Setting Up Individual Print Jobs

To adjust the appearance of individual print jobs, in the **Reports** menu, select **Setup Reports** to enter the **Setup Reports** menu, and then select the appropriate settings.

The menu items **Report Type**, **Report Size**, and **Orientation** may be inactive ("grayed-out") in this menu for reports that can only be started in a special window.

Setup Reports	Selecting this menu item lets you...
Report	choose the report you want to print. Available reports are **Realtime Report**, **Vitals Report**, **Graph Report**, **Event Episode**, **Event Review**, **ECG Report A**, **ECG Report B**, **EEG Report**, **C.O. Report**, **Wedge Report**, **Alarm Limits**, **Calc. Report**, **Calc. Review**, **User Report A**, and **User Report B**.
Report Type	Each template includes patient demographic data, alarm and INOP information. Choose which additional information you want the printout to contain. The setting selected for **Report** defines which **Report Types** are displayed in the menu: **Visible Waves** for all waves currently visible, in the order they appear on the screen. **All Waves** to print all measured waves, **RT Waves** for all currently measured realtime waves, according to the monitor's priority list. **HiRes Waves** to print all measured HiRes waves **OxyCRG Waves** to print the OxyCRG/Neonatal Event Review waves **Vital Signs** for trend information in tabular form. **Graph Trend** for trend information in graphic form. **ECG3X4**, **ECG6X2**, **ECG12X1**, **ECG4X2**, **ECG8X1** define a template for ECG reports. **EEG** to define a template for EEG reports **Episode** to print a single patient event episode. **Review** to print an overview of patient events **Alarm Limits** for a list of all currently set alarm limits.
Report Size	choose the paper size to be used for the report: **Unspecified** to use the default size for the template chosen, or **Universal**, **A4**, **Letter**, **LrgUniversal**, **A3**, or **Ledger**. The list of available sizes depends on the connected printers.
Orientation	choose the orientation of the report printout: **Unspec.** to use the default size for the template chosen, or **Landscape** or **Portrait**.
Target Device	choose which printer the print job will be sent to: **Unspec.** to use the default printer, or the printer name defined at the Information Center or in the monitor's Configuration Mode (for example, **lj_lpt1**).

Checking Printer Settings

The printer settings for your monitor are defined in Configuration Mode. The printer settings **Paper Size**, **Resolution**, **Color Support**, and **Duplex Option** for the active printer are visible but inactive ("grayed-out") in the **Setup Printers** menu.

Printer names for locally-connected printers can be defined in Configuration Mode. You can see whether a specified printer is centrally or locally connected in the **Setup Printers** menu under **Port**: **Local <name>** indicates locally-connected printers, **Remote <name>** indicates centrally-connected printers.

♦ To enter the **Setup Printers** menu, in the **Reports** menu, select **Setup Printers**.

Switching Printers On Or Off for Reports

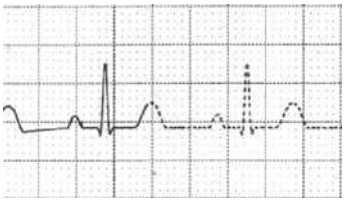
In Monitoring Mode, you can enable or disable the printer status to switch individual printers on or off for report printouts.

1 In the **Setup Printers** menu, select **Printer** and then select the name of the device you want to switch on or off for Reports printing from the pop-up list.

2 Select **Printer Status** to toggle between the settings **Enable** and **Disable**. If you set this to **Disable**, no reports will be printed to the named printer.

If the monitor detects that no printer of a particular type is available, the Enable/Disable setting will automatically be set to **Disable** and "grayed out".

Dashed Lines on Reports



If a section of a wave on a report is drawn with dashed lines, this tells you that a setting that affects the appearance of the wave on the screen was changed while the report was printing.

For example, if you change the wave scale while a report is printing, the wave scale and wave size are changed immediately on the monitor screen and on the report. To indicate that the scale information printed at the beginning of the report no longer matches the currently used scale, the wave will be printed using dashed lines, starting from the moment the change took place.

Some examples of settings that cause dashed lines in reports if changed during printing are: Filter mode, ECG lead placement, wave scale, measurement unit, paced/non-paced setting, and measurement mode. Note that as ECG waves are drawn with a fixed gain on reports (either 10 mm/mV or 20 mm/mV), changing the ECG wave scale will not cause dashed-line reports.

To avoid dashed lines on reports, wait 15 seconds after changing a setting before you trigger a report.

Unavailable Printer: Re-routing Reports

If you send a report to be printed on a printer that is not available, for example, because it has run out of paper, this print job is suspended and stored in the monitor's memory.

If the target device of this print job was set to **Unspecified**, the monitor will periodically try to resend the print job to the first printer listed in the **Setup Printers** menu under **Printer** that is set to **Enabled** and that has paper of the correct size.

To allow the report to print, you must either solve the problem with the target printer, or re-route the print job to another printer with paper of the correct size. To re-rout a print job,

- Enable the new target printer by selecting it in the **Setup Printers** menu and toggling to **Enabled**. As the monitor tries to send the report to the printers in the order they are listed, you must make sure that all the printers above the new target printer are disabled.

If the target device of the print job was set to a specific printer, re-routing is not possible.

Printer Status Messages

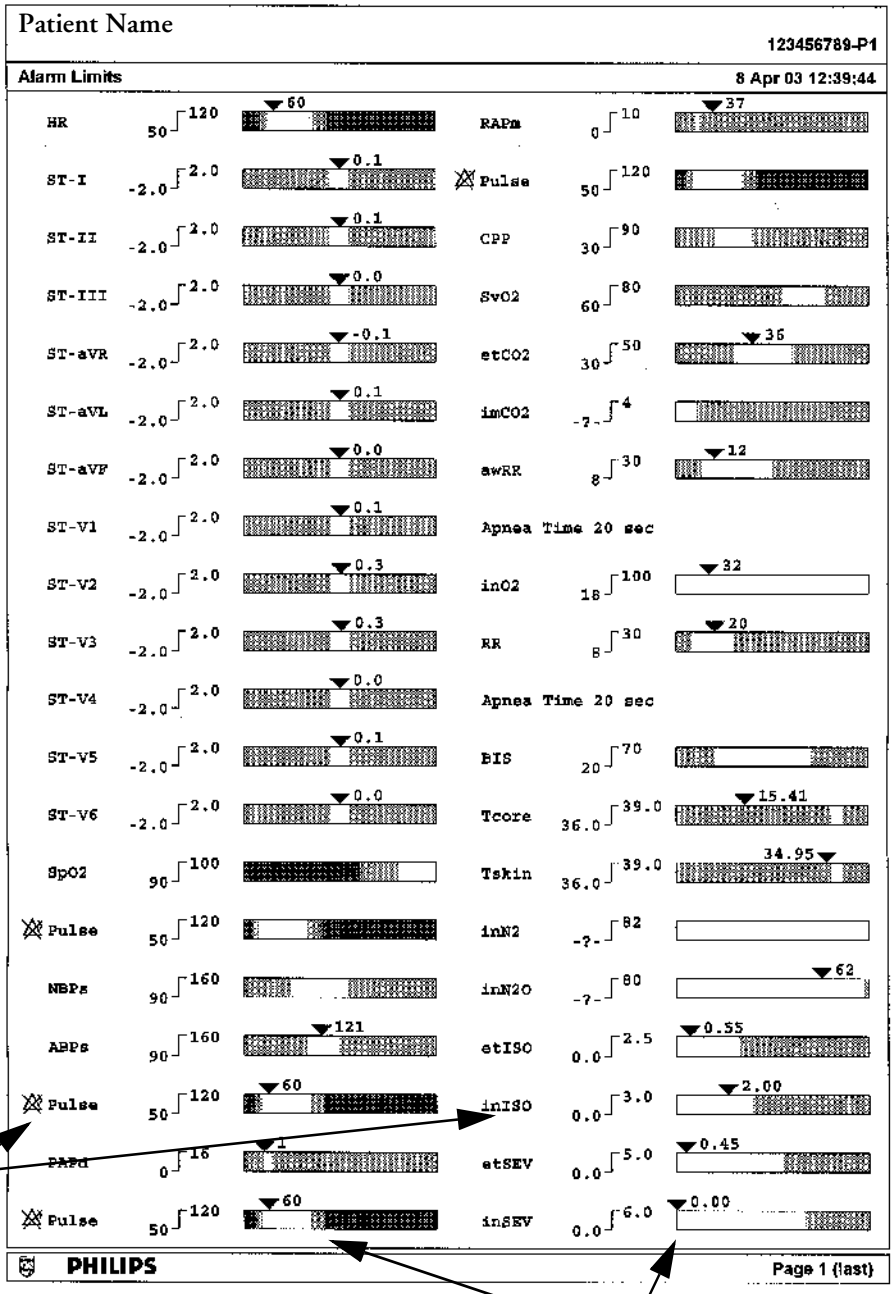
Printer Status Message	Possible causes and suggested action
Print job could not be queued	The printer queue is full and the monitor cannot accept another report request. Wait until some more reports have been printed, then try again, OR A report has been triggered that uses a paper size unavailable with the target printer. Try another printer, if available, or change the paper size of the print request.
Cancelling all print jobs	**Stop All Reports** has been selected in the **Report** menu, OR The Operating Mode has been changed from Monitoring Mode to Demonstration or Service Mode.
Cancelling N print jobs due to patient discharge	When a patient is discharged, all queued print jobs are cancelled. "**N**" is the number of print jobs queued.
Printing failed: no report configured	A report has been triggered which has not been correctly set up. Enter the setup menu for the report type to set up the report.
Printer <Printer name> unavailable - job suspended	The chosen device is unavailable. Check that the printer is properly connected and that paper is available. The requested report will start printing when the printer becomes available.
Job on <Printer name> failed	A report cannot be started on the requested printer. Make sure the printer is plugged in, switched on, and has paper loaded. Try another printer, if available. If this problem persists, call your service personnel.

Sample Report Printouts

Each report header contains the patient's bed label, last name and first name, the patient ID, the date and time, and the name of the report. The report footer contains the hospital label and page number, and the last page contains a note to mark the report end.

The monitor may be configured to leave a space on the top left or right of the report printout to enable you to stick a patient address label on it. This setting is called the Addressograph and it can only be changed in the monitor's Configuration Mode.

Alarm Limits Report



Measurement labels, with alarms off symbol where alarms are switched off

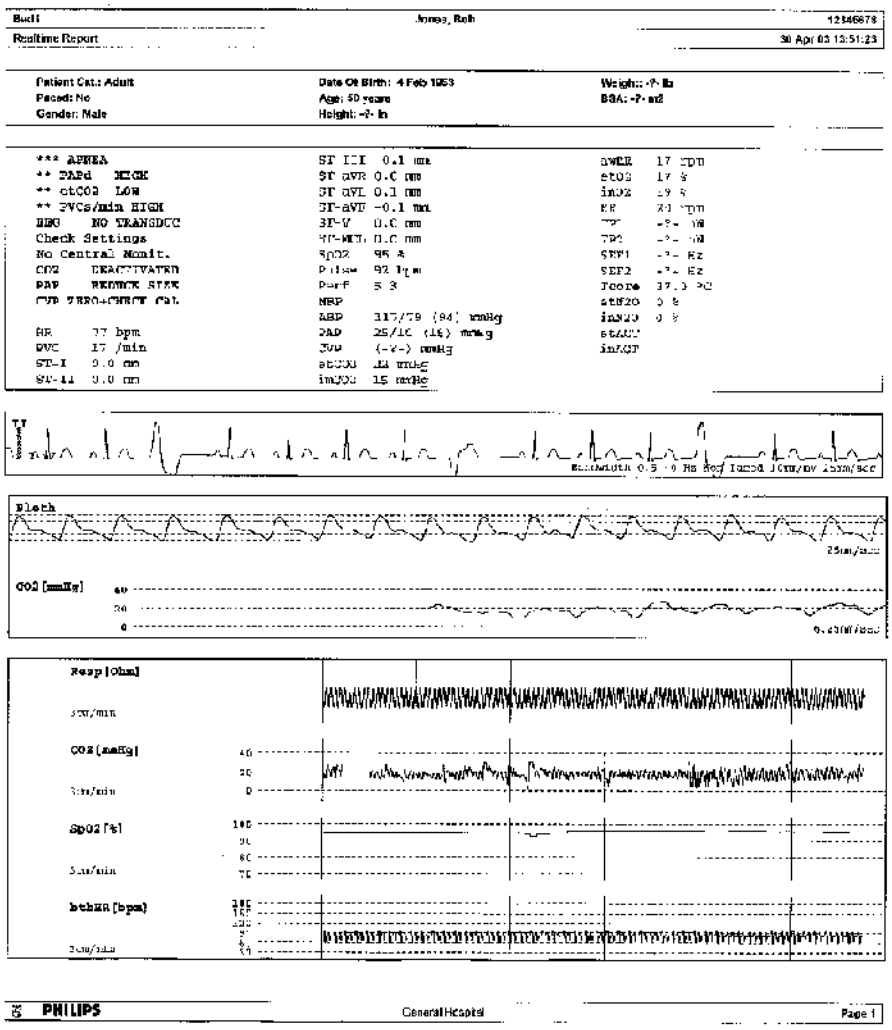
Graphic view of current alarm limits in relation to currently monitored measurement value

Realtime Report

Patient demographic information, time stamp

Active Alarms and INOPs, followed by vital signs

Measurement waves section, including HiRes waves

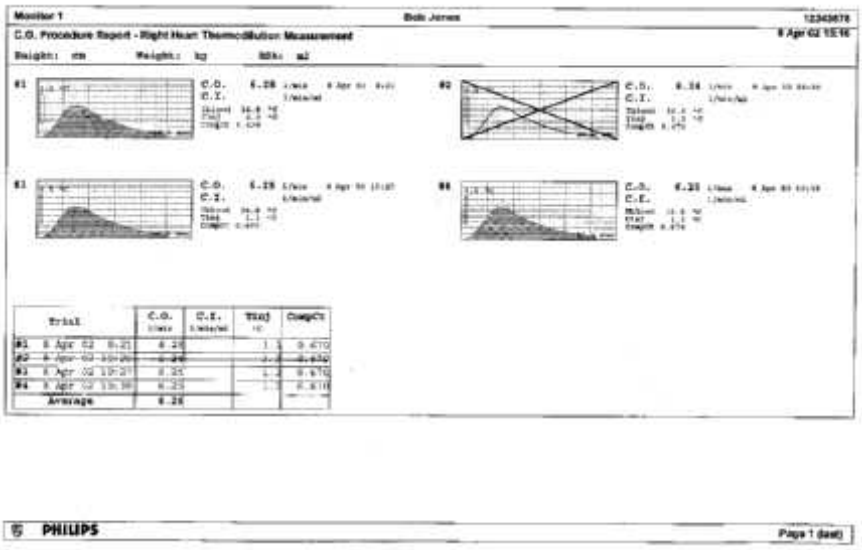


Cardiac Output Report

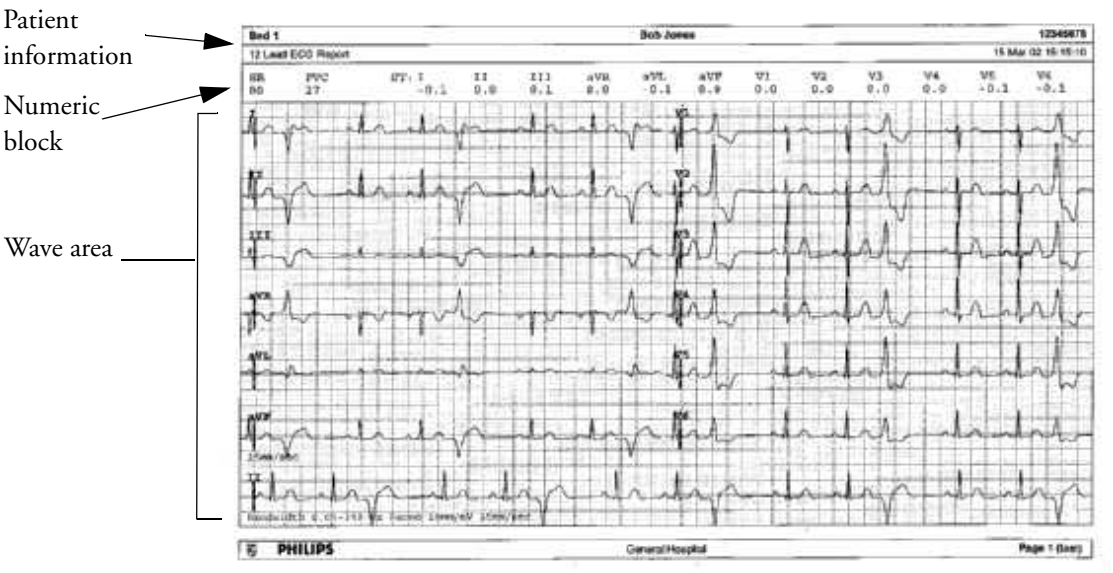
Patient information

Numbered trial curves

Trial information in tabular form



ECG Reports



Below the header on ECG Reports, the numeric block shows the current HR, PVC, and ST values. The wave area shows the printed waves for all available ECG leads. A 1 mV calibration bar is printed at the beginning of each wave. With the 3X4, 6X2, and 2X4 formats, a rhythm stripe prints a longer section of the ECG wave from the primary ECG lead for ECG rhythm evaluation. The ECG signal bandwidth, the patient's paced status, the ECG gain, and the print speed are printed at the bottom of the wave area. Pace pulse marks are automatically printed beside the wave for paced patients. Beat labels can be set to print on the rhythm stripe.

ECG Report type	Available Formats	Available Paper Sizes
12-Lead ECG	3X4 landscape	A4, letter, A3, ledger
	6X2 landscape	A4, letter, A3, ledger
	12X1 portrait	A4 and letter only
	12X1 landscape	A4, letter, A3, ledger
Multi-lead ECG	2X4 landscape	A4, letter, A3, ledger
	8X1 portrait	A4 and letter only
	8X1 landscape	A4, letter, A3, ledger

Other Reports

See the sections on Trends and Calculations and the chapter on Event Surveillance for other example reports.

25

Using the Drug Calculator

Drug mixtures for intravenous (IV) drug infusions combine information on drug dose, rate, amount, volume, concentration, and standardized rate. The Drug Calculator helps you to manage infusions by calculating one of these values at a time.

Term	Definition	Units
Dose	total quantity of drug to be delivered to the patient over time	amount units per time or per kg/ time, if the drug is weight-dependent
Rate	volume of the mixture to be delivered to the patient over time	ml/hour
Amount	amount of drug to be added to diluent to make up a mixture	ng, mcg*, mg, g, mU, U, where g stands for gram and U for unit
Volume	quantity of mixture of diluent and drug	ml
Concentration	ratio of the amount of drug to the solution volume	amount units per ml
Standardized Rate	1ml volume of the mixture to be delivered to the patient per hour	ml/hr

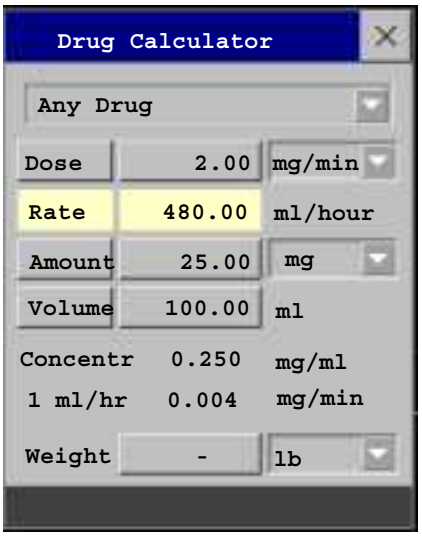
*Be aware that your hospital may use either 'µg' or 'mcg' as an abbreviation for microgram. These abbreviations are equivalent.

WARNING Before you administer any drug, always check that the correct drug, dose, and time are selected. Consult your pharmacy if you have questions.

Decisions on the choice and dosage of drugs administered to patients must always be made by the physician in charge. The Drug Calculator performs calculations based on the values input during use, it does not check the plausibility of the calculations performed.

Performing Drug Calculations

1 To access the Drug Calculator, select **Main Setup** -> **Calculations** -> **Drug Calculator**, or select the **Drug Calculator** SmartKey.



2 Enter three of these four values: dose, amount, volume, and rate of the infusion solution.

To enter values, select the correct unit, then select each value field and use the pop-up keypad to enter the correct value.

3 If you have chosen a weight-relevant dose unit, you must enter the patient weight now or choose a different unit.

The patient weight from the **Patient Demographic** window is entered automatically in the Drug Calculator window when the Drug Calculator is accessed. To change the patient weight, select the **Weight** key then use the on-screen keypad to enter the correct value. This will not change the patient weight stored in the patient demographic information. Any changes made to the patient weight in the patient demographic information while the Drug Calculator is open will not affect the Drug Calculator.

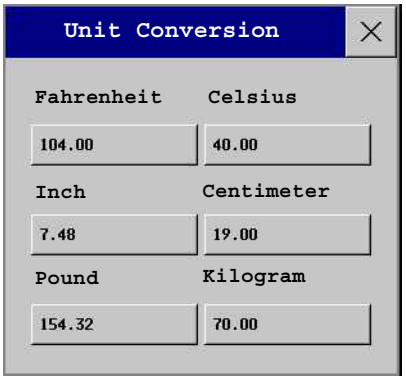
4 When you have entered three values, the Drug Calculator automatically calculates the unknown fourth value and shows it in the highlighted field. Standardized rate and concentration are also calculated.

Converting Units

To convert measurement units for drug calculation values,

1 In the Drug Calculator window, select the pop-up key **Unit Conversion** to open the Unit Conversion window.

2 Select the field under the unit you know and use the on-screen keypad to enter the known value. The converted value automatically appears in the adjacent field.

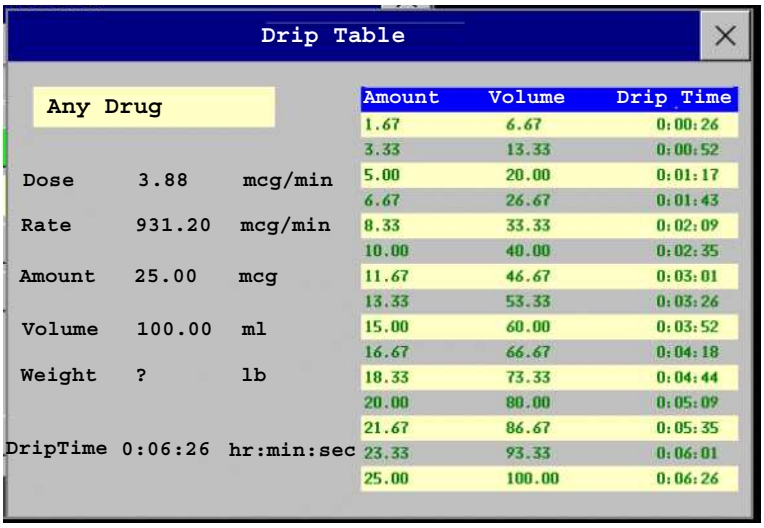


Charting Drip Progress

The Drip Table shows you at a glance how much of the infusion has been administered to your patient and how much time is left.

- To see the Drip Table, in the Drug Calculator window, select the **Drip Table** pop-up key.

If the DripTime exceeds 24 hours, the DripTime timestamp shows - - :- - : - - .

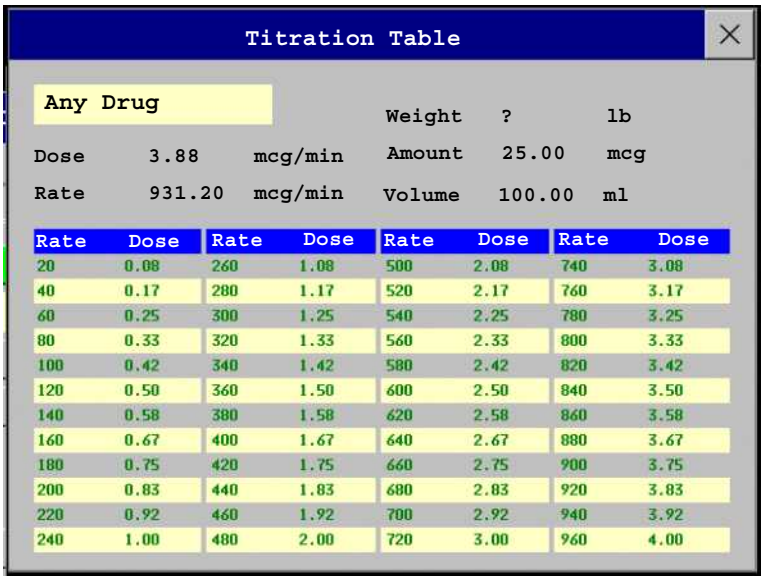


Using the Titration Table

Use the Titration Table to see at a glance what dose your patient would receive of a drug at different infusion rates.

The higher the infusion rate entered, the bigger the steps between table entries.

- To see the Titration Table, in the **Drug Calculator** window, select the pop-up key **Titr.Table.**



Documenting Drug Calculations

- In the Drug Calculator window, select the pop-up key **Record DrugCalc** to immediately start a recording of the current drug calculation.
- In the Titration Table window, select the pop-up key **Print Titr. Tbl** to print a report of the current Titration Table.
- In the Drip Table window, select the pop-up key **Print Drip Tbl** to print a report of the current Drip Table.

26

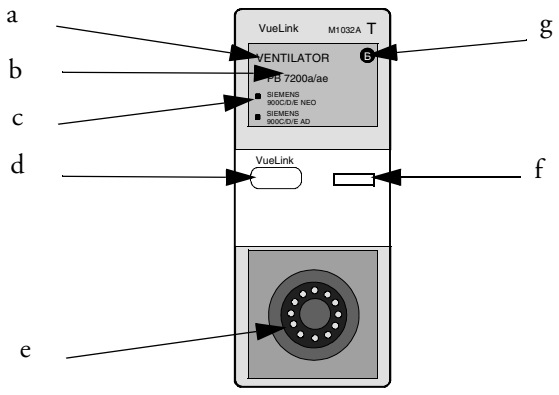
VueLink Modules

A VueLink module transmits information from a connected external device to your monitor. Each module can be connected to up to three external devices, and supports alarms from the external device.

Although the external device may transmit more information, the number of waves and numerics you can view simultaneously on your monitor's main screen depends on the module type. Type A modules support one wave and two numerics, type B modules support two waves and six numerics.

Module:	Type	Max Wave	Max numeric	External Devices
Auxiliary	A	1	2	standalone measurement module
Ventilator	B	2	6	ventilators
Gas Analyzer	B	2	6	gas analyzers
Anesthesia Machine	B	2	6	anesthesia machines
Auxiliary Plus	B	2	6	external multi-measurement devices

a module name
b device label
c selection LED
d setup key
e external device cable connector
f setup indicator LED
g module type (A or B)



The device labels (b) on the module indicate for which external devices the module is configured. The selection LED (C) shows which device is currently active. The device label text may differ slightly from the labels on the external devices.

See the documentation supplied with the VueLink module for a list of supported devices and accessories, and for configuration information.

Connecting an External Device

1 Insert the module into the FMS or integrated module slot.

2 Check that the device selection LED (c) lights to show that it has correctly identified the external device. If not, select **Main Setup** -> **Measurements** -> <**VueLink Device Name**> to enter the setup menu for the connected device, headed **Setup <VueLink Device Name>**.

3 In the device setup menu, select **Device**, select the correct device from the list, and confirm the selection.

4 Connect the external device to the module (e) and switch it on.

Once the VueLink device has been correctly connected, you can select the **VueLink** SmartKey and then select the **Setup VueLink** pop-up key to access the **Setup VueLink** menu for the connected device.

CAUTION Selecting the wrong device can cause unpredictable system behavior. Rectify this by switching off the external device when it is safe to do so, and selecting the correct device.

Changing VueLink Waves and Numerics Displayed

To change the waves and numerics from the VueLink module displayed on the Screen,

1 Select **Main Setup** -> **Measurements** -> <**VueLink Device Name**> to enter the setup menu for the connected device, headed **Setup <VueLink Device Name>**.

2 Select the item you want to change, then select the new item from the pop-up list,

or

Select **Show Device Data** to view the device data window.

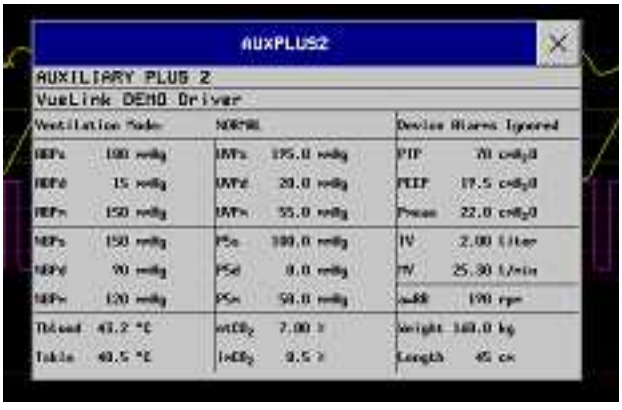
3 Close the setup menu. The monitor takes a few seconds to activate the change.

Viewing the VueLink Device Data Window

To view the VueLink device data window, either

- select the setup hardkey on the VueLink module or the **VueLink** SmartKey, and then select the **<Device Name>** pop-up key, or
- in the **Setup <Device Name>** menu, select **Show Device Data**.

Selecting the device data window opens the setup menu for the connected device.



Using VueLink Screens

Your monitor may be configured to show VueLink device data permanently on the Screens.

Select the device data window to display the VueLink pop-up keys that let you access the setup menu and carry out VueLink tasks.

Switching VueLink On and Off

- To switch VueLink measurements on and off, in the **Setup VueLink** menu, select **Device Interface** to toggle between the settings **On** and **Off**.

Alarms/INOPs From External Devices

The VueLink module itself generates INOPs, but does not generate alarms. If the external device's alarms are on, the module transmits these to the monitor. A message in the VueLink info window tells you either **Device Alarms Ignored** or **Device Alarms Accepted** or **No Alarms Available.** External device alarms status symbols precede some, but not all, measurement labels.

 the monitor is configured to accept external device alarms, but the alarms are switched off at the external device.

! alarms status of this external measurement is unknown

Alarms from external devices are:

- all transmitted to the monitor. For all numerics configured in the **Setup VueLink** menu, an alarm condition is announced at the monitor. For one or more measurements not configured in the **Setup VueLink** menu, an alarm is announced as a text message for the highest priority alarm. Priority is determined at the external device.
- **always** non-latching on the monitor.
- announced as a flashing numeric while the alarm condition persists.
- announced audibly and visibly at the Information Center.

Language Conflict with External Device Drivers

You should avoid language conflicts between the VueLink module device driver and the monitor. Be aware that if you connect a VueLink module with a different operating language to the monitor, the monitor will show:

- measurement labels in the monitor language
- alarm and INOP texts in the VueLink module device driver language.

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Respiratory Loops

Using a VueLink module connected to a ventilator, you can measure and store graphic representations of realtime respiratory loops to help you recognize changes in your patient's lung function over time.

Respiratory loops can help in early detection of patient airway changes, and they can also indicate a fault in the airway tubing (the respiratory loop does not close).

You can measure either

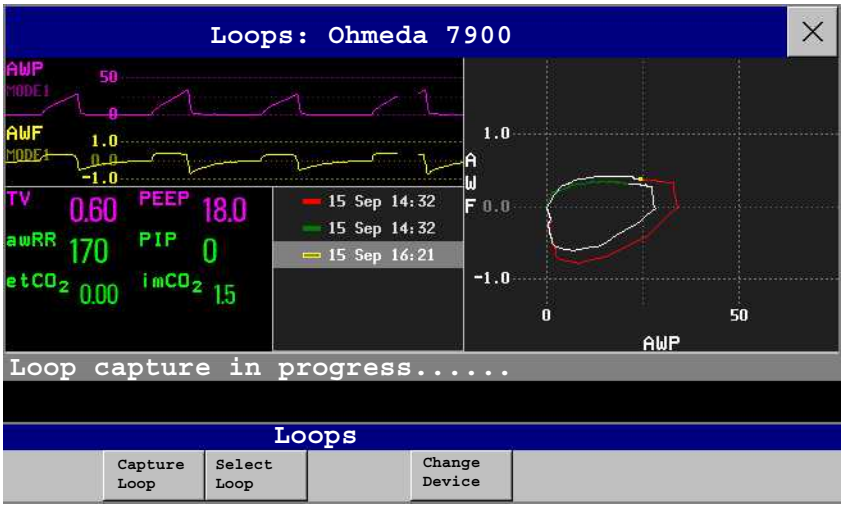
- Pressure-volume (PV) loops, plotting pressure and volume, or
- Pressure-flow loops, plotting pressure and flow

A maximum of six loops of each kind can be stored as reference. Each stored loop is automatically assigned a different color.

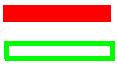
Note that you cannot store Loops from different patients and different source devices in the same list. This prevents you from inadvertently comparing information from different patients.

Using the Loops Window

Select a loop on the Screen or the **Loops** SmartKey, if configured, to open the **Loops** window and its associated pop-up keys.



- Source device: The device used as the source for the loop information is indicated in the window title.
- Waves: On the left, up to three realtime airway waves and six available numerics from the source device can be shown.
- Loops: are shown on the right, with timestamps color-coded to match the corresponding loop.
  - A filled-in rectangle marks loops currently shown in the Loops window
  - A rectangle outline marks loops not currently shown.



- Status Messages: at the bottom of the window provide information on the loop capture process.

Use the Loops pop-up keys to carry out the following tasks:

Capture Loop: capture the current loop and display it in the **Loops** window. The monitor will prompt you to save the loop for reference, either in addition to or in place of previously stored loops.

Select Loops: view the list of stored loops and change the selection of loops displayed in the **Loops** window, or delete loops from the list.

Change Device: view a list of source devices and change the selection.

28

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 "Guidelines for Prevention of Transmission of Human Immunodeficiency Virus and Hepatitis B Virus to Health Care and Public-Safety Workers" issued by the U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, Atlanta, Georgia, February 1989. See also any local policies that apply within your hospital, and country.

General Points

Keep your monitor, modules, Multi-Measurement Server, measurement server extensions, AGM, and Flexible Module Server, 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, decontaminate it first.

Observe the following general precautions:

- Always dilute according to the manufacturer's instructions or use lowest possible concentration.
- Do not allow liquid to enter the case.
- Do not immerse any part of the equipment in liquid.
- Never submerge any part of the system.
- Do not pour liquid onto the system.
- Do not allow cleaning or disinfecting agent to remain on any of the equipment surfaces - wipe it off immediately with a cloth dampened with water.
- Never use abrasive material (such as steel wool or silver polish).
- Never use bleach.
- Remove cleaning and disinfecting agents with a damp cloth and dry with a clean cloth.

CAUTION If you spill liquid on the equipment, battery, or accessories, contact your service personnel or Philips service engineer.

AGM Accessories

Do not clean or disinfect the gas sample tube (M1658A), airway adapter (13902A or M1612A), or gas exhaust return filter (M1656A).

Cleaning

Clean with a lint-free cloth, moistened with warm water (40°C/104°F maximum) and soap, a diluted non-caustic detergent, tenside, ammonia- or alcohol-based cleaning agent. Do not use strong solvents such as acetone or trichloroethylene. You may clean and disinfect the AGM gas exhaust return line (M1655A). Do not immerse or soak the tubing.

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 connectors of the Multi-Measurement Server, the measurement server extensions and measurement modules. Wipe around, not over, connector sockets.

CAUTION To clean 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. Unplug a mouse before cleaning it. Switch off the monitor to disable an attached SpeedPoint Device before cleaning the device.

Recommended cleaning agents are:

Tensides (dishwasher detergents)	Edisonite Schnellreiniger®, Alconox®
Ammonias	Dilution of Ammonia <3%, Window cleaner
Alcohol	Ethanol 70%, Isopropanol 70%, Window cleaner

Disinfecting

CAUTION **Solutions**: Do not mix disinfecting solutions (such as bleach and ammonia) as hazardous gases may result.

Hospital policy: Disinfect the product as determined by your hospital's policy, to avoid long term damage to the product.

Clean equipment before disinfecting. Recommended disinfecting agents are:

Alcohol based	Ethanol 70%, Isopropanol 70%, Cutasept®, Hospisept®, Kodan® Tinktur forte, Sagrosept®, Spitacid®, Sterilium fluid® (only Ethanol 70% and Isopropanol 70% are tested and qualified)
Aldehyde based	Cidex® activated dialdehyde solution, Gigasept (only Cidex is tested and qualified)

Cleaning Monitoring Accessories

To clean, disinfect and sterilize reusable transducers, sensors, cables, leads, the AGM watertrap (M1657B), and so forth, refer to the instructions delivered with the accessory.

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.

Cleaning the Recorder Printhead

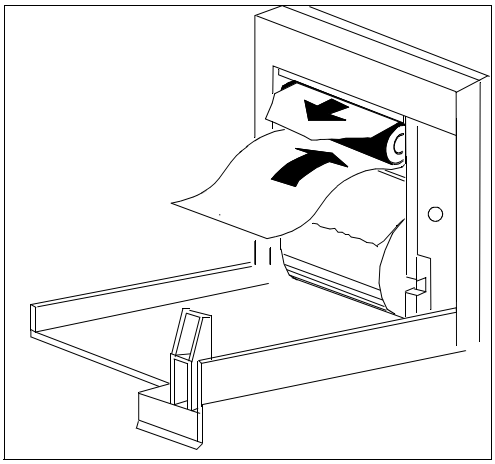
If you run recordings at low speed (1 or 2cm/min) for extended periods, deposits of paper debris may collect on the print head making recordings unevenly fainter in horizontal stripes.

1 Remove the recorder.

2 Open the recorder door and un-thread the paper from behind the rubber roller.

3 Tear off or roll up the excess paper into the roll chamber to get it out of your way.

4 Thread the cloth cleaning strip instead of paper around the rubber roller until approximately two inches of the strip come out from the top of the roller.



5 Close the recorder door, aligning both ends of the strip over the top of the door.

6 Holding the top end of the cleaning strip between your thumb and forefinger, pull the strip through and out of the recorder.

7 Open the door and ensure that the paper cavity is dust-free. Re-thread the paper and replace the recorder.

Cleaning the Batteries and Battery Compartment

MP40/MP50 Only Wipe with a lint-free cloth, moistened with warm water (40°C/104°F maximum) and soap. Do not use strong solvents. Do not soak the battery.

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Using the Batteries

IntelliVue MP40/MP50 only

To use the MP40/MP50 monitor with battery power, two Philips M4605A rechargeable Lithium Ion batteries must be inserted into the battery compartment at the rear of the monitor. The MP60/MP70/MP90 monitors cannot be powered by battery.

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

The batteries recharge automatically whenever the monitor is connected to mains power.

Battery operation may not be available in all geographies.

Battery compartment

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.

When both batteries are empty the monitor switches off automatically.

Battery LED

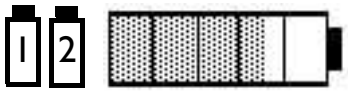
The battery LED on the front panel of the monitor is indicated by a battery symbol.

Battery LED

Battery LED Colors	If the monitor is connected to mains power, this means	If the monitor is running on battery power, this means
Green	batteries full	
Yellow	batteries charging	
Red, flashing		less than 10 minutes power remaining
Red, flashes intermittently	battery malfunction	battery malfunction
Red, flashes once when on/ standby switch is pressed		not enough battery power left to power monitor

Battery Status on the Main Screen

Battery status information can be configured to display permanently on all Screens. It shows the status of each of the batteries detected and the combined battery power remaining.



Battery status symbols: These symbols tell you the status of the batteries detected and which battery compartment they are in, either 1 or 2.

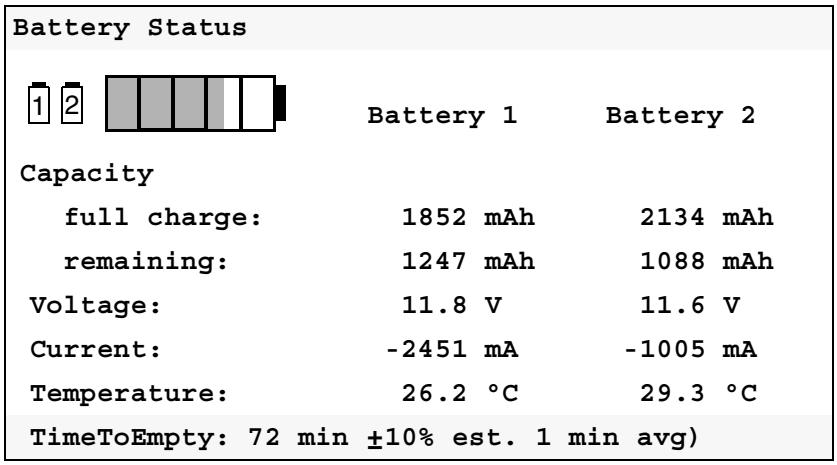
Battery power gauge: This shows the remaining battery power in the combined batteries. It is divided into sections, each representing 20% of the total power. If three and a half sections are shaded, as in this example, this indicates that 70% battery power remains. If no batteries are detected, question marks are shown.

Battery malfunction symbols: If a problem is detected with the battery, these symbols alternate with the battery status symbols to indicate which battery is affected. They may be accompanied by an INOP message or by a battery status message in the monitor information line providing more details.

Battery status symbols			**Battery malfunction symbols, colored red**			
						
Battery 1 is present	Battery compartment 2 is empty	Battery requires maintenance	Incompatible battery	Battery malfunction	Battery is missing, insert battery	One battery is very low on power

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, Full Charge tells you how much power each battery can hold when fully charged.

Capacity, Remaining tells you how much power is left in each battery.

Time To Empty tells you approximately how long you can continue to use the monitor with these batteries. Note that this time fluctuates depending on the system load (how many measurements and recordings you carry out), the age of the battery, and the remaining capacity of the battery.

Time To Full is shown in place of **Time To Empty** If the monitor is connected to mains power, and tells you much time is left until the batteries are fully charged.

Viewing Individual Battery Status

♦ To view information for individual batteries, select the pop-up key **Battery 1** or **Battery 2**.

Documenting Battery Status

To print the information in the **Battery Status** window on a connected recorder,

1 Select the battery status information on the Screen to open the **Battery Status** window

2 Select the **Record Status** pop-up key.

Replacing Batteries

You can replace batteries without switching off the monitor, if you replace them one at a time and if the remaining battery has sufficient power. The **Battery Missing** INOP is suppressed for 30 seconds while you exchange each battery.

To replace batteries,

1 Press the battery compartment latch to open the battery compartment door.

2 To replace battery 1, rotate the battery retainer until the battery can be removed.

To replace battery 2, rotate the battery retainer until the battery can be removed.

3 Pull gently on the canvas strap to move the battery towards you, then grasp the battery and pull it out fully.

4 Slide the new battery into position, making sure that the positive and negative poles are facing in the correct direction, as outlined on the inside of the battery compartment door.

5 Repeat with the second battery if required.

6 Center the battery retainer and close the battery compartment door.

Maintaining Batteries

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

Display Brightness Setting

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

Satisfy yourself that this level of brightness is suitable for your monitoring location.

Note that your monitor may be configured to dim or brighten the display brightness automatically when you disconnect from power, to suit the most common transport scenario ("**TransportBrightn**" setting).

Checking Battery Charge

- To check the charge status of a battery in a monitor, see the battery power gauge on the Screen or select **Main Setup** -> **Battery** to enter the **Battery Status** window.
- To check the charge status of a battery that is not connected to a monitor or battery charger, press the black dot marked “PUSH” on the labeled side of the battery. The remaining charge is indicated by four LEDs on the electronic fuel gauge directly above the dot. Each LED represents 25% of charge. If all LEDs are lit, the battery is fully charged, if only one LED is lit, 25% charge is left.

Charging Batteries

Batteries can be charged in monitors used to monitor patients. Charging is quicker in unused monitors. Contact your local Philips representative for information on external battery chargers.

1 Insert the batteries into a monitor connected to mains power. The battery LED will light yellow to indicate that charging is in process.

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

Reconditioning Batteries

CAUTION Do not use a monitor being used to monitor patients to recondition batteries. The monitor switches off automatically when the battery is empty.

You must recondition a battery when its “battery requires maintenance” symbol shows on the Screen. To recondition a battery,

1 Insert the battery into a monitor connected to mains power.

2 Charge the battery until it is completely full. Open the **Battery Status** window and check that the **Time to Charge** is zero hours and zero minutes.

3 Disconnect the monitor from mains power, and let the monitor run until the battery is empty and the monitor switches itself off.

4 Reconnect the monitor to the mains power and charge the battery until it is completely full again. Open the **Battery Status** window and check that the **Time to Charge** is zero hours and zero minutes.

Contact your local Philips representative for information on external battery chargers.

Unequally-Charged Batteries

If two batteries in a monitor are unequally charged, the monitor can compensate by causing the fuller battery to discharge faster. For this mechanism to work, the charge state of the two batteries should not differ by more than 50%.

Battery Safety Information

WARNING 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.

CAUTION Do not disassemble, heat above 212°F (100°C) 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. Clean the battery compartment according to the instructions.

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Maintenance and Troubleshooting

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.

Contact: If you discover a problem with any of the equipment, contact your service personnel, Philips, or your authorized supplier.

Inspecting the Equipment and Accessories

You should perform a visual inspection before every 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 and that there are no signs of abuse.

2 If the MMS and Server Extensions are mounted on the monitor, make sure that they are locked into place and do not slide out without releasing the locking mechanism.

3 Inspect all accessories (cables, transducers, sensors and so forth). If any show signs of damage, do not use.

4 Switch the monitor on and make sure the backlight is bright enough. Check that screen is at its full brightness. 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 Philips power cord.

2 Inspect the Measurement Server Link cable and ensure that it makes good connection with the MMS and the FMS. Make sure that there are no breaks in the insulation.

3 If the MMS is not mounted directly on the monitor, inspect the cable connecting it to the monitor. Make sure the connectors are properly engaged.

4 Inspect the patient 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.

5 Apply the transducer or electrodes to the patient, and with the monitor switched on, flex the patient cables near each end to make sure that there are no intermittent faults.

Service Task Schedule

The following tasks, documented in the service manual, are for Philips-qualified service professionals only.
Carry out the tasks as indicated by the monitor's maintenance schedule, or as specified by local laws. 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 Schedule	Frequency
Safety checks according to IEC 60601-1	At least once every two years, or as needed, after any repairs where the power supply is replaced, or if the monitor has been dropped.
Synchronization of the monitor and defibrillator (only if hospital protocol requires use of monitor during defibrillation)	At least once every two years, or as needed.
Replace backlight	25,000 hours (about three years) of continuous usage, or as needed.
Performance assurance for all measurements not listed below.	At least once every two years, or if you suspect the measurement values are incorrect.
NBP calibration	Once a year, or as specified by local laws.
Microstream CO_2 calibration and performance test	At least once a year or after 4000 operating hours.
Microstream CO_2 preventive maintenance	At least once every three years or after 15,000 operating hours.
BIS performance test	Optional (Philips recommends once a year)
AGM preventive maintenance (gas span calibration check, ambient pressure check, flow rate check, pump check, leakage check, internal Nafion tubing and bacterial filter replacement and so forth as described in AGM service manual)	At least once a year or if you suspect the measurement values are incorrect.
AGM ventilator fan	At least every six months.

Troubleshooting

If you suspect a problem with an individual measurement, read the Instructions for Use and doublecheck that you have set up the measurement correctly.

If you suspect an intermittent, system-wide problem call your service personnel. You may be asked for information from the status log. To view the status log,

1 In the **Main Setup** menu, select **Revision**.

2 Select a pop-up key according to the status log you want to consult, for example, to check the status log for the MMS, select the **M3001A** pop-up key.

3 View the status log by selecting the **Stat Log** pop-up key.

Disposing of the Monitor

WARNING To avoid contaminating or infecting personnel, the environment or other equipment, make sure you disinfect and decontaminate the monitor appropriately before disposing of it in accordance with your country's laws for equipment containing electrical and electronic parts. For disposal of parts and accessories such as thermometers, where not otherwise specified, follow local regulations regarding disposal of hospital waste.

You can disassemble the monitor, MMS, FMS and modules as described in the Service Guide.

- There is no metal molded into the plastic case, and there are 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.
- The sheet metal card cage uses only one kind of steel.
- The screen has a touch resistor laminate.
- You can recycle the paper Instructions for Use.

Disposing of Empty Calibration Gas Cylinders

1 Empty the cylinder completely by pushing in the pin of the regulator valve or by pulling out the pin of the fill wave using a tire valve stem wrench or a pair of needle nose pliers.

2 When the cylinder is empty, either remove the valve step from the fill (or regulator) hole, or drill a hole in the cylinder.

3 Write "Empty" on the cylinder and dispose of it appropriately for scrap metal.

WARNING Ensure that the cylinder is completely empty before trying to remove the valve stem or drill the tank.

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Accessories

You can order parts and accessories from Philips supplies at www.medical.philips.com or consult your local Philips representative for details.

WARNING **Reuse:** Never reuse disposable transducers, sensors, accessories and so forth that are intended for single use, or single patient use only.

Philips' approval: Use only Philips-approved accessories.

Packaging: Do not use a sterilized accessory if its packaging is damaged.

ECG/Resp Accessories

This symbol indicates that the cables and accessories are designed to have special protection against electric shocks (particularly regarding allowable leakage currents), and are defibrillator proof.

Trunk Cables

Length	3-Electrode Cable Set		5-Electrode Cable Set		10-Electrode Cable set
	AAMI Part No.	IEC Part No.	AAMI Part No.	IEC Part No.	AAMI/IEC Part No.
0.9m	M1540C	M1550C	M1560C	M1570C	n/a
2.7m	M1500A	M1510A	M1520A	M1530A	M1949A

3-Electrode Cable Sets

Description	Length	AAMI Part No.	IEC Part No.
OR	1.0m	M1601A	M1611A

Description	Length	AAMI Part No.	IEC Part No.
ICU Grabber shielded	1.0m	M1603A	M1613A
ICU snap shielded	1.0m	M1605A	M1615A
ICU Clip non-shielded	0.45m	M1608A	M1618A
ICU Clip non-shielded	0.7m	M1609A	M1619A

5-Electrode Cable Sets

Description	Length	AAMI Part No.	IEC Part No.
OR Grabber shielded	1.0m/1.6m	M1621A	M1631A
ICU Grabber shielded	1.0m/1.6m	M1623A	M1633A
ICU Snap shielded	1.0m/1.6m	M1625A	M1635A
ICU Clip non-shielded	0.7m/1.3m	M1629A	M1639A

10-Electrode Cable Sets

Description	Length	AAMI Part No.	IEC Part No.
OR Grabber - extremities	1.0m/1.6m	M1973A	M1974A
OR Grabber - chest	1.0m	M1979A	M1984A
ICU Extremities	1.0m/1.6m	M1968A (grabber)	M1971A (grabber)
ICU Chest	1.0m	M1976A (grabber)	M1978A (grabber)

3-Electrode One Piece Cables

AAMI 3-Electrode One Piece Cables	Length	AAMI Part No.	IEC 3-electrode One Piece Cables	IEC Part No.
OR Grabber	1.9m	M1970A	OR Grabber	M1980A
ICU Snap	1.9m	M1972A	ICU Grabber	M1981A

5-Electrode One Piece Cables

AAMI 5-electrode One Piece Cables	Length	AAMI Part No.	IEC 5-electrode One Piece Cables	IEC Part No.
OR Grabber	2.5m	M1975A	OR Grabber	M1985A
ICU Snap	2.5m	M1977A	ICU Grabber	M1986A

Set Combiners and Organizers

Set combiners and organizers		Part No.
Set combiner	3-electrode	M1501A
	5-electrode	M1502A
Set organizer	Shielded 3-electrode	M1503A
	Shielded 5-electrode	M1504A
Bedsheet clip		M1509A

NBP Accessories

These cuffs and tubings are designed to have special protection against electric shocks (particularly regarding allowable leakage currents), and are defibrillator proof. You can use them during electrosurgery.

Adult/Pediatric Multi-Patient Comfort Cuffs and Disposable Cuffs

Patient Category	Limb Circumference	Bladder Width	Disposable cuff Part No.	Reusable cuff Part No.	Tubing
Adult (Thigh)	42 to 54 cm	20 cm	M1879A	M1576A	M1598B (1.5m) or M1599B (3m)
Large Adult	34 to 43 cm	16 cm	M1878A	M1575A	
Adult	27 to 35 cm	13 cm	M1877A	M1574A	
Small Adult	20.5 to 28 cm	10.5 cm	M1876A	M1573A	
Pediatric	14 to 21.5 cm	8 cm	M1875A	M1572A	
Infant	10 to 15 cm	5.5 cm	M1874A	M1571A	

Reusable Cuff Kits

Cuff Kits	Part No.
Infant, pediatric, small adult, adult	M1577A
Small adult, adult, large adult, thigh	M1578A
Infant, pediatric, small adult, adult, large adult, thigh	M1579A

Adult/Pediatric Antimicrobial Coated Reusable cuffs

Patient Category (color)	Limb Circumference (cm)	Bladder Width	Part No.	Tubing
Adult Thigh (grey)	45 - 56.5	21.0 cm	**M4559A**	M1598B (1.5m) or M1599B (3m)
Large Adult X-Long (burgundy)	35.5 - 46.0	17.0 cm	**M4558A**	
Large Adult (burgundy)	35.5 - 46.0	17.0 cm	**M4557A**	
Adult X-Long (navy blue)	27.5 - 36.5	13.5 cm	**M4556A**	
Adult (navy blue)	27.5 - 36.5	13.5 cm	**M4555A**	
Small Adult (royal blue)	20.5 - 28.5	10.6 cm	**M4554A**	
Pediatric (green)	13.8 - 21.5	8.0 cm	**M4553A**	
Infant (orange)	9 - 14.8	5.4 cm	**M4552A**	

Adult/Pediatric Soft Single Patient Single-Hose Disposable Cuffs

Patient Category	Limb Circumference (cm)	Bladder Width	Part No.	Tubing
Adult (Thigh)	45 - 56.5 cm	20.4 cm	M4579A	M1598B (1.5m) or M1599B (3m)
Large Adult X-Long	35.5 - 46 cm	16.4 cm	M4578A	
Large Adult	35.5 - 46 cm	16.4 cm	M4577A	
Adult X-Long	27.5 - 36.5	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	
Pediatric	15.0 - 21.5 cm	8.0 cm	M4573A	
Infant	9 - 15 cm	5.6 cm	M4572A	

Neonatal/Infant Cuffs (Disposable, non-sterile)

Cuffs	Limb Circumference (cm)	Bladder Width	Part No.	Tubing
Size 1	3.1 to 5.7 cm	2.2 cm	M1866A	M1596B (1.5m) or M1597B (3m)
Size 2	4.3 to 8.0 cm	2.8 cm	M1868A	
Size 3	5.8 to 10.9 cm	3.9 cm	M1870A	
Size 4	7.1 to 13.1 cm	4.7 cm	M1872A	

Invasive Pressure Accessories

These transducers and accessories are designed to have special protection against electric shocks (particularly regarding allowable leakage currents), and are defibrillator proof.

If you are using the M3012A Hemodynamic Measurement Server Extension, and you want to measure temperature and invasive pressure at the same time, we recommend that you use the pressure transducer CPJ840J6, with a round module connector piece, and not a transducer with a square connector. Pressure transducers with square connectors may make it difficult to connect the adjacent Temperature connector at the same time.

Transducer, accessories, sensor kits	Part No
Reusable pressure transducer 5 µV/.V/mmHg sensitivity	CPJ840J6
Sterile disposable pressure domes for CPJ840J6 (pack of 50)	CPJ84022
Transducer holder for CPJ840J6 (pack of 4)	CPJ84046
IV pole mount for CPJ840J6	CPJ84447
Single channel disposable sensor kit (20) - (EU/EFTA only)	M1567A
Dual channel disposable sensor kit (20) (EU/EFTA only)	M1568A
Transducer holder for M1567/8A (EU/EFTA only)	M2271A
IV pole mount for M1567/8A (EU/EFTA only)	M2272C
Adapter cable for disposable sensor kit 3,0m for M1567/8A	M1634A
Pressure transducer kits	
PiCCO monitoring kit, 30cm pressure line, includes PV4046 injectate temperature sensor housing for M1646A	PV8103
PiCCO monitoring kit, 150cm pressure line, includes PV4046 injectate temperature sensor housing for M1646A	PV8115
PiCCO monitoring kit, 150cm pressure line, includes PV4046 injectate temperature sensor housing for M1646A and central venous pressure line	PV8115CVP
PULSION Pressure Interface Cable for disposable pressure transducer	PMK 206

SpO_2 Accessories

The Nellcor sensors Oxisensor N-25, I-20, OxiCliq N, and I contain natural rubber latex which may cause allergic reactions. Disposable sensors are not available in USA from Philips. Purchase Nellcor OxiCliq sensors and adapter cables directly from Tyco Healthcare.

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 “Long” version).

All listed sensors operate w/o risk of exceeding 41°C on the skin if ambient temperature is below 37°C.

The M1020B SpO_2 module with Option A02 may not be available in all countries.

Make sure you choose the correct accessories from the following table for the SpO_2 measurement device you are using, either

Standard: Multi-Measurement Server M3001A and Standard SpO_2 module M1020B, Option A01, or

OxiMax: OxiMax Module SpO_2 module M1020B, Option A02.

OxiMax sensors may not be available in all countries.

Product Number	Description	Standard	OxiMax	Comments
Philips reusable sensors.				
M1191A	Adult finger sensor, for patient size >30kg. Cable length 2 m.	yes	no	Cable: silicone; sensor housing: silicone.
M1191AL	M1191A with longer cable (3 m).	yes	no	M1191AL may not be available in all countries.
M1192A	Pediatric foot/finger sensor/adult finger. Cable length 1.5 m.	yes	no	Cable: polyurethane; sensor housing: silicone.
M1193A	Neonatal foot/adult finger sensor.	yes	no	
M1194A	Adult/pediatric ear clip sensor. Cable length 1.5 m.	yes	no	Cable: polyurethane; sensor housing: polyurethane.
M1195A	Infant finger sensor. Cable length 1.5 m.	yes	no	Cable: polyurethane; sensor housing: silicone.
Philips disposable sensors. Not available in the USA.				
M1904B	Identical to OxiMax MAX-A	yes	yes	**Standard**: Use adapter cable M1943A or M1943AL. **OxiMax**: Must use adapter cable M1943NL.
M1903B	Identical to OxiMax MAX-P	yes	yes	
M1902B	Identical to OxiMax MAX-I	yes	yes	
M1901B	Identical to OxiMax MAX-N	yes	yes	
NELLCOR disposable sensors (must be ordered from Nellcor)				
OxiMax MAX-A	Adult finger sensor (patient size >30kg)	yes	yes	**Standard**: Use adapter cable M1943A or M1943AL. **OxiMax**: Must use adapter cable M1943NL.
OxiMax MAX-AL	OxiMax MAX-A with long cable	yes	yes	
OxiMax MAX-P	Pediatric foot/hand sensor (patient size 10-50 kg)	yes	yes	
OxiMax MAX-I	Infant foot/hand sensor (patient size 3-20 kg)	yes	yes	
OxiMax MAX-N	Adult finger or neonatal foot/hand sensor (patient size >40 kg or <3 kg)	yes	yes	

Product Number	Description	Standard	OxiMax	Comments
MAX-FAST	Forehead sensor	no	yes	Needs M1943NL adapter cable.
OxiMax MAX-R	Adult nasal sensor	no	yes	
OxiMax SC-A	Adult softcare sensor	no	yes	
OxiMax SC-NEO	Neonatal softcare sensor	no	yes	
OxiMax SC-PR	Preterm infant softcare sensor	no	yes	
Oxisensor II D-25	Adult sensor (patient size >30kg)	yes	no	Needs M1943A adapter cable.
Oxisensor II D-20	Pediatric sensor (patient size 10-50 kg)	yes	no	
Oxisensor II I-20	Infant sensor (patient size 3-20 kg)	yes	no	
Oxisensor II N-25	Neonatal sensor (patient size <3 kg or >40 kg)	yes	no	
OxiCliq A	See OxiMax MAX-A	yes	yes	Standard: Use adapter cable M1943A or M1943AL together with OC3 adapter cable. OxiMax: Must use adapter cables M1943NL and OC3 adapter cable.
OxiCliq P	See OxiMax MAX-P	yes	yes	
OxiCliq I	See OxiMax MAX-I	yes	yes	
OxiCliq N	See OxiMax MAX-N	yes	yes	
Oxiband OXI-A/N	Adult / neonatal sensor	no	yes	Needs M1943NL adapter cable.
Oxiband OXI-P/I	Pediatric / infant sensor	no	yes	
Durasensor DS100A	Adult finger clip sensor	no	yes	
Dura-Y D-YS	Y-sensor	no	yes	
Extension / Adapter Cables				
M1941A	Extension cable	yes	yes	For use with Philips reusable sensors and adapter cables. Cable: polyurethane, 2 m.

Product Number	Description	Standard	OxiMax	Comments
M1943A	Adapter cable (1.1 m cable)	yes	no	Adapter cable for Philips/Nellcor disposable sensors.
M1943AL	Adapter cable (3 m cable)	yes	no	
M1943NL	OxiMax adapter cable (3 m cable)	no	yes	Adapter cable for Philips disposable/ Nellcor disposable and reusable sensors.
OC 3	Adapter Cable for OxiCliq sensors	yes	yes	Available from Nellcor only.

Temperature Accessories

Temperature Probes	Part No.	Minimum measurement time for accurate readings
Reusable		
General purpose probe	21075A	90 sec
Small flexible vinyl probe (Infant/Pediatric)	21076A	60 sec
Attachable surface probe	21078A	60 sec
Disposable		
General purpose probe	M1837A	90 sec
Skin probe	21091A	60 sec
Esophageal/Stethoscope Probe (12 French)	21093A	180 sec
Esophageal/Stethoscope Probe (French 18)	21094A	210 sec
Esophageal/Stethoscope Probe (French 24)	21095A	310 sec
Foley Catheter Probe (12 French)	M2255A	180 sec
Foley Catheter Probe (16 French)	21096A	180 sec
Foley Catheter Probe (18 French)	21097A	180 sec
Adapter cable 1.5m	21082B	
Adapter cable 3.0m	21082A	

Cardiac Output (C.O.) Accessories

See Pressure accessories for PULSION continuous cardiac output accessories.

Description		Part No
Common Accessories		
Accessories	Set of ice buckets	14455A
	Remote handswitch	15244A
PiCCO inline temperature probe for warmer injectate	Latex free	M1646A
Right Heart Thermodilution		
C. O. Interface Cables	2.7 meter cable (right heart only)	M1642A
	2.4 m + 2.4 m cable	M1643A
Injectate Probes	2.4m injectate temp. probe	23001A
	0.5m injectate temp. probe	23001B
	Ice bath temp. probe (right heart only)	23002A
Transpulmonary Thermodilution		
C. O. Interface Cables	2.4 m + 2.4 m cable	M1643A
Injectate Probes	(2.4m) injectate temp. probe (reusable)	23001A
	(0.5m) injectate temp. probe (reusable)	23001B
Pressure Transducer Kits (PULSION)	PV 8003 (30cm pressure line)	
	PV 8010 (100cm pressure line)	
	PV 8015 (150cm pressure line)	
Pressure Interface Cable for disposable pressure transducer	PULSION PMK 206	

Mainstream CO_2 Accessories

Description	Part No.
CO_2Transducer Sensor	M1460A
Standard Airway Adapter (reusable)	M1465A
Small Airway Adapter (reusable)	14363A

Microstream CO_2 Accessories

- “FilterLine Set” is a combination of a FilterLine with an Airway Adapter.
- “H” in the accessory name indicates suitability for humidified ventilation and longer usage due to the active removal of humidity from the sample line.
- “Smart CapnoLine” is a combined oral-nasal FilterLine.
- “Smart CapnoLine O_2” is a combined oral-nasal-O_2-CO_2 FilterLine.
- “NIV Line” is a nasal FilterLine suitable for mask ventilation (for example, C-PAP).

- "Single purpose" means CO_2 measurement only, "dual purpose" means CO_2 measurement and O_2 delivery.

Ventilation	Environment	Patient Weight	Description	Quantity	Part No.
Intubated	Non-humidified	≥ 2 kg	Airway Adapter Adult/Pediatric	25	M1990A*
			FilterLine	25	M1925A*
			FilterLine OR Set Adult/ Pediatric	25	M1922A*
			FilterLine Set Adult/Pediatric	25	M1920A
		< 2 kg	Airway Adapter Infant/Neonatal	25	M1996A*
			FilterLine	25	M1925A*
			FilterLine H Set Infant/Neonatal: use M1923A		
	Humidified	≥ 2 kg	Airway Adapter Adult/Pediatric	25	M1990A*
			FilterLine H	25	M1926A*
			FilterLine H Set Adult/Pediatric	25	M1921A
		< 2 kg	Airway Adapter Infant/Neonatal	25	M1996A
			FilterLine H	25	M1926A
			FilterLine H Set Infant/Neonatal	25	M1923A
Non-intubated, single-purpose	Nasal, CO_2, ≥ 12 hours use	> 45 kg	Nasal FilterLine Adult	25	M1927A
		10-45 kg	Nasal FilterLine Pediatric	25	M1928A
		< 10 kg	Nasal FilterLine Neonatal	25	M1929A
	Nasal, CO_2, ≥ 24 hours use	> 45 kg	CapnoLine H Adult	25	M4689A
		10- 45 kg	CapnoLine H Intermediate	25	M4690A
		< 10 kg	CapnoLine H Infant/Neonatal	25	M4691A
	Oral-nasal, CO_2, ≥ 12 hours use	> 55 kg	Smart CapnoLine Adult	25	M2526A
		20-55 kg	Smart CapnoLine Intermediate	25	M2525A
		10-20 kg	Smart CapnoLine Pediatric	25	M2524A
Non-intubated, dual-purpose	Nasal, CO_2 + O_2, up to 12 hours use	> 45 kg	CapnoLine H O2 Adult	25	M4680A
		10 - 45 kg	CapnoLine H O2 Pediatric	25	M4681A
	Oral-nasal, CO_2 + O_2, up to 12 hours use	> 55 kg	Smart CapnoLine O_2 Adult	25	M2522A
		20-55 kg	Smart CapnoLine O_2 Intermediate	25	M2521A
		10 - 20 kg	Smart CapnoLine O_2 Pediatric	25	M2520A
Mask, single purpose	C-PAP, CO_2, up to 12 hours use	> 45 kg	NIV Line Adult	25	M4686A
		10 - 45 kg	NIV Line Intermediate	25	M4687A
***Accessories supported for use with monitor but no longer orderable**					

tcGas Accessories

This symbol indicates that the specified transducer (but not its membranes) is designed to have special protection against electric shocks (particularly regarding allowable leakage currents), and is defibrillator proof.

Description	Part No.
12x tc Accessory Kit (O-ring remover, absorbent paper, electrolyte solution, replacement membrane)	15209-60010
tc Application Kit (4x25 disposable fixation rings, 4x20ml contact fluid)	15209-60020
Calibration gas - 6 gas bottles	15210-60010
Calibration gas - 6 gas bottles (Europe and Japan only)	15210-64010
Replacement tubing (5 tubes)	M2205A
$tcpO_2/CO_2$ transducer	M1918A
Calibration unit	15210B
Radiometer TCC3 calibration unit (available from Radiometer)	n/a

EEG Accessories

Description	Part No.
Trunk Cable 2.7m	M2268A
Trunk Cable, 1.0 m	M2269A
Reusable 80-cm-long 5-lead cables with 10mm silver/silverchloride leadwired cup electrodes (Adult)	M1931A
Reusable 80-cm-long 5-lead cables with 6mm silver/silverchloride leadwired cup electrodes (Pediatric/Neonatal)	M1932A
Reusable 80 cm 5-lead cables with clip	M1934A
Disposable EEG electrodes	M1935A
EC2™ Electrode Cream (conductive paste)	M1937A

BIS Accessories

Use only Aspect BIS sensors with the BIS module. The sensor is a silver/silverchloride electrode array that uses Aspect's patented ZipPrep technology and a proprietary connector. The sensor is for single patient use only. Check its shelf-life before use.

The patient interface cable has an estimated lifetime of one year. Do not scrap it when disposing of the BIS sensor.

BIS Sensors

To re-order sensors outside North America, contact your nearest Philips sales office and quote the Philips ordering number. In North America, contact Aspect Medical Systems.

Description	Pieces per pack	Philips Ordering No	Aspect Part No
BIS Sensor Quatro (formerly Sensor XP)	50	M1997A	186-0106
BIS Sensor Plus	50	M4546A	186-0076
BIS Sensor Pediatric	25	M1998A	186-0110
BIS Sensor Extend	50	n/a	186-0160

Other BIS Accessories

Order the following parts from your nearest Philips sales office and quote the Philips ordering number

Description	Philips Ordering No
BIS Engine Cable - Short (0.8 m)	M1034-61610
BIS Engine Cable - Long (2.0 m)	M1034-61620
PIC PLUS Cable	M1034-61630
BIS Universal Clamp Mount	M1180A #C32
BIS FMS Mount (Flexible Module Server)	M1180A #C33

AGM Accessories

Description	Pieces per Pack	Part No.
Elbow Airway Adapter	20	13902A
Straight Airway Adapter	20	M1612A
Gas Exhaust Return Line	1	M1655A
Gas Exhaust Return Filter	20	M1656A
Watertrap	25	M1657B
Gas Sample Tube (2.6m)	20	M1658A

SvO_2 Accessories

Contact your Abbott representative to order Abbott Critical Care Systems accessories. They are not available from Philips.

Description	Abbott Part No.
Optical Module	P50131-04

Description	Abbott Part No.
Opticath Fiber-optic Catheters	P575-EH
	P575-EH10CM
	P7110-E
	P7110-EH
	P7110-EP-H
	P7110-EP8
	P7110-EP8-H
	P7110-PZ8-H
	P575-EH
	P575-EH10CM
	U440

Recorder Accessories

Description	Part No.
10 rolls of paper	40477A
80 rolls of paper	40477B

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Installation and Specifications

The specifications in this section apply to the MP40, MP50, MP60, MP70, and MP90 patient monitors, unless otherwise stated.

The monitors are not user installable. They must be installed by qualified service personnel.

Intended Use

The monitor is intended to be used for monitoring, recording, and alarming of multiple physiological parameters of adults, pediatrics, and neonates in health care facilities. The device is to be used in health care facilities by trained health care professionals. The monitor is for single patient use only. It is not intended for home use. Rx only: U.S. Federal Law restricts this device to use by or on the order of a physician. Not a therapeutic device.

The transcutaneous gas measurement (tcGas) is restricted to neonatal patients only. EASI 12-lead ECG is only for use on adult and pediatric patients. ST Segment monitoring is restricted to adult patients only. Assessment of EASI-derived 12-Lead ST measurements is recommended for patients that meet the following requirements of age: 33 to 82, height: 147 to 185 cm (58 to 73 in), weight: 53 to 118 kg (117 to 261 lb), height-to-weight ratio: 1.41 to 2.99 cm/kg (0.25 to 0.54 in/lb). The ECG measurement is intended to be used for diagnostic recording of rhythm and detailed morphology of complex cardiac complexes (according to AAMI EC 11).

Bispectral Index (BIS) monitoring is for use in monitoring the state of the brain by data acquisition of EEG signals in the intensive care unit, operating room, and for clinical research. The Bispectral Index, a processed EEG variable, may be used as an aid in monitoring the effects of certain anesthetic agents.[1]

Indication for Use

The monitor is indicated for use by health care professionals whenever there is a need for monitoring the physiological parameters of patients.

1.See Gan TJ, Slass P, Windsor A, Payne F, Rosow C, Sebel P, Manberg P. Bispectral Index Monitoring Allows Faster Emergence and Improved Recovery from Propofol, Alfentanil, and Nitrous Oxide Anesthesia. *Anesthesiology*, October 1997; (4) 87:808-15.

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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Philips considers itself responsible for any effects on safety, reliability and performance of the equipment only if:

- assembly operations, extensions, re-adjustments, modifications or repairs are carried out by persons authorized by Philips.
- the electrical installation of the relevant room complies with national standards.
- the instrument is used in accordance with the instructions for use.

To ensure safety, use only those parts and accessories specified for use with the monitor. If other parts are used, Philips is not liable for any damage that these parts may cause to the equipment.

See your sales contract for product warranty information.

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Symbols

These symbols appear on the monitor and its associated equipment.

Symbols		
 Refer to accompanying documents	 Protective earth	 RS-232 RS232 connector
 Standby	 Equipotential grounding	 2002-06 Identifies year and month of manufacture
 Connection direction indicator	Alternating current	Connection direction indicator
 Electrical input indicator (On some older measurement servers and extensions, modules, and Anesthetic Gas Modules, this symbol may indicate the gas input.)	 Electrical output indicator (On some older measurement servers and extensions, modules, and Anesthetic Gas Modules, this symbol may indicate the gas output.)	 Connector has special protection against electric shocks and is defibrillator proof
 Gas output indicator	 Gas input indicator	 Quick mount release
 FMS Power On Indicator - Ready for operation	 Serial/MIB connector	Interruption indicator
 Mouse connection indicator	 Keyboard connection indicator	 Printer connection indicator

Symbols		
Parallel — Parallel interface indicator for connection to parallel printer	Alarm — Nurse call relay connection indicator	DVI Video — Digital video device connection indicator for connection to independent display
MSL — Measurement server link connection indicator	12V LAN — 12 Volt DC LAN connection, for connection to wireless device	LAN — LAN connection indicator for connection to a wired network
Remote Device — Philips remote device (SpeedPoint or Alarm Device) connection indicator	Analog — Analog interface indicator for connection to any analog video display	Digital — Digital interface indicator for connection to any digital video display
12V — 12 Volt DC LAN connection, for connection to wireless devices	Battery symbol	LAN/SER — LAN connection indicator for connection to serial interface

Installation Safety Information

WARNING If multiple instruments are connected to a patient, the sum of the leakage currents may exceed the limits given in IEC/EN60601-1. Consult your service personnel.

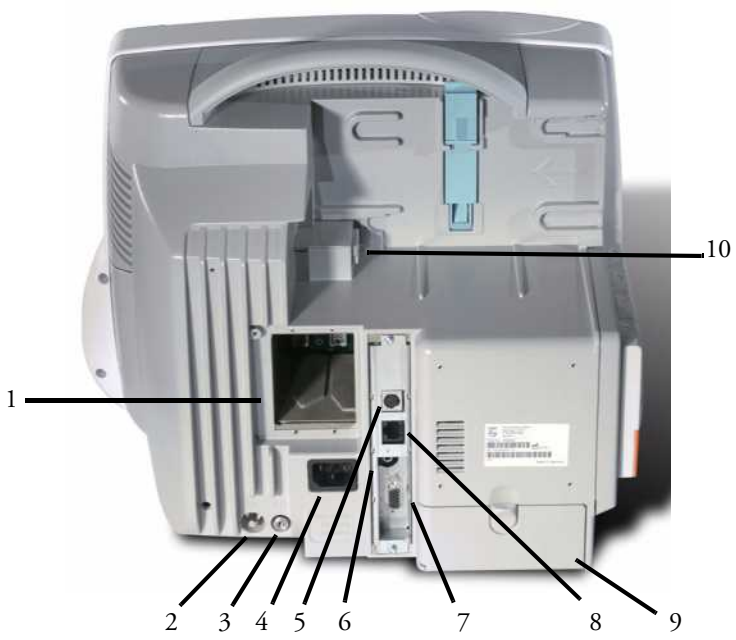
Grounding	The monitor, AGM and MP90 processing unit must be grounded during operation. If a three-wire receptacle is not available, consult the hospital electrician. Never use a three-wire to two-wire adapter.
Equipotential Grounding	If the monitor, AGM or MP 90 processing unit are used in internal examinations on the heart or brain, ensure that the room incorporates an equipotential grounding system to which the monitor, MP 90 processing unit and AGM all have separate connections.
Combining equipment	Combinations of medical equipment with non-medical equipment must comply with IEC 60601-1-1.
Fusing	The monitor uses double pole/neutral fusing.

Connectors

The actual placement of boards and configuration of connections for your monitor depends on how your hardware has been configured. See the symbols table on page 285 to see which symbols are used to mark the connections.

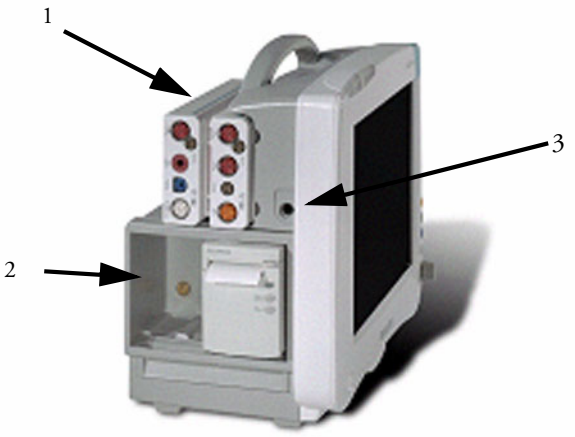
MP40/MP50

MP40/MP50 Rear of monitor



1 Space for optional interface boards, e.g. serial/MIB (RS232) connectors, or optional parallel printer connection
2 Equipotential grounding
3 Protective earth
4 AC power inlet
5 Wired network connector
6 Remote alarm connector
7 Analog video out connector
8 Wireless network connector
9 Battery compartment
10 Measurement Server Link connector

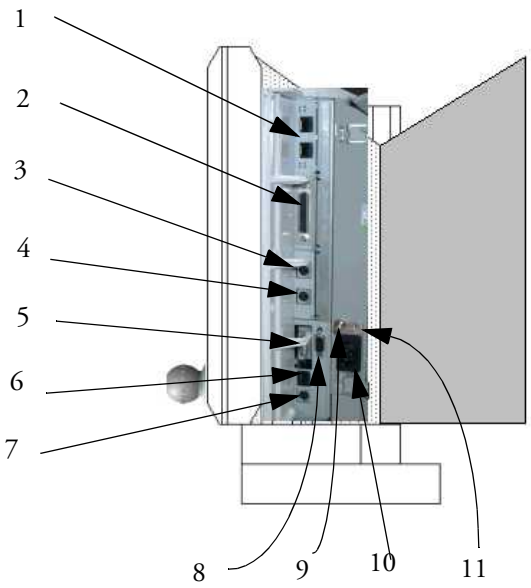
MP40/MP50 Left side of monitor



1 MMS and one extensions
2 Plug-in module slots
3 ECG analog (sync) output connector

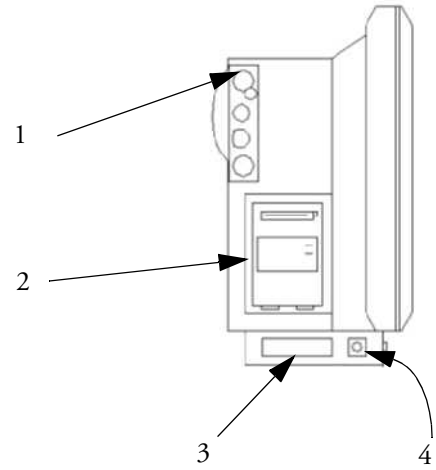
MP60/MP70

Right side of monitor (MP60/70)



1 Serial/MIB (RS232) connectors (optional), type RJ45
2 Parallel printer connector
3 Keyboard connector
4 Mouse/trackball connector
5 Main measurement server link (MSL)
6 Wired network connector
7 Wireless network connector
8 Analog video out connector
9 Equipotential ground connector
10 AC power input
11 Protective earth screw hole

Left side of monitor (MP60/70)

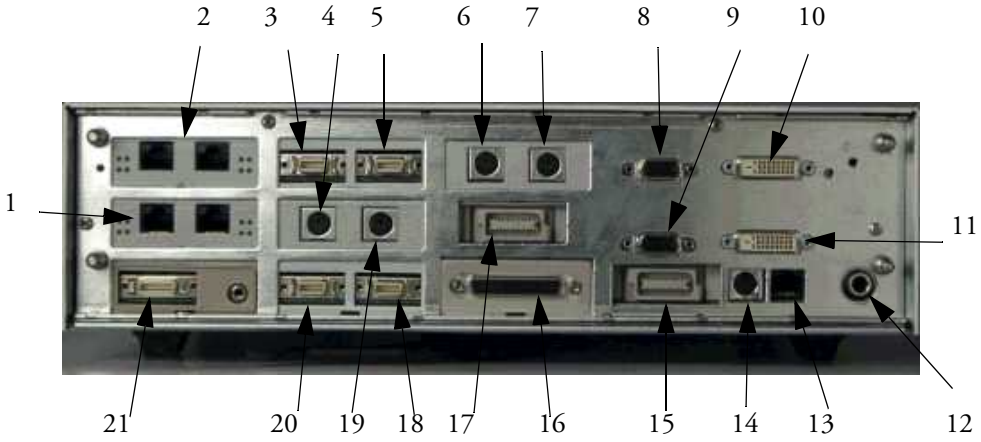


1 MMS patient cable connectors
2 Slot for integrated recorder module
3 Additional measurement server link (MSL) cable (alternative or additional to MSL on right of monitor)
4 ECG analog (sync) output connector

WARNING Connect only medical devices to the ECG output connector socket.

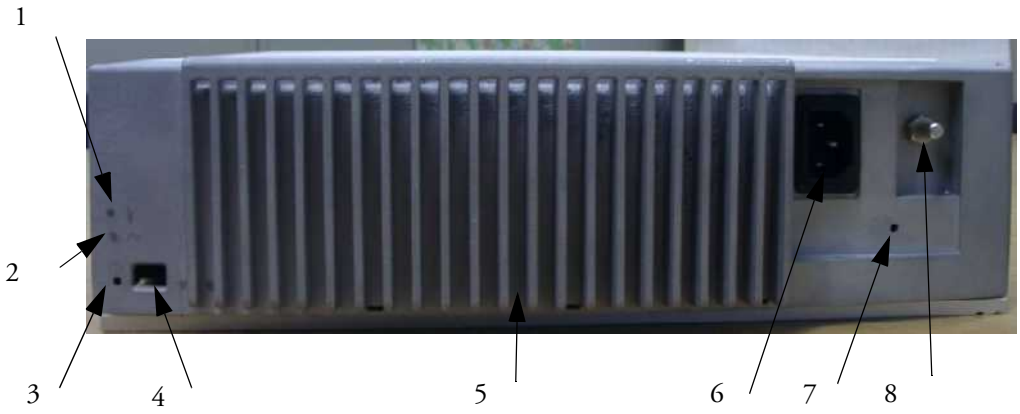
MP90

MP 90 (rear of processing unit)



1	Serial/MIB (RS232) connectors, type RJ45	12	ECG Sync out
2	Serial/MIB (RS232) connectors, type RJ45	13	Wired network connector
3	Independent display - remote alarm device connector	14	Wireless network connector
4	Keyboard connector	15	Primary measurement server link
5	Independent display - remote SpeedPoint connector	16	Parallel printer connector
6	Independent display - mouse/trackball connector	17	Additional measurement server link
7	Independent display - keyboard connector	18	Remote SpeedPoint connector
8	Independent display analog video out connector	19	Mouse/trackball connector
9	Primary display - analog video out connector	20	Remote alarm connector
10	Independent display - digital video out connector	21	Flexible nurse call interface
11	Primary display - digital video out connector		

MP 90 (front of processing unit)



1	AC Power LED	5	Power supply
2	Error LED	6	AC power input
3	Power on LED	7	Protective earth screw hole
4	Power on switch	8	Equipotential grounding point

Altitude and Barometric Pressure

Altitude and barometric pressure affect tcGas and CO_2 measurements. The monitor must be configured at installation to the correct altitude and barometric and pressure values for your hospital site.

Monitor Safety Specifications

The monitors, together with the Multi-Measurement Server (M3001A), and the Flexible Module Server (M8048A), all modules and measurement server extensions, comply with the Medical Device Directive 93/42/EEC (CE_{0366}). In addition, the product complies with

IEC 60601-1:1988 + A1:1991 + A2:1995; EN60601-1:1990 + A1:1993 + A2:1995; UL 2601-1:1994; CAN/CSA C22.2#601.1-M90:1993; JIS T 1001-1992; IEC 60601-1-1+A1:1995; EN 60601-1-1+A1:1995; IEC 60601-1-2:1993; EN 60601-1-2:1993.

Classification (according to IEC 60601-1): Class 1, Type CF, Continuous Operation.

The possibility of hazards arising from software errors was minimized in compliance with EN1441, EN60601-1-4 and IEC 60601-1-4.

This ISM device complies with Canadian ICES-001. Cet appareil ISM est conforme a la norme NMB-001 du Canada.

WARNING To minimize the risk of causing severe burns during MR imaging, ensure that transducers, sensors and cables are positioned so that no inductive loops are formed. If the measurement does not appear to be operating properly, remove all transducers, sensors and cables immediately from the patient.

Physical Specifications

Product	Max Weight	W x H x D	Comments
M8003A/M8004A IntelliVue MP40/ MP50 (with navigation point)	< 8.6 kg < 19 lb	< 365 x 330 x 217 mm 14 x 13 x 8.5 in	including M3001A, recorder, and battery, without options
M8005A IntelliVue MP60 (with speedpoint) M8007A IntelliVue MP70 (with touchscreen operation)	< 10 kg < 22.05 lb	< 405 x 360 x 170 mm 15.95 x 14.17 x 6.69 in	without handle and speedpoint device, without options
M8010A IntelliVue MP90	< 10 kg < 22.05 lb	342 x 108 x 505 mm 13.47 x 4.25 x 19.88 in	including AC cable, cable cover and feet
M3001A Multi-Measurement Server (MMS)	< 650g < 1.4lb	188 x 96.5 x 51.5 mm 7.4 x 3.8 x 2 in	
M3015A Measurement Server Extension - Microstream CO_2	< 550 g < 1.21 lb	188.0 x 96.5 x 38.5 mm 7.4 x 3.8 x 1.5 in	
M3016A Measurement Server Extension - Mainstream CO_2	< 450 g < 0.99 lb	188.0 x 96.5 x 38.5mm 7.4 x 3.8 x 1.5 in	
M3012A Hemodynamic Measurement Server Extension	< 550 g	98 x 40 x 190 mm	
M8048A Flexible Module Server (FMS)	< 3500g < 7.7lb	< 320 x 120 x 35 mm 12.6 x 4.7 x 5.3 in	without plug-in modules
M1026A Anesthetic Gas Module (AGM)	< 8.2 kg < 18 lb	370 x 90 x 467 mm 14.6 x 3.5 x 18.4 in	
M8025A Remote Alarm Device	< 300 g < 0.7 lb	62 x 125 x 63 mm 2.4 x 5 x 2.5 in	
M8026A Remote SpeedPoint	< 400 g < 0.9 lb	103 x 139 x 63 mm 4 x 5.5 x 2.5 in	
M8031A XGA Touchscreen LCD Display	< 4.9 kg < 10.8 lb	408 x 333 x 85 mm 16 x 13.1 x 3.4 in	with mounting bracket
M1006B Invasive Press Module	190 g (6.7 oz) Option #C01: 225 g (7.9 oz)	36 x 99.6 x 97.5 mm 1.4 x 3.9 x 3.8 in	
M1029A Temperature Module	215 g (7.6 oz)	36 x 99.6 x 97.5 mm, 1.4 x 3.9 x 3.8 in	
M1012A Cardiac Output Module	225 g (7.9 oz.)	36 x 99.6 x 97.5 mm 1.4 x 3.9 x 3.8 in	

Product	Max Weight	W x H x D	Comments
M1018A Transcutaneous Gas Module	350 g (11.3 oz)	72.5 x 99.6 x 97.5 mm, 2.9 x 3.9 x 3.8 in	
M1020B SpO_2 Module	< 250 g	36 x 99.6 x 97.5 mm 1.4 x 3.9 x 3.8 in	
M1021A Mixed Venous Oxygen Saturation Module	460 g (13.04 oz)	72.5 x 99.6 x 97.5 mm 2.9 x 3.9 x 3.8 in)	
M1027A Electroencephalograph Module	210 g (7.4 oz)	36 x 99.6 x 97.5 mm 1.4 x 3.9 x 3.8 in	
M1034A BIS Interface Module	215 g 7.6 oz	36 x 99.6 x 97.5 mm 1.4 x 3.9 x 3.8 in	
- DSC Digital Signal Converter	130 g (4.6 oz) (without cabling)	66 x 25 x 107 mm 2.6 x 1.0 x 4.25 in	Integral Cables: 3.7m (12ft) DSC-BIS Engine cable; 0.15m (0.5ft) DSC-PIC PLUS cable
- BIS Engine	170 g (6.0 oz)	43 x 93 x 95 mm 1.7 x 3.7 x 3.8 in	
M1032A Vuelink Module	240 g (8.4 oz)	36 x 99.6 x 97.5 mm 1.4 x 3.9 x 3.8 in	
M1116B Thermal Array Recorder Module	507.5 g 17.9 oz.	73 x 99.6 x 97 mm 2.9 x 3.6 x 3.9 in.	

Environmental Specifications

The monitor may not meet the performance specifications given here if stored or used outside the specified temperature and humidity ranges.

Monitor M8003A, M8004A, M8005A, M8007A, M8010A		
Item	**Condition**	**Range**
Temperature Range	Operating	0 to 35 °C (32 to 95 °F)
	Non-operating	-20 to 60 °C (-4 to 140 °F)
	Battery storage	-20 to 50 °C (-4 to 122 °F)
Humidity Range	Operating	20% to 85% Relative Humidity (RH) (non condensing)
	Non-operating	5% to 85% Relative Humidity (RH)
Altitude Range	Operating	0 m to 3000 m (10000 ft)
	Non-operating	0 m to 12000 m (40000 ft)

Measurement Server M3001A, Measurement Server Extensions M3015A, M3016A, M3012A, Measurement Modules, and Flexible Module Server M8048A		
Item	**Condition**	**Range**
Temperature Range	Operating	0 to 45 °C (32 to 113 °F)
	Non-operating	-40 to 70 °C (-40 to 158 °F)
Humidity Range	Operating	95% Relative Humidity (RH) max. @ 40 °C (104 °F). M3015A only non-condensing.
	Non-operating	90% Relative Humidity (RH) max. @ 65 °C (150 °F)
Altitude Range	Operating	-500 m to 4600 m (-1600 to 15000 ft)
	Non-operating	-500 m to 15300 m (-1600 to 50000 ft)

Anesthetic Gas Module M1026A		
Item	**Condition**	**Range**
Temperature Range	Operating	15 to 40 °C (59 to 104 °F)
	Non-operating	-40 to 65 °C (-40 to 149 °F)
Humidity Range	Operating	up to 95% Relative Humidity (RH) max. @ 40 °C (104 °F) (non-condensing)
	Non-operating	up to 95% Relative Humidity (RH) max. @ 65 °C (150 °F)
Altitude Range	Operating	-305 m to 3048 m(-1000 to 10000 ft)
	Non-operating	-305 m to 5486 m (-1000 to 18000 ft)
Warmup Time		After switching on: 2 minutes to measure, 8 minutes for full accuracy

Thermal Array Recorder Module M1116B		
Item	**Condition**	**Range**
Temperature Range	Operating	+5 to 45 °C (41 to 113°F)
	Non-operating	-10 to 70 °C (14 to 158 °F)
Humidity Range	Operating	95% Relative Humidity (RH) max @ 40°C (104°F) (non condensing)
	Non-operating	95% Relative Humidity (RH) max @ 65°C (150°F) (non condensing)
Altitude Range	Operating	up to 3048 m (10000 ft)
	Non-operating	up to 3048 m (10000 ft)

Remote SpeedPoint M8026A		
Item	**Condition**	**Range**
Temperature range	Operating	0 ... 55 °C (32 ...130 °F)
	Storage	-20 … 60 °C (-4 ... 140 °F)

Remote SpeedPoint M8026A		
Item	**Condition**	**Range**
Humidity range	Operating	95 %RH max. at 40 °C (100 °F)
	Storage	85 %RH max. at 50 °C (120 °F)
Altitude range	Operating	-500 … 4.600 m (-1600 ... 15000 ft)
	Storage	-500 … 13.100 m (-1600 ... 43000 ft)

M4605A Battery Specifications

MP40/MP50 Only Two batteries are required to operate the monitor.

M4605A Battery Specifications		
Physical Specifications		
	W x D x H	149 mm (5.866 in) x89 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 45°C (32 to 113°F) Storage -20 to 60°C (-4 to 140°F)
	Humidity Range	40% to 95% Relative Humidity (RH)
Battery Type		Smart Battery 10.8V, 6000mAh, Lithium Ion
Safety		complies with UL 1642 (UL Recognized) and EN 61960-2:2001
Electromagnetic Compatibility (EMC)		complies with the requirements for FCC Type B computing Device, and EN 61000-4-2 and EN 61000-3
Communication Standard		complies with the SMBus specification v1.1

Monitor Performance Specifications

MP40/50, MP60/70/90		
Power Specifications	Power consumption	MP60/70/90: < 145 W MP40/50: < 100 W
	Line Voltage	100 to 240 V ~
	Current	1.6 to 0.7 A
	Frequency	50/60 Hz ~

MP40/50, MP60/70/90		
Battery Specifications **MP40/MP50**	Operating Time (with 2 new, fully charged batteries)	Basic monitoring configuration: 5 hours (**Brightness** set to **Optimum**, MMS connected, NBP measurement every 15 minutes)
		Extended monitoring configuration: 4 hours (**Brightness** set to **Optimum**, MMS and measurement server extension connected, NBP every 15 minutes, Recorder, Pressure, Temperature modules connected)
	Charge Time	When monitor is off: 4 hours When monitor is in use: 5 to 12 hours, depending on monitor configuration
Indicators	Alarms Off	red (crossed-out alarm symbol) LED
	Alarms	red/yellow/cyan LED
	On/Standby	green LED
	AC Power	green LED
	Error	red LED
	Battery LED (MP40/50 only)	red/yellow/green LED
Sounds	Audible feedback for user input Prompt tone QRS tone, or SpO_2 modulation tone 4 different alarm sounds	
Trends	Resolution	12, 16, 24 or 32 numerics @ 12 sec, 1 minute, 5 minute resolution
	Information	Multiple choices of number of numerics, resolution and duration depending on trend option and application area. For example: neonatal extended 12 numerics, 24 hours @ 12 secs or 32 numerics 32 hours @ 1 minute intensive care extended: 16 numerics 120 hours @ 5 minutes anesthesia extended 32 numerics 9 hours @ 12 seconds
Events	Information	trigger condition and time, event classification and associated detailed view of episode data
	Episode data	configurable, either: 4 minutes of high resolution trend or 20 minutes of numerics trend @ 12 sec. resolution or 15 seconds of 4 waves @ 125 samples/sec. (Snapshot) including all current numerics, alarms and inops
	Capacity (max)	25 or 50 events for either 8 or 24 hours
Alarm signal	System delay	less than 3 seconds
	Pause duration	1,2,3 minutes or infinite, depending on configuration
	Extended alarm pause	5 or 10 minutes
Review Alarms	Information	all alarms / inops, main alarms on/off, alarm silence and time of occurrence
	Capacity	100 items

MP40/50, MP60/70/90		
Real Time Clock	Range	from: January 1, 1997, 00:00 to: December 31, 2080, 23:59
	Accuracy	< 2 seconds per day (typically)
	Hold Time	infinite if powered by AC; otherwise at least 48 hours (typical: > 72 hours)
Buffered Memory	Hold Time	if powered by AC: infinite without power: at least 48 hours (typical: > 72 hours) Contents: Active settings, trends, patient data, realtime reports, events, review alarms

MMS M3001A Performance Specifications		
Trends	**Trend Data Buffered Memory**	if powered by monitor mains connection via MSL: infinite without power applied: at least 6 hours
	Contents	trend data, patient identification and all active settings

Monitor Interface Specifications		
Network	Standard	IEEE 802.3 10-Base-T
	Connector	RJ45 (8 pin)
	Isolation	1.5 kV
Parallel Printer Port	Standard	IEEE 1284-I
	Connector	DB-25
	Signals	Level 1 and Level 2 (switchable)
	Isolation	1.5 kV
	Communication Modes	Compatibility (for example Centronics), Nibble, ECP, EPP
Dual PS/2 Inputs	Input Voltage	5V ±5%
	Output Current	250mA (comb. max) to connected PS/2 devices
Dual MIB/RS232	Standard	IEEE 1073-3.2-2000
	Connectors	RJ45 (8 pin)
	Mode	Software-controllable BCC (RxD/TxD cross over) or DCC (RxD/TxD straight through)
	Power	5V +/- 5%, 100mA (max.)
	Isolation	1.5kV
MIB-ready/RS-232 Interface (not available in all geographies)	Measurement data exported to external systems:	Numerics, alarms and INOPs, patient demographics, waves (up to 7; maximum number depends on the sample rate of the selected waves).
ECG Output/Marker Input (1/4" stereo phone jack with tip, ring, sleeve)		
General	Connector	1/4" phone each with tip, ring, sleeve
	Isolation	500 V

Monitor Interface Specifications		
ECG Output (ring, tip)	Signal Gain	320 to 3200
	Full Scale on Display	$3.2V_{pp}$
	Gain Error	<20%
	Baseline Offset	<150mV
	Bandwidth	1 to 80Hz
	Output Impedance	ECG Output (ring): <2.2KΩ±20% ECG Output/Marker Input (tip) <2.5kΩ ±20%
	Signal delay	≤30ms
Marker Input Requirements (tip)	Signal Type	0 to -12V, negative edge pulse
	Pulse Source Impedance	<7kΩ
	Pulse Fall Time	<100µs
	Pulse Duration	>4ms
Flexible Nurse Call Relay	Connector	20 pin MDR (Mini D-Ribbon), active open and closed contacts 3.5 mm phone jack, active closed contact only
	Contact	<= 100 mA, <= 24 V DC
	Isolation	1.5 kV
	Delay	< (Configured Latency + 0.5 sec)
Wireless Network Device Interface	Connector	8 pin Mini-DIN
	Signals	RD+/-, TD+/-: IEEE 802.3 10Base-T, PWR, GND 12.5 V ±20%, 3.5 W continuous
Remote Application Support	Technology	Citrix® and ICA® (Independent Computing Architecture) client, Tunneling Control Engine (TCE)
	Capabilities	a monitor connected to a Philips Application Server can show a Windows NT application on the monitor display. The application can be controlled by the monitor user input devices.

Display Specifications		
	Refresh rate	60 Hz
	Sweep Speeds	6.25, 12.5, 25 and 50 mm/s with ±5% accuracy (guaranteed only for integrated displays)
Integrated SVGA Display, MP40/50	Resolution	800 x 600
	Refresh frequency	60 Hz
	Useful screen	246 x 184.4 mm
	Pixel size	0.3075 x 0.3075 mm
Integrated XGA Display, MP60/70	Resolution	1024 x 768
	Refresh frequency	60 Hz
	Useful screen	304 x 228 mm (12 x 9 in)
	Pixel size	0.297 x 0.297 mm
External SXGA Display (e.g. M8033A), MP90 only	Resolution	1280 x 1024 pixel
	Refresh frequency	60 Hz or 75 Hz
	Useful screen	depends on size of display
	Pixel size	depends on size of display

Display Specifications		
Video Interface MP40/50, MP60/70	Specifications must be the same as the integrated display	
Video Interface SVGA MP40/MP50	Horizontal Frequency	37.5 kHz
	Video Signals	TTL
	Connector	15 pin D-SUB
Video Interface MP90 SXGA (MP90 only), XGA	Horizontal Frequency	48.4 kHz or 60.0 kHz or 64.0 kHz
	Video Signals	0.7 Vpp @ 75 Ohm, HSYNC/VSYNC Signals TTL
	DDC	Signals I2C compliant, 5V, 100 mA (max) (M8010 only)
	Connector	15 pin D-SUB
Digital Video (M8010A only)	Video Signals	Single Link TMDS
	DDC Signals	I2C compliant
	DDC Power	5V, 100mA (max)
	Connector	DVI

Compatible Devices		
Printers	PCL5 capability required	HP Laserjet 1200 (monochrome) HP Laserjet 2100 (monochrome) HP DeskJet 2500 C+ (color)
Displays (must be approved for medical use)		
MP60/70/90	M1097A option A02 :	XGA color 15” LCD touchscreen
	M1097A option A01	XGA color 15” LCD
MP90	M8033A	SXGA color 17” LCD touchscreen
MP40/50/60/70/90	M3080A option H65	15” CRT
Wireless Network	Type	Proxim Range LAN2 7920
	Technology	Frequency Hopping Spread Spectrum (FHSS)
	Frequency Band	2.4 GHz ISM Band
	Weight	300g max.

Measurement Specifications

See the Appendix on Default Settings for a list of the settings the monitor is initially shipped with.

ECG/Arrhythmia/ST

Complies with IEC 60601-2-25:1993 + A1:1999 /EN60601-2-25:1995 + A1:1999, IEC 60601-2-27/EN60601-2-27:1994 and AAMI EC11/EC13:1992.

ECG/Arrhythmia/ST Performance Specifications		
Cardiotach	Range	Adult/pedi: 15 to 300 bpm Neo range: 15 to 350 bpm
	Accuracy	±1% of range
	Resolution	1 bpm
	Sensitivity	≥200 μV_{peak}

ECG/Arrhythmia/ST Performance Specifications		
PVC Rate	Range	0 to 300 bpm
	Resolution	1 bpm
ST Numeric	Range	-20 to +20 mm
	Accuracy	±0.5 mm or 15%, whichever is greater
	Resolution	0.1 mm
Sinus and SV Rhythm Ranges	Brady	Adult: 15 to 60 bpm Pedi: 15 to 80 bpm Neo: 15 to 90 bpm
	Normal	Adult:60 to 100 bpm Pedi: 80 to 160 bpm Neo: 90 to 180 bpm
	Tachy	Adult: > 100 bpm Pedi: >160 bpm Neo: >180 bpm
Bandwidth	Diagnostic Mode	Adult: 0.05 to 150Hz Neo/pedi: 0.5 to 150Hz
	Monitoring Mode	Adult: 0.5 to 40Hz Neo/pedi: 0.5 to 55Hz
	Filter Mode	Adult/neo/pedi: 0.5 to 20Hz
Differential Input Impedance		>2MΩ RA-LL leads (Resp) >5MΩ at all other leads (at 10Hz including patient cable)
Common Mode Rejection Ratio		Diagnostic mode: >86 dB (with a 51 kΩ/47 nF imbalance). Filter mode: >106 dB (with a 51 kΩ/47 nF imbalance).
Electrode Offset Potential Tolerance		±500mV
Auxiliary Current (Leads off Detection)		Active electrode: <100 nA Reference electrode: <900 nA
Input Signal Range		±5 mV

ECG/Arrhythmia/ST Alarm Specifications	Range	Adjustment
HR	15 to 300 bpm maximum delay: 10 seconds according to AAMI EC 13-1992 standard	Adult:1 bpm steps (15 to 40 bpm) 5 bpm steps (40 to 300 bpm) Pedi/Neo:1 bpm steps (15 to 50 bpm) 5 bpm steps (50 to 300 bpm)
Extreme Tachy	Difference to high limit 0 to 50 bpm	5 bpm steps
	Clamping at 150 to 300 bpm	5 bpm steps
Extreme Brady	Difference to low limit 0 to 50 bpm	5 bpm steps
	Clamping at 15 to 100 bpm	5 bpm steps
Run PVCs	2 PVCs	Not adjustable by user
PVCs Rate	1 to 99 PVCs/minute	1 PVC
Vent Tach HR	20 to 300 bpm	5 bpm

ECG/Arrhythmia/ST Alarm Specifications	Range	Adjustment
Vent Tach Run	3 to 99 PVCs/minute	1 PVC
Vent Rhythm Run	2 to 99 PVCs/minute	1 PVC
SVT HR	120 to 300 bpm	5 bpm
SVT Run	3 to 99 SV beats	1 SV beat
ST High	-19.8 to +20 mm	0.2 mm
ST Low	-20 to +19.8 mm	0.2 mm

ECG/Arrhythmia/ST Supplemental Information as required by AAMI EC11/13		
Respiration Excitation Waveform		Sinusoidal signal, 260 µA, 39 kHz
Noise Suppression		RL drive gain 44 dB max., max. voltage 1.8 Vrms
Time to Alarm for Tachycardia	Vent Tachycardia 1mV$_{pp}$,206 bpm	Gain 0.5, Range 6.5 to 8.4 seconds, Average 7.2 seconds
		Gain 1.0 Range 6.1 to 6.9 seconds, Average 6.5 seconds
		Gain 2.0, Range 5.9 to 6.7 seconds, Average 6.3 seconds
	Vent Tachycardia 2 mV$_{pp}$,195bpm	Gain 0.5, Range 5.4 to 6.2 seconds, Average 5.8 seconds
		Gain 1.0, Range 5.7 to 6.5 seconds, Average 6.1 seconds
		Gain 2.0, Range 5.3 to 6.1 seconds, Average 5.7 seconds
Tall T-Wave Rejection Capability		Exceeds ANSI/AAMI EC 13 Sect. 3.1.2.1(c) minimum recommended 1.2 mV T-Wave amplitude
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.
Response Time of Heart Rate Meter to Change in Heart Rate		HR change from 80 to 120 bpm: Range: [6.4 to 7.2 seconds] Average: 6.8 seconds HR change from 80 to 40 bpm: Range: [5.6 to 6.4 sec] Average: 6.0 seconds
Heart Rate Meter Accuracy and Response to Irregular Rhythm		Ventricular bigeminy: 80 bpm Slow alternating ventricular bigeminy: 60 bpm Rapid alternating ventricular bigeminy: 120 bpm Bidirectional systoles: 90 bpm
Accuracy of Input Signal Reproduction		Methods A and D were used to establish overall system error and frequency response.

Respiration

Respiration Performance Specifications		
Respiration Rate	Range	Adult/pedi: 0 to 120 rpm Neo: 0 to 170 rpm
	Accuracy	at 0 to 120 rpm ±1 rpm at 120 to 170 rpm ±2 rpm
	Resolution	1 rpm
Bandwidth		0.3 to 2.5Hz (–6dB)
Noise		Less than 25mΩ (rms) referred to the input

Respiration Alarm Specifications	Range	Adjustment	Delay
High	Adult/pedi: 10 to 100 rpm Neo: 30 to 150 rpm	under 20 rpm: 1 rpm steps over 20 rpm: 5 rpm steps	max. 14 seconds
Low	Adult/pedi: 0 to 95 rpm Neo: 0 to 145 rpm	under 20 rpm: 1 rpm steps over 20 rpm: 5 rpm steps	for limits from 0 to 20 rpm: max. 4 seconds for limits above 20 rpm: max. 14 seconds
Apnea Alarm	10 to 40 seconds	5 second steps	

SpO_2

Unless otherwise specified, this information is valid for SpO_2 measured using M3001A measurement server and M1020B measurement module.

Complies with EN 865:1997/ISO9919:1992.

Measurement Validation: The SpO_2 accuracy has been validated in human studies against arterial blood sample reference measured with a co-oximeter. Display Update Period: Typical: 2 seconds, Maximum: 30 seconds. Max. with NBP INOP suppression on: 60 seconds.

SpO_2 Performance Specifications		
SpO_2	Range	0 to 100%
	M3001A and M1020B Option #A01 Accuracy SD = Standard Deviation	**Philips Reusable Sensors:** M1191A, M1192A1SD = ±2.5% (70% to 100%) M1193A, M1194A, M1195A1SD = ±3% (70% to 100%) **Philips Disposable Sensors with M1943A(L):** M1901B, M1902B, M1903B, M1904B 1SD = ±3% (70% to 100%) **NellcorPB® Sensors with M1943A(L):** MAX-A, MAX-AL, MAX-P, MAX-I, MAX-N, D-25, D-20, I-20, N-25, OxiCliq A, P, I, N 1SD = ±3% (70% to 100%)
	M1020B Option #A02 Accuracy SD = Standard Deviation	MAX-A, MAX-AL, MAX-P, MAX-I, MAX-FAST, SC-A, MAX-N (Adult): 2% (70% to 100%) OxiCliq A, P, I, N (Adult) 2.5% (70% to 100%) MAX-N (Neonate), SC-NEO, SC-PR, Oxiband OXI-A/N, OXI-P/I: 3% (70% to 100%) MAX-R, OxiCliq N (Neonate): 3.5% (70% to 100%) Oxiband OXI-A/N (Neonate): 4% (70% to 100%)
	Resolution	1%
Pulse	Range	30 to 300 bpm
	Accuracy	±2% or 1 bpm, whichever is greater
	Resolution	1 bpm
Transducers		Wavelength range: 500 to 1000 nm Emitted Light Energy: ≤ 15mW
Pulse Oximeter Calibration Range		70 - 100%

SpO_2 Alarm Specifications	Range	Adjustment	Delay
SpO_2	Adult: 50 to 100% Pedi/Neo: 30 to 100%	1% steps	(0, 1, 2, 3,... 30) + 4 seconds
Desat	Adult: 50 to Low alarm limit Pedi/Neo: 30 to Low alarm limit	1% steps	
Pulse	30 to 300 bpm	Adult: 1 bpm steps (30 to 40 bpm) 5 bpm steps (40 to 300 bpm) Pedi/Neo: 1 bpm steps (30 to 50 bpm) 5 bpm steps (50 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	

NBP

Complies with IEC 60601-2-30:1999/EN60601-2-30:2000.

NBP Performance Specifications		
Measurement Ranges	**Systolic**	Adult: 30 to 270 mmHg (4 to 36 kPa) Pedi: 30 to 180 mmHg (4 to 24 kPa) Neo: 30 to 130 mmHg (4 to 17 kPa)
	Diastolic	Adult: 10 to 245 mmHg (1.5 to 32 kPa) Pedi: 10 to 150 mmHg (1.5 to 20 kPa) Neo: 10 to 100 mmHg (1.5 to 13 kPa)
	Mean	Adult: 20 to 255 mmHg (2.5 to 34 kPa) Pedi: 20 to 160 mmHg (2.5 to 21 kPa) Neo: 20 to 120 mmHg (2.5 to 16 kPa)
Accuracy		Max. Std. Deviation: 8 mmHg (1.1 kPa) Max. Mean Error: ±5 mmHg (±0.7 kPa)
Heart Rate Range		40 to 300 bpm
Measurement Time		Typical at HR > 60bpm Auto/manual: 30 seconds (adult) 25 seconds (neonatal) Stat: 20 seconds Maximum time: 180 seconds (adult/pediatric) 90 seconds (neonates)
Cuff Inflation Time		Typical for normal adult cuff: Less than 10 seconds Typical for neonatal cuff: Less than 2 seconds
Initial Cuff Inflation Pressure		Adult: 165 ±15 mmHg Pedi: 130 ±15 mmHg Neo: 100 ±15 mmHg
Auto Mode Repetition Times		1, 2, 2.5, 3, 5, 10, 15, 20, 30, 45, 60 or 120 minutes
STAT Mode Cycle Time		5 minutes
Venipuncture Mode Inflation		
Inflation Pressure	**Adult**	20 to 120 mmHg (3 to 16 kPa)
	Pediatric	20 to 80 mmHg (3 to 11 kPa)
	Neonatal	20 to 50 mmHg (3 to 7 kPa)
Automatic deflation after	**Adult/pediatric**	170 seconds
	Neonatal	85 seconds

Measurement Validation: In adult and pediatric 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 patient population. For the auscultatory reference the 5th Korotkoff sound was used to determine the diastolic pressure.

In neonatal mode, the blood pressure measurements determined with this device comply with the American National Standard for Electronic or Automated Sphygmomanometers (ANSI/AAMI SP10 - 1992 and AAMI/ANSI SP10A -1996) in relation to mean error and standard deviation, when compared to intra-arterial measurements in a representative patient population.

NBP 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 (1kPa)
	Pedi: 30 to 180 mmHg (4 to 24 kPa)	
	Neo: 30 to 130 mmHg (4 to 17 kPa)	
Diastolic	Adult: 10 to 245 mmHg (1.5 to 32 kPa)	
	Pedi: 10 to 150 mmHg (1.5 to 20 kPa)	
	Neo: 10 to 100 mmHg (1.5 to 13 kPa)	
Mean	Adult: 20 to 255 mmHg (2.5 to 34 kPa)	
	Pedi: 20 to 160 mmHg (2.5 to 21 kPa)	
	Neo: 20 to 120 mmHg (2.5 to 16 kPa)	

NBP Overpressure Settings		
Adult	> 300 mmHg (40 kPa) > 2 sec	not user adjustable
Pedi	> 300 mmHg (40 kPa) > 2 sec	
Neo	> 150 mmHg (20 kPa) > 2 sec	

Invasive Pressure and Pulse

Complies with IEC 60601-2-34:2000/EN60601-2-34:2000.

Invasive Pressure Performance Specifications		
Measurement Range		–40 to 360 mmHg
Pulse Rate	Range	25 to 350 bpm
	Accuracy	±1% Full Range
	Resolution	1 bpm
Input Sensitivity		Sensitivity:5µV/V/mmHg (37.5µV/V/kPa) Adjustment range:±10%
Transducer		Load Impedance:200 to 2000 Ω (resistive) Output Impedance:≤3000 Ω (resistive)
Frequency Response		dc to 12.5 Hz or 40 Hz
Zero Adjustment	Range:	±200 mmHg (±26 kPa)
	Accuracy	±1 mmHg (±0.1 kPa)
	Drift	Less than 0.1mmHg/°C (0.013 kPa/°C)
Gain Accuracy	Accuracy	±1%
	Drift	Less than 0.05%/°C
	Non linearity and Hysteresis	Error of ≤ 0.4% FS (@CAL 200 mmHg)
Overall Accuracy	(including transducer)	± 4% of reading or ± 4 mmHg (± 0.5 kPa), whichever is greater

Invasive Pressure Performance Specifications		
Analog Output available only with M1006B #C01 (@ CAL 200 mmHg)	Range	-0.4 V to 3.6 V
	Level	1 V / 100 mmHg
	Accuracy	± 3% full scale
	Offset	± 30 mV
	Resolution	8 Bit (@ 5 V range)
	Signal delay	20 ms
Volume displacement of CPJ840J6		0.1 mm^3 /100 mmHg

Invasive Pressure Alarm Specifications	Range	Adjustment	Delay
Pressure	–40 to 360 mmHg (–5.0 to 48 kPa)	-40 to 30 mmHg 2 mmHg (0.5 kPa) > 30 mmHg 5 mmHg (1 kPa)	max. 12 seconds
Pulse	25 to 300 bpm	Adult: 1 bpm steps (25 to 40 bpm) 5 bpm steps (40 to 300 bpm) Pedi/Neo: 1 bpm steps (25 to 50 bpm) 5 bpm steps (50 to 300 bpm)	
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 25 to 100 bpm	5 bpm steps	

Temp

Temp Performance Specifications		
Temp	Range	–1 to 45 °C (30 to 113 °F)
	Resolution	0.1°C (32.2 °F)
	Accuracy	±0.1 °C (±0.2 °F)
Average Time Constant		Less than 10 seconds
Alarms	Range	–1 to 45 °C (30 to 113 °F)
	Adjustment	-1 to 35 °C (30 to 95 °F): 0.5 °C (1.0 °F) steps 35 to 45 °C (95 to 113 °F): 0.1 °C (0.2 °F) steps

Temp Alarm Specifications	Range	Adjustment
Temp High/Low Alarms	–1 to 45 °C (30 to 113 °F)	-1 to 35 °C (30 to 95 °F), 0.5 °C (1.0 °F) steps 35 to 45 °C (95 to 113 °F), 0.1 °C (0.2 °F) steps

CO_2

Complies with EN864/ISO9918

M3015A Microstream CO_2 Performance Specifications		
CO_2	Range	0 to 98mmHg (0 to 13 kPa), or 13% CO_2, whichever is lower
	Accuracy	after 4 minutes warmup: ±4 mmHg or 12%, whichever is greater after 20 minutes warmup: 0 to 40 mmHg (0 to 5.3 kPa):±2.2 mmHg (±0.3 kPa) Above 40 mmHg (5.3 kPa):±(5.5% + (0.08%/mmHg above 40 mmHg)) of reading These specifications are valid for 21% O_2 and N_2 balance, up to 35°C ambient temperature, up to 60 rpm in adult mode and 100 rpm in neonatal mode. Outside of these conditions the accuracy reaches at a minimum ±4 mmHg or ±12% of the reading, whichever is greater.
	Resolution	Numeric: 1.0 mmHg (0.1 kPa) Wave: 0.1 mmHg (0.01 kPa)
awRR	Range	0 to 150 rpm
	Accuracy	0 to 40 rpm: ±1 rpm 41 to 70 rpm: ±2 rpm 71 to 100 rpm: ±3 rpm >100 rpm: ±5% of reading
Warm-up Time		20 minutes for full accuracy specification
Rise Time		190 ms for neonatal mode (measured with FilterLine H for neonatal) 240 ms for adult mode (measured with FilterLine H for adult)
Sample Flow Rate		50 ±7.5 ml/minute
Gas Sampling Delay Time		Typical:2.3 seconds Maximum:3 seconds
Sound Pressure		Acoustic noise: < 45 dBA
Total System Response Time		The total system response time is the sum of the delay time and the rise time.

Microstream CO_2 Humidity Correction Factor

Either BTPS or STPD can be selected as the humidity correction factor for the Microstream CO_2 readings. The formula for the correction calculation is:

$$P_{BTPS} = (P_{STPD} \cdot 094)$$

M3016A Mainstream CO_2 Performance Specifications		
CO_2	Range	–4 to 150 mmHg (-0.5 to 20.0 kPa)
	Accuracy	after 20 minutes warmup and calibration: For values between 0 and 40 mmHg:±2.2 mmHg (±0.29 kPa) For values between 40 and 76 mmHg:±5.5% of reading The specifications are valid for 45% O_2 and N_2 or N_2O balance. Outside these conditions the accuracy reaches at a minimum the requirements of EN864/ISO9918.
	Resolution	Numeric: 1.0 mmHg (0.1 kPa) Wave: 0.1 mmHg (0.01 kPa)
	Stability	±1.0 mmHg over a 7 day period
awRR	Range	0 to 150 rpm
	Accuracy	±2 rpm
Warm-up Time		20 minutes with CO_2 transducer attached for full accuracy specification
Response Time		Less than 125 ms (for step from 10% to 90%)

Mainstream CO_2 Humidity Correction Factor

Either BTPS or STPD can be selected as the humidity correction factor for the Mainstream CO_2 readings. The formula for the correction calculation is:

$$P_{STPD} = P_{BTPS} \cdot \frac{P_{abs}}{P_{abs} - P_{H2O}}$$

Where p = partial pressure, P_{abs} = absolute pressure, and P_{H2O} = 47 mmHg @37°C and 100% RH.

CO_2 Alarm Specifications	Range	Adjustment	Delay
etCO_2 High	20 to 95 mmHg (2 to 13 kPa)	1 mmHg (0.1 kPa)	M3016A: less than 14 seconds M3015A: less than18 seconds.
etCO_2 Low	10 to 90 mmHg (1 to 12 kPa)		
imCO_2 High	2 to 20 mmHg (0.3 to 3.0 kPa)	steps of 1 mmHg (0.1 kPa)	M3016A: less than 14 seconds M3015A: less than18 seconds.
awRR High	Adult/pedi: 10 to 100 rpm Neo: 30 to 150 rpm	under 20 rpm: 1 rpm steps over 20 rpm:5 rpm steps	M3016A: less than 14 seconds M3015A: less than18 seconds.
awRR Low	Adult/pedi: 0 to 95 rpm Neo: 0 to 145 rpm		M3015A: settings < 20 rpm: less than 8 seconds > 20 rpm: less than 18 seconds M3016A settings < 20 rpm: less than 4seconds > 20 rpm: less than 14 seconds
Apnea delay	10 to 40 seconds	5 second steps	set apnea delay time + 4 seconds (M3016A) or 8 seconds (M3015A)

Cardiac Output / Continuous Cardiac Output

C.O./CCO Performance Specifications		
C.O. (right heart)	Range	0.1 to 20.0 l/min
	Accuracy	Instrument Specification (electrical):+ 3% or 0.1 l/min System Specification:+ 5%.or 0.2 l/min
	Repeatability	Instrument Specification (electrical):+ 2% or 0.1 l/min System Specification:+ 3%.or 0.1 l/min
C.O. (transpulmonary)	Range	0.1 to 25.0 l/min
	Accuracy	Instrument Specification (electrical):± 4% or 0.15 l/min System Specification:± 5% or 0.2 l/min
	Repeatability	Instrument Specification (electrical):± 2% or 0.1 l/min System Specification:± 3% or 0.1 l/min
EVLW not available in USA	Range	10 to 5000 ml
	Standard Deviation	10% or 1 ml/kg
ITBV	Range	50 to 6000 ml
	Accuracy	± 10% or 30 ml
	Repeatability	± 5% or 20 ml
CCO	Range	0.1 to 25.0 l/min
	Standard Deviation	10% or 0.3 l/min
	Display Update	2 seconds nominal
Blood Temperature	Range	17,0 to 43°C (62,6 to 109,4°F)
Injectate Temperature	Range	-1 to 30°C

C.O./CCO Alarm Specifications	Range	Adjustment	Delay
TBlood	17 to 43°C	Steps of 0.5°C (17 to 35°C) Steps of 0.1°C (35 to 43°C) Steps of 1°F (63 to 95°C) Steps of 0.2°F (95 to 109°C	10 seconds after the value exceeds the set limit range
CCO	0.1 to 25.0 l/min	0.1 l/min (0.1 to10.0 l/min) 0.5 l/min (10.0 to 25.0 l/min)	10 seconds after the value exceeds the set limit range

tcGas

Complies with IEC 60601-2-23:1999/EN60601-2-23:2000.

tcGas Performance Specifications		
$tcpO_2$	Range	0 to 750 mmHg (0 to 100 kPa)
	Accuracy	0.5% (± 1 digit)
	Resolution	1 mmHg (0.1 kPa)
	Overall Accuracy (incl. transducer)	0 to 160 mmHg ± 5 mmHg 0.0 to 21.3 kPa ± 0.7 kPa >160 mmHg (21.3 kPA) ± 3% of reading
$tcpO_2$ Temperature Drift		< 0.1% / °C
$tcpO_2$ Test Signal		60 mmHg (8.0 kPa)

tcGas Performance Specifications		
$tcpO_2$ Drift, including transducer		< 1 mmHg / h @ 10% O_2
$tcpO_2$ response time, including transducer		< 30 s
$tcpCO_2$	Range	5 to 200 mmHg (0.7 to 26.7 kPa)
	Accuracy	1.0% (1 ± digit)
	Resolution	1 mmHg (0.1 kPa)
	Overall Accuracy (incl. transducer)	0 to 76 mmHg ± 5 mmHg 0.0 to 10.1 kPa ± 0.7 kPa >76 mmHg (10.1 kPa) ± 10% of reading
$tcpCO_2$ Temperature Drift		< 0.1% / °C
$tcpCO_2$ Test Signal		40 mmHg (5.3 kPa)
$tcpCO_2$ Drift, including transducer		< 1 mmHg / h @ 5% CO_2
$tcpCO_2$ response time, including transducer		< 50 s
Warm-up Time		< 3 minutes
Site Timer		0.5, 1, 1.5, 2, 2.5, 3, 4, 5, 6, 7, or 8 hours. Change Site alarm when site time is expired and configurable automatic heating switch-off
Transducer Heating		*Available Temperatures -* 37.0°C, 41.0 to 45°C in steps of 0.5°C

tcGas Alarm Specifications	Range	Adjustment	Alarm Delay
$tcpO_2$	10 to 745 mmHg 1.0 to 99.5 kPa	10 to 30 mmHg: 1 mmHg 1.0 to 4.0 kPa: 0.1 kPa 32 to 100 mmHg: 2 mmHg 4.2 to 13 kPa: 0.2 kPa 105 to 745mmHg: 5 mmHg 13.5 to 99.5 kPa: 0.5 kPa	10 seconds after the value exceeds the set limit range.
$tcpCO_2$	10 to 195 mmHg 1.0 to 26 kPa	10 to 30 mmHg: 1 mmHg 1.0 to 4.0 kPa: 0.1 kPa 32 to 100 mmHg: 2 mmHg 4.2 to 13 kPa: 0.2 kPa 105 to 195 mmHg: 5 mmHg 13.5 to 26 kPa: 0.5 kPa	

SvO_2

SvO_2 Performance Specifications		
SvO_2	Range	10% to 100%
	Accuracy	± 2 % (i.e. ± 2 units), 1 standard deviation over 40 % to 100 % range.
	Resolution	1%
Stability (system)		Drift < 2% over 24 hours
Response Time (10 % to 90%)		5 seconds

SvO_2 Alarm Specifications	Range	Adjustment	Delay
SvO_2	10% to 100%	1%	max. 15+4 seconds after value goes beyond the low/high alarm limit settings

EEG

Complies with IEC 60601-2-26:1994/EN60601-2-26:1994.

EEG Performance Specifications		
Leakage Current		<=10 µA @ $110V_{ac}$
Input Signal Range		1 mV_{p-p}
Differential Input Impedance		>15 MΩ @ 10 Hz
Max. DC Input Offset Voltage		±320 mV
Input Protection		Against defibrillation (5 kV) and electrosurgery
Common Mode Rejection		>105 dB @ 5kΩ imbalance and 60 Hz
Noise		<0.4 µVRMS (1 to 30 Hz)
Electromagnetic Susceptibility		<10 μV_{p-p} @ 3 V/m, 26-1000 MHz
Electrode Impedance Measurement	Range	0 to 30 kΩ
	Accuracy	±1 kΩ
Bandwidth		0.5 Hz to 50 Hz (–3 dB)
Low Filter Cut-Off Frequencies		0.5, 1.0, 2.0, and 5.0 Hz (12 dB/octave)
High Filter Cut-Off Frequencies		15 Hz (65 dB/octave) 30 Hz (75 dB/octave) 50 Hz (85 dB/octave)

BIS

BIS Performance Specifications	
Bispectral Index (BIS) Range	0 - 100
Signal Quality Index (SQI) Range	0 - 100%
EMG Range	0 - 100dB
Suppression Ratio (SR)	0 - 100%
Spectral Edge Frequency (SEF)	0.5 - 30.0Hz
Total Power (TP)	0 - 100 dB
Noise	<0.3µV RMS (2.0µV peak-to-peak)
Wave Scale	*With gridlines on*: ± 25µV, ± 50µV, ± 100µV, ± 250µV *With gridlines off*: 50µV, 100µV, 200µV, 500µV
Update Frequency (BIS Numeric)	2048 ms
Bandwidth	0.25 - 100Hz (-3dB)

BIS Performance Specifications	
High Pass Filters	0.25 Hz, 1 Hz, 2 Hz (-3dB)
Low Pass Filters	30 Hz, 50 Hz, 70 Hz, 100 Hz (-3dB)
Notch Filters (for line frequency)	50 Hz, 60 Hz
Impedance Measurement Range	0 to 999 kΩ

BIS Alarm Specifications	Range	Adjustment	Alarm Delay
BIS High/Low Alarm	0 - 100	1	Max. 2 seconds

Anesthetic Gas Module

Complies with ISO 9918 (1993)/EN 864 (1996), ISO 11196 (1977), EN 12598 (1999)/ISO 7767.

AGM Performance Specifications		
CO_2	Range	0 to 76 mmHg
	Accuracy	1.5 mmHg (0 - 40 mmHg) 2.5 mmHg (40 - 60 mmHg) 4.0 mmHg (60 - 76 mmHg)
	Resolution	1 mmHg
	Rise Time	410 msec typical
O_2	Range	0 to 100 vol%
	Accuracy	2.5 vol% or 5% relative which ever is greater
	Resolution	1 vol%
	Rise Time	450 msec typical
N_2O	Range	0 to 85 vol%
	Accuracy	1.5 vol% + 5% relative
	Resolution	1 vol%
	Rise Time	510 msec typical
Halothane Enflurane Isoflurane	Range	0 - 7.5 vol%
	Accuracy	Halothane: 0.2 vol% + 4.0% relative Enflurane, Isoflurane: 0.1 vol% + 4.0% relative
	Resolution	0.05
	Rise Time	Halothane: < 740 ms Enflurane: < 620 ms Isoflurane: < 610 ms
Sevoflurane	Range	0 - 9.0
	Accuracy	0.1 vol% + 4.0% relative
	Resolution	0.05
	Rise Time	< 570
Desflurane	Range	0 - 20.0
	Accuracy	0.1 vol% + 6.0% relative
	Resolution	0.05 (0-10) 0.1 (10.1 - 20)
	Rise Time	< 540

AGM Performance Specifications		
awRR	Range	0 to 60 rpm
	Accuracy	± 2 rpm
	Resolution	1 rpm
	Detection Criteria	6 mmHg variation in CO_2.
Agent ID Response Time		15 s
Agent Thresholds[1]	HAL, ISO, ENF	0.20 vol%
	SEV	0.24 vol%
	DES	0.30 vol%
1. During warmup, the thresholds are three times the values listed.		

All Performance and accuracy specifications are valid based on gas sample tubing M1658A, including watertrap M1657B, and airway adapter 13902A.

Humidity Correction: For CO_2 the humidity correction can be set to “wet” or “dry”.

Wet: p [mmHg] = c [Vol%] * (p_abs - p_H_2O)/100

Dry: p [mmHg] = c [Vol%] * p_abs /100

Where p = partial pressure, c = gas concentration, p_abs = pressure in breathing circuit, p_H_2O = 47 mmHg, partial pressure of water vapor of exhaled gas (37 °C, 100% rh).

For all other gases the readings are always given as dry values.

Sample Flow Rate: 150 ml/min.

Sample Delay Time: All measurements and alarms are subject to a delay of 3 seconds.

Total System Response Time = the sum of the delay time and the rise time.

AGM Alarm Specifications	Range	Adjustment	Delay
$etCO_2$ High	20 to 76 mmHg (2.7 to 10.1 kPa)	1 mmHg (0.1 kPa)	less than 18 seconds
$etCO_2$ Low	10 to 75 mmHg (1.3 to 10.0 kPa)		
$imCO_2$ High	2 to 20 mmHg (0.3 to 2.7 kPa)	1 mmHg (0.1 kPa)	
inO_2	90 to 800 mmHg 12 to 107 kPa 18 to 100 vol%	10 mmHg 1 kPa 1 vol%	
inN_2O	0 to 660 mmHg 0 to 88 kPa 0 to 82 vol%	10 mmHg 2 kPa 2 vol%	
in/et HAL/ISO/ENF	0 to 60 mmHg 0.0 to 8 kPa 0.0 to 7.5 vol%	1 mmHg 0.1 kPa 0.1 vol%	
in/et SEV	0 to 72 mmHg 0.0 to 9.6 kPa 0.0 to 9.0 vol%	1 mmHg 0.1 kPa 0.1 vol%	
in/et DES	0 to 160 mmHg 0.0 to 21.2 kPa 0.0 to 20.0vol%	2 mmHg 0.2 kPa 0.2 vol%	
awRR High	Adult/pedi: 10 to 60 rpm Neo: 30 to 60 rpm	under 20 rpm: 1 rpm over 20 rpm:5 rpm	
awRR Low	Adult/pedi: 0 to 55 rpm Neo: 0 to 55 rpm		settings < 20 rpm: less than 8 seconds > 20 rpm: less than 18 seconds
Apnea delay	15 to 40 seconds	5 second steps	set apnea delay time + 8 seconds

Safety and Performance Tests

You must observe any national regulations on the qualification of the testing personnel and suitable measuring and testing facilities. See the maintenance section for a list of required tests. Safety and performance tests, and what to do if the instrument does not meet these specifications are described in the Installation and Service guide.

Electromagnetic Compatibility (EMC) Specifications

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. Portable and mobile radio frequency (RF) communications equipment can affect medical electrical equipment.

Accessories Compliant with EMC Standards

All accessories listed in the accessories section comply with the requirements of IEC 60601-1-2.

WARNING Using accessories other than those specified may result in increased electromagnetic emission or decreased electromagnetic immunity of the monitoring equipment.

Electromagnetic Emissions

The monitor is suitable for use in the electromagnetic environment specified in the table below. You must ensure that it is used in such an environment

Emissions test	Compliance	Avoiding Electromagnetic Interference
Radio Frequency (RF) emissions	Group 1	The monitor 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
RF emissions CISPR 11	Class A	The monitor is suitable for use in all establishments other than domestic and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes
Harmonic emissions IEC 61000-3-2	n/a	
Voltage fluctuations IEC 61000-3-3	n/a	

Avoiding Electromagnetic Interference (Resp and BIS)

The respiration (Resp) and BIS measurements are very sensitive measurements that measure very small signals. Technological limitations don't allow higher immunity levels than 1V/m for radiated RF electromagnetic fields and 1Vrms for conducted disturbances induced by RF fields. Electromagnetic fields with field strengths above 1 V/m and conducted disturbances above 1Vrms may cause erroneous measurements. Therefore Philips recommends that you avoid using electrically radiating equipment in the close proximity of these measurements.

WARNING The monitor should not be used next to or stacked with other equipment. If you must stack the monitor, you must check that normal operation is possible in the necessary configuration before you start monitoring patients.

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.

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 40% U_T (60% dip in U_T) for 5 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 0.5 cycles 40% U_T (60% dip in U_T) for 5 cycles 70% U_T (30% dip in U_T) for 25 cycles < 5% U_T (> 95% dip in U_T) for 5 sec	Mains power quality should be that of a typical commercial and/or hospital environment. If the user of the monitor requires continued operation during power mains interruptions, it is recommended that the monitor is equipped with an internal battery or is powered from an uninterruptible power supply.
Power frequency (50/60 Hz) magnetic field IEC 61000-4-8	3 A/m	3 A/m	Power frequency magnetic fields should be a t levels characteristic of a typical location in a typical commercial and/or hospital environment

In this table, U_T is the a.c. mains voltage prior to application of the test level.

Recommended Separation Distance

WARNING The monitor, equipped with a wireless network interface, intentionally receives RF electromagnetic energy for the purpose of its operation. Therefore, other equipment may cause interference, even if that other equipment complies with CISPR emission requirements.

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 metres (m). The values given in brackets are for respiration and BIS.

Portable and mobile RF communications equipment should be used no closer to any part of the monitor, 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 (over the frequency range 150 kHz to 80 MHz, field strengths should be less than 1 V/m for respiration and BIS and 3 V/m for all other functions).

Interference may occur in the vicinity of equipment marked with this symbol:

Immunity test	IEC 60601-1-2 test level	Compliance level	Electromagnetic environment guidance
Conducted RF IEC 61000-4-6	3 V_{RMS} 150 kHz to 80 Mhz	3 V_{RMS} (1 V_{RMS} for respiration and BIS)	Recommended separation distance: $d = 1,2\sqrt{P}$ for respiration and BIS:: $d = 3,5\sqrt{P}$
Radiated RF IEC 61000-4-3	3 V/m 80 Mhz to 2.5 GHz	3 V/m (1 V/m for respiration and BIS)	Recommended separation distance: 80 MHz to 800 MHz $d = 1,2\sqrt{P}$ 80 MHz to 800 MHz for respiration and BIS:: $d = 3,5\sqrt{P}$ 800 MHz to 2,5 GHz $d = 2,3\sqrt{P}$ 800 MHz to 2,5 GHz for respiration and BIS $d = 7,0\sqrt{P}$

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 monitor is used exceeds the applicable RF compliance level above, the monitor should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as reorienting or relocating the monitor.

These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects, and people.

Recommended separation distances from portable and mobile RF communication equipment

The monitor is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The customer or user of the monitor can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment and the monitor as recommended below, according to the maximum output power of the communications equipment.

Frequency of transmitter	150 kHz to 80 MHz	150 kHz to 800 MHz	800 MHz to 2,5 GHz
Equation	$d = 1,2\sqrt{P}$ for respiration and BIS: $d = 3,5\sqrt{P}$	$d = 1,2\sqrt{P}$ for respiration and BIS: $d = 3,5\sqrt{P}$	$d = 2,3\sqrt{P}$ for respiration and BIS: $d = 7,0\sqrt{P}$
Rated max. output power of transmitter (W)	Separation distance (m)	Separation distance (m)	Separation distance (m)
0.01	0.1 (0.4)	0.1 (0.4)	0.2 (0.7)
0.1	0.4 (1.1)	0.4 (1.1)	0.7 (2.2)
1	1.3 (3.5)	1.3 (3.5)	2.3 (7.0)
10	3.8 (11.1)	3.8 (11.1)	7.3 (22.1)
100	12.0 (35.0)	12.0 (35.0)	23.0 (70.0)

Electrosurgery Interference/Defibrillation/Electrostatic Discharge

The equipment returns to the previous operating mode within 10 seconds without loss of any stored data. Measurement accuracy may be temporarily decreased while performing electro-surgery or defibrillation. This does not affect patient or equipment safety. Do not expose the equipment to x-ray or strong magnetic fields (MRI).

Fast Transients/Bursts

The equipment will return to the previous operating mode within 10 seconds without loss of any stored data. If any user interaction is required, the monitor indicates with a technical alarm (INOP).

Restart time

After power interruption, an ECG wave will be shown on the display after 30 seconds maximum.

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Default Settings Appendix

This appendix documents the most important default settings of your monitor as it is delivered from the factory. For a comprehensive list and explanation of default settings, see the Configuration Guide supplied with your monitor. The monitor's default settings can be permanently changed in Configuration Mode.

Settings are only entered once per table row if they are the same for all patient categories.

Alarm Default Settings

Alarm Settings	Factory Default
Alarm Volume	5
Alarms Off	3 min.
Pause Al. 5min	Enabled
Pause Al. 10min	Enabled
Auto Alarms Off	Off
Alarm Off Reminder	Off
Visual Latching	Red & Yell (for Anesthesia configurations (option H30) Visual Latching: Red)
Audible Latching	Red & Yell (for Anesthesia configurations (option H30) Audible Latching: Off)
Alarm Reminder	On
Reminder Time	3 min
Alarm Sounds	Traditional
Red Alarm Interval	10 sec
Yel. Al. Interval	20 sec
Alarm Low	4
Red Alarm Volume	AlarmVol +2
Yell. Alarm Volume	AlarmVol +0
Inop Volume	AlarmVol +0
Auto Increase Vol.	2 Steps
Increase Vol Delay	20 sec
Keep Blinking	No
Relay 1 Sensitiv.	R & Y & I
Relay 2 Sensitiv.	Red & Yell
Relay 3 Sensitiv.	Red
Inop Relay Latency	5 sec
Yel. Relay Latency	2 sec
Alarm Text	Standard
No Centr Mon Min Vol	6

ECG, Arrhythmia, and ST Default Settings

ECG Settings	Factory Adult	Factory Pedi	Factory Neo
High Limit	120 bpm	160bpm	200 bpm
Low Limit	50 bpm	75 bpm	100 bpm
Alarms	On		
Alarm Source	HR		
ECG	On		
QRS Volume	1		
Primary Lead	II		

ECG Settings	Factory Adult	Factory Pedi	Factory Neo
Secondary Lead	V		
Analysis Mode	Multi-lead		
Lead Placement	Standard		
Mod. Lead Placment	Off		
Filter	Monitor		
Speed	25mm/s		
Auto Filter	Off		
Default ECG Size	x1		
Color	Green		
Asystole Thresh	4.0 sec		3.0 sec
Δ ExtrTachy	20 bpm		
Tachy Clamp	200 bpm	220 bpm	240 bpm
Δ ExtrBrady	20 bpm		
Brady Clamp	40 bpm		50 bpm
ALL ECG IN.	On		
Fallback	On		
Alarms Off	Enabled		
Alarm Source Sel.	Enabled		

Arrhythmia Settings	Factory Adult	Factory Pedi	Factory Neo
Arrhythmia	On (for Anesthesia (H30) options Arrhythmia: Off.)		Off
Pause Threshold	2.0 sec		1.5 sec
VTach HR	100	120	150
VTach Run	5		
Vent Rhythm	14		
SVT HR	180	200	210
SVT Run	5		
PVCs/min	10	5	5
Non-Sustain	On		
Vent Rhythm	On		
Run PVCs	On		
Pair PVCs	On		
R-On-T PVCs	On		
V.Bigeminy	On		
V.Trigeminy	On		
PVCs/min	On		
Multif.. PVCs	On		
Pacer N. Cap	On		
Pacer N. Pac	On		
Pause	On		
Missed Beat	On		
SVT	On		
IrregularHR	On		
TimeOut 1st	3 min		
TimeOut 2nd	10 min		
Arrhy Off Message	Yes		
SOME ECG IN	On		

Note for H30 Options: The default settings for Arrhythmia alarms for the Anesthesia configurations (H30 options) are: all Arrhythmia Alarms: On, and the individual alarms Pair PVCs, R-On-T PVCs, V.Bigeminy, V.Trigeminy, PVCs/min, Multif. PVCs, Pause, Missed Beat, Irregular HR Off. Note that all Arrhythmia alarms are inactive as long as Arrhythmia is off.

Lead-independent ST Settings	Factory Adult	Factory Pedi	Factory Neo
ST Alarm Mode	Single ST		
Alarms	On		
ST Analysis	On	Off: ST is only available for Adult patients	
ST-Index	On		
ISO Point	-80 ms		
J Point	48 ms		
ST Point	J+60		

Lead I, II, III, V, aVR, aVL, aVF, V1-6, MCL Settings	Factory Adult	Factory Pedi	Factory Neo
ST(Label)	On	Off	
For Alarm Mode = Single-ST			
ST(Label) High	+2.0 mm		
ST(Label) Low	-2.0 mm		
For Alarm Mode = Multi-ST			
ST(Label) High	+1.0 mm		
ST(Label) Low	-1.0 mm		

Pulse Default Settings

Pulse Settings	Factory Adult	Factory Pedi	Factory Neo
Alarm Source	HR		
Pulse (Label)	On		
System Pulse	SpO2		
Alarms Off	Enabled		
Alarm Source Sel.	Enabled		

Pulse Alarm Settings	Factory Adult	Factory Pedi	Factory Neo
Pulse (SpO2)	on		
Pulse Alarms	on		
High Limit	120 bpm	160 bpm	200 bpm
Low Limit	50 bpm	75 bpm	100 bpm
Δ Extr Brady	20 bpm		
Brady Clamp	40 bpm		50 bpm
Δ Extr Tachy	20 bpm		
Tachy Clamp	200 bpm	220 bpm	240 bpm

Pulse alarms use the settings of the currently selected Pulse alarm source.

Respiration Default Settings

Resp Settings	Factory Adult	Factory Pedi	Factory Neo
High Limit	30 rpm		100 rpm
Low Limit	8 rpm		30 rpm
Apnea Time	20 sec		
Alarms	On		
Resp	On (for Anesthesia configurations (option H30): Resp Off)		
Auto/Manual	Auto (Trigger Mode)		
Resp Speed	6.25mm/s		
Color	Yellow		

SpO_2 Default Settings

SpO_2 Settings	Factory Adult	Factory Pedi	Factory Neo
Alarms	On		
QRS Volume	1		
Tone Modulation	Yes		
Tone Mod. Type	Enhanced		
Speed	25mm/s		
Perfusion	On		
Average	10 sec		
NBP Alarm Suppr.	On		
Color	Cyan		

SpO_2 Alarm Default Settings			
Setting	**adult**	**pediatric**	**neonatal**
Desat Limit	80	80	80
Low Limit	90	90	85
High Limit	100	100	95
Desat delay	20 sec	20 sec	20 sec
High Alarm delay	10 sec	10 sec	10 sec
Low Alarm delay	10 sec	10 sec	10 sec
Parameter Alarms On/Off	on	on	on
Label	SpO_2	SpO_2	SpO_2
Pulse Settings			
Pulse (SpO2) On/Off	on	on	on
Pulse Alarms On/Off	on	on	on
Pulse High Limit	120 bpm	160bpm	200 bpm

SpO_2 Alarm Default Settings			
Setting	**adult**	**pediatric**	**neonatal**
Pulse Low Limit	50 bpm	75 bpm	100 bpm
Δ Extr Brady	20 bpm	20 bpm	20 bpm
Brady Clamp	40 bpm	40 bpm	50 bpm
Δ ExtrTachy	20 bpm	20 bpm	20 bpm
Tachy Clamp	200 bpm	220 bpm	240 bpm

NBP Default Settings

NBP Settings	Factory Adult	Factory Pedi	Factory Neo
Auto/Manual	Auto		Manual
Alarms from	Sys.		
High Alarm Limit	160/ 90 (110)	120/ 70 (90)	90 / 60 (70)
Low Alarm Limit	90 / 50 (60)	70 / 40 (50)	40 / 20 (24)
Alarms	On		
NBP	On		
Repetition Time	15 min (for Anesthesia configurations (H30 options) Repetition Time: 5 mins)		
Unit	mmHg		
Done Tone	Off		
Start Time	Synchronized		
VP Pressure	60 mmHg	40 mmHg	30 mmHg
Reference	Auscultatory		Invasive
Color	Red		

Temperature Default Settings

Temp Settings	Factory Adult	Factory Pedi	Factory Neo
Low Limit	36		
High Limit	39		
Alarms	On		
Unit	^{0}C		
Range	35...43		
Color	Green		

Invasive Pressure Default Settings

Invasive Pressure Settings	ABP, ART, Ao, UAP, P Settings			CVP, RAP, LAP, UVP Settings		
	Factory Adult	Factory Pedi	Factory Neo	Factory Adult	Factory Pedi	Factory Neo
Alarms from	Sys.			Mean		
High Limit	160/ 90 (110)	120/ 70 (90)	90/ 60 (70)	14 / 6 (10)	10 / 2 (4)	10 / 2 (4)
Low Limit	90/ 50 (70)	70/ 40 (50)	55/ 20 (35)	6 / -4 (0)	2 / -4 (0)	2 / -4 (0)
Alarms	On			On		
Scale	150	100	100	20		
Speed	25mm/s			25mm/s		
Mean Only	No			Yes		
Filter	12 Hz			12 Hz		
Mercury Cal.	Yes			Yes		
Artifact Suppr.	60 sec			60 sec		
Unit	mmHg			mmHg		
Color	Red			Cyan		

Invasive Pressure Settings	PAP Settings			ICP Settings		
	Factory Adult	Factory Pedi	Factory Neo	Factory Adult	Factory Pedi	Factory Neo
Alarms from	Diastolic			Mean		
High Limit	35 / 16 (20)	60 / 4 (26)	60 / 4 (26)	14 / 6 (10)	10 / 2 (4)	10 / 2 (4)
Low Limit	10 / 0 (0)	24 / -4 (12)	24 / -4 (12)	6 / -4 (0)	2 / -4 (0)	2 / -4 (0)
Alarms	On			On		
Scale	20			20		
Speed	not applicable			not applicable		
Mean Only	12 Hz			Yes		
Filter	Yes			12 Hz		
Mercury Cal.	No			Yes		
Artifact Suppr.	60 sec			60 sec		
Unit	mmHg			mmHg		
Color	Yellow			Magenta		

Cardiac Output Default Settings

C.O. Settings	Factory Adult	Factory Pedi	Factory Neo
Auto-Calibration	On		
Tblood High Limit	39.0 °C		

C.O. Settings	Factory Adult	Factory Pedi	Factory Neo
Tblood Low Limit	36.0 °C		
Tblood Alarm On/Off	On		
Temperature Unit	^{0}C		
Color	Green		

CCO/CCI Settings	Factory Adult	Factory Pedi	Factory Neo
Settings common to CCO and CCI			
Alarms from	CCO		
CCO from	ABP		
Color	Green		
CCO			
Alarms	On		
CCO High Limit	8.5 l/min	3.7 l/min	1.3 l/min
CCO Low Limit	4.0 l/min	2.6 l/min	0.3 l/min
CCI			
Alarms	On		
CCI High Limit	4.3 l/min/m^2	3.7 l/min/m^2	5.2 l/min/m^2
CCI Low Limit	2.0 l/min/m^2	2.6 l/min/m^2	1.2 l/min/m^2

CO_2 Default Settings

CO_2 Alarm Settings	Factory Adult	Factory Pedi	Factory Neo
$etCO_2$ low	30		
$etCO_2$ high	50		
$imCO_2$ high	4		
CO_2 Alarms	on		
Unit	mmHg		
Scale	40 mmHg		
$ImCO_2$	on		
N_2O Corr	Off		
Humidity Corr	BTPS		
Max Hold	Off		
AwRR	On		
AwRR Alarms	On		
AwRR high limit	30		100
AwRR low limit	8		30
Apnea time	20 secs		
Color	Yellow		

tcGas Default Settings

tcGas Settings	Factory Adult	Factory Pedi	Factory Neo
$tcpO_2$ High	80 mmHg		
$tcpO_2$ Low	50 mmHg		
$tcpO_2$ Alarms	On		
$tcpCO_2$ High	50 mmHg		
$tcpCO_2$ Low	30 mmHg		
$tcpCO_2$ Alarms	On		
Site Time	4.0 hours		
Disable Timer	Not Allowed		
Heat Switch Off (i.e., after Site Timer elapsed)	No		
Transducer Temp.	43.0 °C		
CO_2 Correction (*Severinghaus)*	On		
Metabolism Factor	8 mmHg		
TcGas Unit	mmHg		
Temperature Unit	^0C		
$tcpO_2$ Color	Blue		
$tcpCO_2$ Color	Green		

SvO_2 Default Settings

SvO_2 Settings	Factory Adult	Factory Pedi	Factory Neo
Low Limit	60%		
High Limit	80%		
Alarms	On		
Light Intensity	On		
Color	Yellow		

AGM Default Settings

AGM Settings			
AGM Alarms	On	**No Al. til breath**	On
CO_2	et + im	**$imCO_2$ High**	Adult/Pedi/Neo: 4 mmHg
$etCO_2$ Low	Adult/Pedi/Neo: 30 mmHg	**$etCO_2$ High**	Adult/Pedi/Neo: 50 mmHg
Apnea Time	20 sec		
awRR Low	Adult/Pedi: 8 rpm	**awRR High**	Adult/Pedi: 30 rpm
	Neo: 30 rpm		Neo: 60 rpm
O_2	et + in		

AGM Settings			
inO_2 Low	Adult/Pedi/Neo: 18 %	**inO_2 High**	Adult/Pedi/Neo: 100 %
N_2O	et + in	**inN_2O High**	80 %
Agent Channel	et + in		
etHAL Low	Adult/Pedi/Neo: 0 %	**etHAL High**	Adult/Pedi/Neo: 1.6 %
inHAL Low	Adult/Pedi/Neo: 0 %	**in HAL High**	Adult/Pedi/Neo: 2 %
etISO Low	Adult/Pedi/Neo: 0 %	**etISO High**	Adult/Pedi/Neo: 2.5 %
inISO Low	Adult/Pedi/Neo: 0 %	**inISO High**	Adult/Pedi/Neo: 3 %
etENF Low	Adult/Pedi/Neo: 0 %	**etENF High**	Adult/Pedi/Neo: 3.3 %
inENF Low	Adult/Pedi/Neo: 0 %	**inENF High**	Adult/Pedi/Neo: 4 %
etSEV Low	Adult/Pedi/Neo: 0%	**etSEV High**	Adult/Pedi/Neo: 5 %
inSEV Low	Adult/Pedi/Neo: 0%	**inSEV High**	Adult/Pedi/Neo: 6 %
etDES Low	Adult/Pedi/Neo: 0 %	**etDES High**	Adult/Pedi/Neo: 10 %
inDES Low	Adult/Pedi/Neo: 0 %	**inDES High**	Adult/Pedi/Neo: 15 %

EEG Default Settings

EEG Settings	Factory Adult	Factory Pedi	Factory Neo
TP, SEF, MDF, PPF, Delta, Theta, Alpha, Beta	On		
SEF Threshold	90 %		
Numeric Average	8 sec		
Wave Scale	100uV (or +/- 50uV if **`Show Gridlines`** is configured to **`Yes`**)		
Show Gridlines	No		
Speed	25 mm/s		
Low Filter	0.5 Hz		
High Filter	30 Hz		
Impedance Limit	5 kOhm		
Smoothing CSA	On		
Color	Yellow		

BIS Default Settings

BIS Settings	Factory Adult	Factory Pedi	Factory Neo
SQI	On		
EMG	On		
SR	On		
SEF	Off		
TP	Off		
Scale	100uV (or +/- 50uV if **`Show Gridlines`** is configured to **`Yes`**)		
Show Gridlines	No		

BIS Settings	Factory Adult	Factory Pedi	Factory Neo
Speed	25 mm/s		
Filters	On		
Low Filter	2 Hz		
High Filter	70 Hz		
Notch Filter	On		
High Alarm Limit	70		
Low Alarm Limit	20		
Alarms	On		
Smoothing Rate	30 sec		
Color	Yellow		

VueLink Default Settings

Device Alarms	Ignored
Color	Green

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