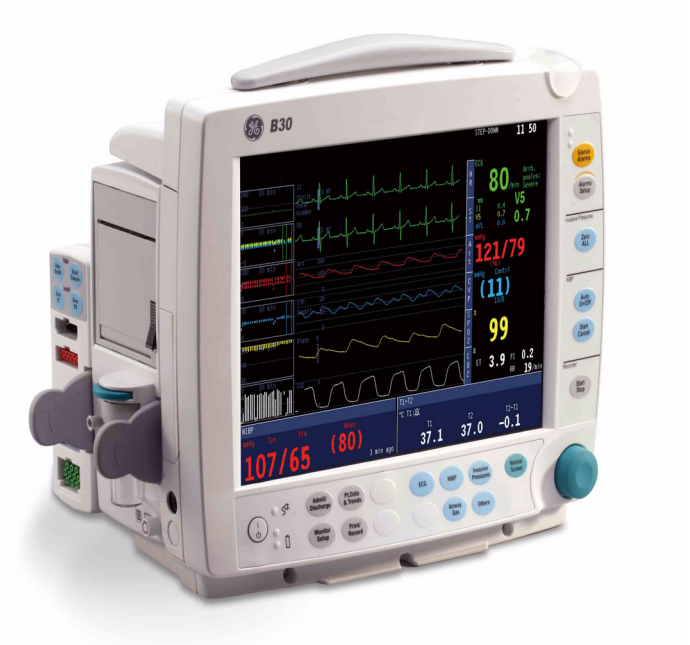
GE Healthcare

B30 Patient Monitor

User's Reference Manual



B30 Patient Monitor
English
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B30 patient Monitor

User's Reference Manual

Related to software license L-DICU08

Monitoring functions

CE 0459

Conformity according to the Council Directive 93/42/EEC concerning Medical Devices.

All specifications are subject to change without notice.

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Intended purpose (Indications for use)

The B30 patient monitor is intended for multiparameter patient monitoring. The B30 monitor is indicated for continuous monitoring of hemodynamic parameters (including arrhythmia and ST segment analysis) and respiratory status and creation of limit alarms. The B30 monitor is intended for all hospital patients and all hospital departments including intra-hospital transport but excluding harsh physical environment like MRI.

The Patient side module E-PSM(P)W and accessories are indicated for monitoring of hemodynamic parameters of all hospital patients. The hemodynamic parameters of the module comprise ECG (including ST-Segment and arrhythmia), impedance respiration, oscillometric NIBP (sys/dia/mean), temperature, SpO_2 (including monitoring during conditions of clinical patient motion), and invasive blood pressure. Impedance respiration measurement is indicated for patients ages three years and up. The NIBP measurement is indicated for patients who weight 5kg (11 lb) or up.The E-PSM(P)W is intended for all hospital departments including intra-hospital transport but excluding harsh physical environment like MRI.

The extension module N-FCREC (option N-FCREC or N-FC) is indicated for monitoring of CO_2 and respiration rate of all hospital patients. CO_2 measurements are indicated for patients who weight over 5 kg (11 lb).

The B30 monitor and N-F(C)(REC) Extension Module and E-PSM(P)W Patient Side Module are indicated for use by qualified medical personnel only.

Classifications

In accordance with IEC 60601-1

Class I and internally powered equipment – the type of protection against electric shock.

Type BF or CF equipment. The degree of protection against electric shock is indicated by a symbol on each parameter module.

Equipment not suitable for use in the presence of a flammable anesthetic mixture with air or with oxygen or nitrous oxide.

Continuous operation according to the mode of operation.

Portable Monitor.

In accordance with IEC 60529

IPX1 - degree of protection against harmful ingress of water.

In accordance with EU Medical Device Directive

The B30 patient monitor is classified as IIb.

In accordance with CISPR 11:

Group 1, Class B:

- Group 1 contains all ISM (Industrial, scientific and medical) equipment in which there is intentionally generated and/or used conductively coupled radio-frequency energy which is necessary for the internal functioning of the equipment itself.
- Class B equipment is suitable for use in domestic establishments and in establishments directly connected to a low voltage power supply network which supplies buildings used for domestic purposes.

Responsibility of the manufacturer

GE Medical Systems *Information Technologies*, Inc. is responsible for the effects on safety, reliability and performance of the equipment only if:

- assembly, extensions, readjustments, modifications, servicing and repairs are carried out by personnel authorized by GE.
- the electrical installation of the monitor room complies with appropriate requirements.
- the equipment is used in accordance with the "User's Guide."

Product availability

Some of the products mentioned in this manual may not be available in all countries. Please, consult your local representative for the availability.

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Table of contents

Table of contents

About this manual

Intended audience

This manual is intended for clinical professionals. Clinical professionals are expected to have a working knowledge of medical procedures, practices, and terminology, as required for monitoring critically ill patients.

Overview

This User's Reference Manual describes the functions offered by the B30 patient monitor running the software license L-DICU08. As the monitor setup may vary, some menus, displays and functions described may not be available in the monitor you are using.

This manual is an integral part of the product and describes its intended use. Keep it always close to the equipment. Observance of the manual is a prerequisite for proper product performance and correct operation and ensures patient and operator safety.

NOTE: Before using your monitor, please read the "User's Guide" or this manual thoroughly. This User's Reference Manual gives you more specific information about the clinical and technical aspects. Pay special attention to WARNING and CAUTION statements.

The new user of the monitor should begin with sections "Safety precautions" "System description" and "Monitoring basic." These sections describe the system and the basic operation of the monitor.

The measurement sections describe the measurement technique, setup and how to adjust displays and menus for patient monitoring and special views.

Section "Monitor setup" gives instructions about setting up the system and making changes in the default settings. Section "Cleaning and care" describes cleaning and daily maintenance procedures.

Illustrations and names

All illustrations in this manual are only examples, and may not necessarily reflect your system settings or data displayed in your system. If a particular selection is not available in your system, the selection is shown grayed in the menu.

All names used in examples and illustrations are fictitious.

Conventions used in this manual

To help you find and interpret information easily, the manual uses consistent text formats:

Hard keys	Names of the hard keys on the Command board, side panel and modules are written in the following way: **Others.**
Menu items	Software terms that identify window parts or menu items are written in bold italic: ***Lab Data.***
Menu access	Menu access is described from top to bottom. For example, the selection of the **Monitor Setup** hard key, the ***Screen Setup*** menu item and the ***Waveform Fields*** menu item would be shown as **Monitor Setup - *Screen Setup - Waveform Fields***.
File names etc.	File names, file paths and text to be entered are written in the following way: comm.exe.
Messages	Messages (alarm messages, informative messages) displayed on the screen are written inside single quotes: 'Please wait.'
References	When referring to different sections in this manual or to other manuals, manual names and section names are enclosed in double quotes: See section "Cleaning and care." Please refer to "Technical Reference Manual: Installation."
WARNING	**This is a WARNING.**
CAUTION	This is a CAUTION.
NOTE	This is a NOTE.

The following symbols are also used to distinguish procedures:

Press the menu key described.

Turn the ComWheel.

Push the ComWheel.

Related documentation

Software options and default settings are described in the "Default Configuration Worksheet" delivered with each monitor.

Available accessories are described in the "Supplies and Accessories" catalog delivered with each monitor.

For more information about the iCentral, see the "iCentral User's Reference Manual".

Installation and service

A separate “Technical Reference Manual” describes installation, interfacing, connectors, service, maintenance and reparation procedures of the monitor.

Medical electrical equipment needs special precautions regarding EMC and needs to be installed and put into service according to the EMC information provided in the “Technical Reference Manual” by qualified personnel.

Service and repairs are allowed for authorized service personnel only.

Table of contents

1 Safety precautions

The following list contains all the general warnings and cautions you should know before starting to use the system. Warnings and cautions specific to parts of the system can be found in the relevant section.

Warnings

WARNING **A WARNING indicates a situation in which the user or the patient may be in danger of injury or death.**

- To avoid explosion hazard, do not use the monitor in presence of flammable anesthetics.
- Connect only one patient to the monitor at a time.
- Do not use the monitor without manufacturer approved mounting attached.
- Use only hospital-grade grounded power outlets and power cord.
- To avoid the risk of electric shock, this equipment must only be connected to a supply mains with protective earth.
- Do not use an additional multiple socket outlet, extension cord or adapter of any kind.
- Use only an intact power cord.
- Do not user the power cord for any other product or purpose.
- Do not apply mechanical tension to the power cord, otherwise it may be damaged.
- Some equipment malfunctions may not generate a monitor alarm. Always keep the patient under close surveillance.
- Never install the monitor so that it is above the patient.
- Do not use the monitor in high electromagnetic fields (for example, during MRI).
- Do not connect any external devices to the system other than those specified.
- Do not touch the patient, table, instruments, modules or the monitor during defibrillation.
- Pins of connectors identified with the ESD warning symbol should not be touched. Connections should not be made to these connectors unless ESD precautionary procedures are used. For details, see "ESD precautionary procedures" page 1-2.
- Use only approved accessories, including mounts and batteries, and defibrillator-proof cables and invasive pressure transducers. For a list of approved supplies and accessories, see the "Supplies and Accessories" catalog delivered with the monitor. Other cables, transducers, batteries and accessories may cause a safety hazard, damage the equipment or system, result in increased emissions or decreased immunity of the equipment or system or interfere with the measurement. Protection against cardiac defibrillator discharge is due in part to the accessories for pulse oximetry (SpO_2), temperature (T) and invasive pressure (P) measurement.
- Single-use accessories are not designed to be re-used. Re-use may cause a risk of contamination and affect the measurement accuracy.
- The monitor or its components should not be used adjacent to or stacked with other equipment. If adjacent or stacked use is necessary, the monitor and its components should be observed to verify normal operation in configuration in which it will be used.

- When detaching modules, be careful not to drop them. Always support with one hand while pulling out with the other.
- If you accidentally drop the monitor or modules, have them checked by authorized service personnel prior to clinical use.
- If the integrity of the external protective earth conductor arrangement is in doubt, use the monitor with battery operation.
- Vibrations during intrahospital transport may disturb SpO_2, ECG, impedance respiration, InvBP and NIBP measurements.
- If the unit fails to respond as described, do not use the monitor until tested and repaired by authorized service personnel.
- The system is intended for use by qualified medical personnel only.
- When using the electrosurgery unit, ensure proper contact of the ESU return electrode to the patient to avoid burns at monitor measurement sites.
- Make sure that the leadwire set clips or snaps do not touch any electrically conductive material including earth.

Cautions

CAUTION A CAUTION indicates a situation in which the unit or the devices connected to it may be damaged.

- Before connecting the power cord to a power supply, check that the local voltage and frequency correspond with the rating stated on the device plate.
- Leave space for air circulation to prevent the monitor from overheating.
- Do not store or use the monitor outside the temperature and humidity ranges specified in "Performance" in section "System description" of this manual.
- Refresh the batteries completely every six months.

ESD precautionary procedures

- To avoid electrostatic charges to build up, it is recommended to store, maintain and use the equipment at a relative humidity of 30% or greater. Floors should be covered by ESD dissipative carpets or similar. Non-synthetic clothing should be used when working with the component.
- To prevent applying a possible electrostatic discharge to the ESD sensitive parts of the equipment, one should touch the metallic frame of the component or a large metal object located close to the equipment. When working with the equipment and specifically when the ESD sensitive parts of the equipment may be touched, a grounded wrist strap intended for use with ESD sensitive equipment should be worn. Refer documentation provided with the wrist straps for details of proper use.

ESD precautionary procedure training

- It is recommended that all potential users receive an explanation of the ESD warning symbol and training in ESD precautionary procedures.
- The minimum content of an ESD precautionary procedure training should include an introduction to the physics of electrostatic charge, the voltage levels that can occur in normal practice and the damage that can be done to electronic components if they are touched by an operator who is electrostatically charged. Further, an explanation should be given of methods to prevent build-up of electrostatic charge and how and why to

discharge one's body to earth or to the frame of the equipment or bond oneself by means of a wrist strap to the equipment or the earth prior to making a connection.

Points to note

- Medical electrical equipment needs special precautions regarding electromagnetic compatibility, EMC, and needs to be installed and put into service according to the EMC information provided in the "Technical Reference Manual" by qualified personnel.
- Portable and mobile RF communications equipment can affect the medical electrical equipment.
- The equipment is suitable for use in the presence of electrosurgery. Please notice the possible limitations in the parameter sections and in "Performance" on page 2-30.
- Service and repairs are allowed for authorized service personnel only.

Disposal

- Dispose of the whole device, parts of it, its packing material and manuals in accordance with local environmental and waste disposal regulations.

Product Compliance

The B30 Patient Monitor is classified in the following categories for compliance:

- This equipment is suitable for connection to public mains as defined in CISPR 11.
- This Monitor conforms to general safety standard for medical devices to IEC 60601-1.
- This Monitor conforms to EMC safety standard to IEC 60601-1-2.
- This Monitor conforms to usability safety standard for medical devices to IEC 60601-1-6.
- Software is developed in accordance with IEC 60601-1-4.
- The application of risk management analysis to medical device conforms to ISO 14971.
- The SpO2 Parameter conforms to ISO 9919.
- The TEMP parameter conforms to EN 12470-4.
- The CO2 parameter conforms to ISO 21647.
- This Monitor conforms to particular safety standard for multifunction patient monitoring equipment to IEC 60601-2-49 with the exception of Sub- clause 51.103; 51.103.1 and 51.102.4.

  NOTE:

  – This Monitor conforms to particular safety standard for multifunction patient monitoring equipment to IEC 60601-2-49 with the exception of Sub- clause 51.103: Both non-latched and latched alarms are selectable for technical alarms.
  – If the Latching Alarms selection is active, both technical alarm and physiological alarm messages stay on the screen even if the initial alarm condition goes away.

WARNING **The latching alarms function is convenient for the user to analyze and track the old state of the patient. This is a advanced function, which protected by the password in the monitor. This function should be operated by a qualified medical personnel only. The latched technical alarms do not affect safety and effectiveness of monitor.**

NOTE:

– This Monitor conforms to particular safety standard for multifunction patient monitoring equipment to IEC 60601-2-49 with the exception of Sub- clause 51.103.1: A new technical alarm only triggers a visual indication, not the audible alarm.
– During silencing, all new alarms for the same reason and all alarms for a different reason are indicated only visually.

WARNING **In clinical conditions, caregivers are more likely to silence alarms when they consider these alarms quietly cacophony and may distract and overwhelm the clinicians. Appropriate visual textual message indicated in B30 still work to direct the caregiver's attention to the unexpected situation when alarms are silenced. However, the alarm silence function should be carefully used, the clinical practitioner should check the monitor's screen frequently during silencing.**

NOTE:

– This Monitor conforms to particular safety standard for multifunction patient monitoring equipment to IEC 60601-2-49 with the exception of Sub- clause 51.102.4: New PHYSIOLOGICAL ALARM(S) beginning after the activation of SILENCE/ RESET resume audio-visual ALARM manifestations
– Refer to the exception of Sub- clause 51.103.1 for the same performance and warning.

- The invasive blood pressure parameter conforms to the IEC 60601-2-34 with the exception of Sub-clause 51.300 and 51.207.4

  NOTE:

  – The invasive blood pressure parameter conforms to the IEC 60601-2-34 with the exception of Sub-clause 51.300: Both non-latched and latched alarms are selectable for technical alarms.
  – Refer IEC 60601-2-49 item for monitor's performance and warnings.

  NOTE:

  – The invasive blood pressure parameter conforms to the IEC 60601-2-34 with the exception of Sub-clause 51.207.4: A new alarm only triggers a visual indication, not the audible alarm.
  – Refer IEC 60601-2-49 item for monitor's performance and warnings.

- The ECG parameter conforms to IEC 60601-2-27 with the exception of Sub-clause 50.102.8 a); 51.103.2; 51.103.3.4; 51.104.1 and 51.104

  NOTE:

  – The ECG parameter conforms to IEC 60601-2-27 with the exception of Sub-clause 50.102.8 a): Frequency response: The output signal amplitudes are out of range at Method A 40HZ and Method B
  – The ECG high-frequency response limit for monitoring filter and ST filter with 50 Hz power supply frequency is 30 Hz, but not 40 Hz according the 60601-2-27.

WARNING **In clinical conditions, the high-frequency response limit of 30 Hz for monitoring filter and ST filter with 50 Hz power supply frequency is adequately and safe for these lethal arrhythmia identification which are available in B30. The diagnostic filter is recommended for diagnostic purposes.**

NOTE:

– The ECG parameter conforms to IEC 60601-2-27 with the exception of Sub-clause 51.103.2: SILENCE/RESET of PHYSIOLOGICAL ALARMS/Sub-clause 51.104.1: Auditory manifestation of TECHNICAL ALARMS: A new alarm only triggers a visual indication, not the audible alarm.
– Refer IEC 60601-2-49 item for monitor's performance and warnings.

NOTE:

– The ECG parameter conforms to IEC 60601-2-27 with the exception of Sub-clause 51.103.3.4: New PHYSIOLOGICAL ALARM(s) beginning after activation of SILENCE/ RESET resumed the auditory and visual ALARM manifestations
– Refer IEC 60601-2-49 items for monitor's performance and warnings.

NOTE:

– The ECG parameter conforms to IEC 60601-2-27 with the exception of Sub-clause 51.104: Both non-latched and latched alarms are selectable for technical alarms.
– Refer IEC 60601-2-49 items for monitor's performance and warnings.

- The NIBP parameter conforms to IEC 60601-2-30, EN 1060-1, EN 1060-3 with the exception of Sub-clause 22.4.1, 51.103 of IEC 60601-2-30 and Sub-clause 5 of EN 1060-1.

  NOTE:

  – The NIBP parameter conforms to IEC 60601-2-30 with the exception of Sub- clause 22.4.1: In single fault condition, the functioning independently of the normal pressure control system does not prevent immediately.

WARNING **Prolonged use and frequent blood pressure determinations can lead to venous pooling and congestion. Devices that exert pressure on tissue have been associated with purpura, skin avulsion, compartmental syndrome, ischemia, and/or neuropathy. To minimize these potential problems, especially when monitoring at frequent intervals or over extended periods of time, make sure the cuff is applied appropriately and examine the cuff site and the limb distal to the cuff regularly for signs of impeded blood flow.**

NOTE:

– The NIBP parameter conforms to IEC 60601-2-30 with the exception of Sub-clause 51.103: Both non-latched and latched alarms are selectable for technical alarms.
– Refer IEC 60601-2-49 item for monitor's performance and warnings.

NOTE:

– The NIBP parameter conforms to EN1060-1 with the exception of Sub-clause 5: Abbreviations; "Mean" used instead "M" or "MAP".
– The word "Mean" is used in monitor instead of "M" or "MAP" as the value for the NIBP pressure mean average.

WARNING **The clinical practitioner can understand "Mean" is the abbreviation of NIBP pressure mean average. The B30 monitor is intended for use by qualified medical personnel only.**

- The alarm systems of the Monitor conform to IEC 60601-1-8 with the exception of Sub-clause 6.3.3.1a

  NOTE:

– The alarm systems of the Monitor conform to IEC 60601-1-8 with the exception of Sub-clause 6.3.3.1a: An ALARM SYSTEM provided with auditory ALARM SIGNALS shall have at least one set of ALARM SIGNALS.
– The characteristics of auditory alarm signals are different from IEC 60601-1-8 requirement. This is only ms quantitative difference that can't be defected by human audition, according to the usability study, it has no negative effect in clinical use.

CE 0459 Comformity according to the Council Directive 93/42/EEC concerning Medical Devices.

Table of contents

2 System description

Principles of functions

The B30 monitor is a modular multiparameter patient monitor. The monitor is especially designed for monitoring in PACU, ED, Wards, Step down units, ICU, CCU and OR in regions where anesthesia gas monitoring is not required. It can also be used during transportation within the hospital.

The modular design makes the system flexible and easy to upgrade.

System introduction

The B30 monitor system may consist of the elements shown below.

NOTE: Your system may not include all these components. Consult your local representative for the available components.

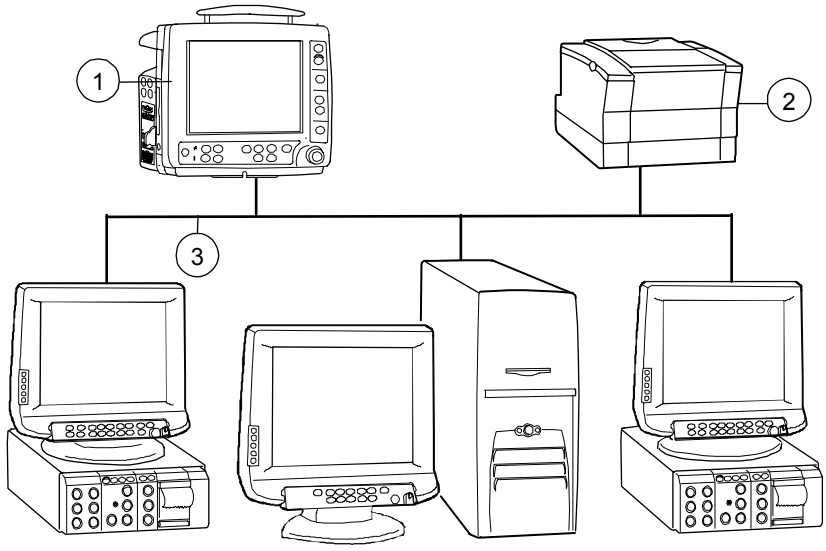


Figure 2-1 B30 patient monitor system

(1) B30 with module(s)

(2) Printer (network printer only)

(3) Other monitors in the network. NOTE: You cannot view other monitors on the B30 with L-DICU08 software.

NOTE: The allowed cables, batteries, transducers and accessories for the monitor are listed in the “Supplies and Accessories” catalog delivered with the monitor.

WARNING **If you accidentally drop the monitor, modules or frames, have them checked by authorized service personnel prior to clinical use.**

WARNING **Connect only one patient to the monitor at a time.**

WARNING **Do not use the monitor without manufacturer approved mounting attached.**

WARNING **Before starting to use the system, ensure that the whole combination complies with the international standard IEC 60601-1-1 and with the requirements of the local authorities. Do not connect any external devices to the system other than those specified.**

CAUTION The monitor display is fragile. Ensure that it is not placed near a heat source or exposed to mechanical shocks, pressure, moisture or direct sunlight.

Components

The main components of the B30 are the monitor frame and the interchangeable modules.

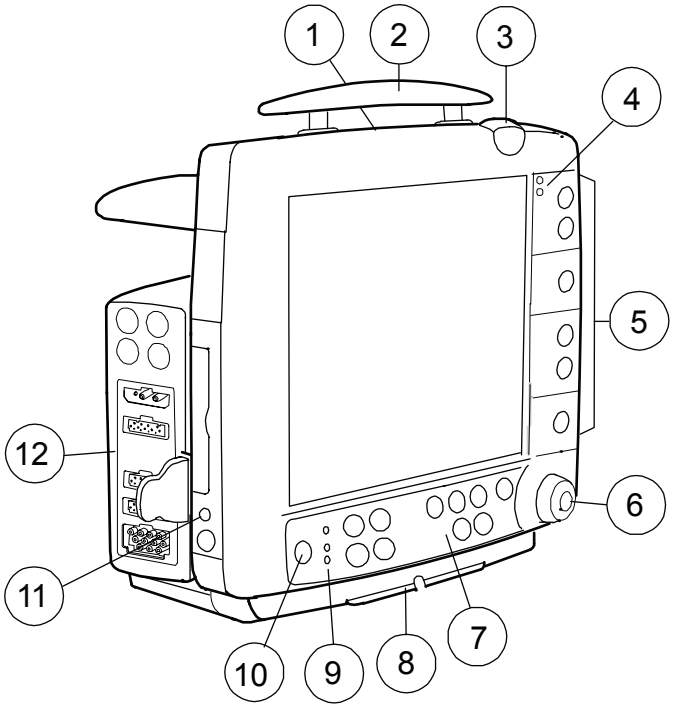


Figure 2-2 B30 monitor front panel

(1) Battery compartment
(2) Transportation handle
(3) Alarm light
(4) Alarm LED indicators
(5) Side panel keys
(6) The ComWheel
(7) Command Board keys
(8) Guide rail for GCX mounting
(9) Mains power and battery LEDs
(10) ON/standby key
(11) Defibrillator & IABP synchronization connector (marked with X5)
(12) Measurement modules, see page 2-4

You can use one E-PSM(P)W and/or one N-Fx module in the monitor at a time.

Optional components

Optional components are:

- Patient Side Modules E-PSMW and E-PSMPW
- Extension Modules N-FREC, N-FCREC and N-FC

Rear panel connections

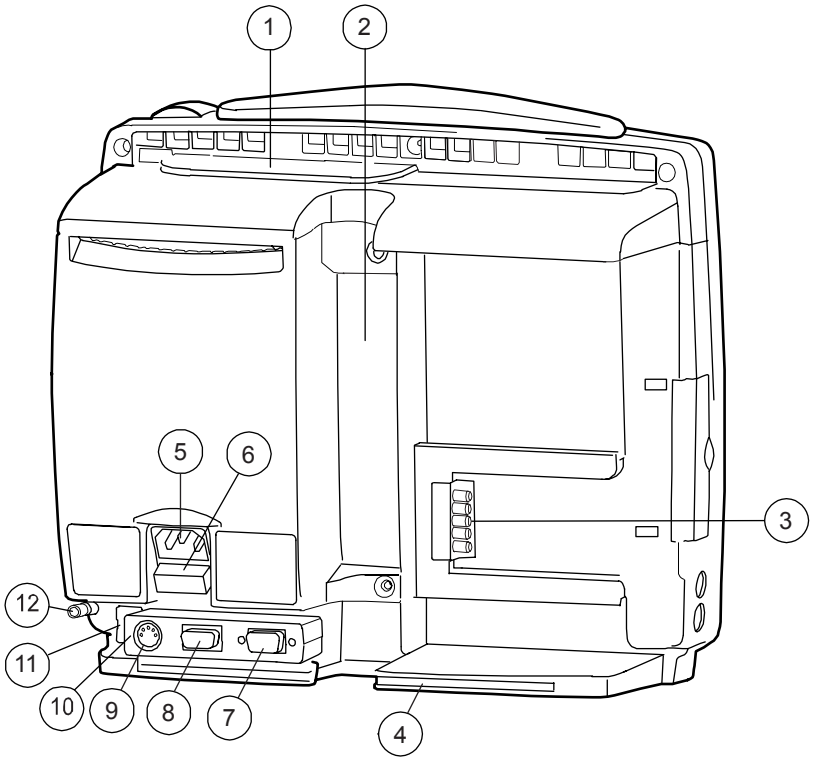


Figure 2-3 Rear panel connections

(1) Battery compartment
(2) Slot for infusion pole mounting
(3) Module connector (marked with X4)
(4) Guide rail for GCX mounting
(5) Receptacle for power cord
(6) Fuse holder
(7) Serial port (marked with X9)
(8) Network ID connector (marked with X8)
(9) Connector for future use (marked with X7)
(10) Accessory: Multi I/O adapter (with connectors 7 - 9 above)
(11) Network connector
(12) Equipotential connector

Module overview

Different modules measure different parameters. See below for module descriptions and features.

Patient Side Module E-PSMW

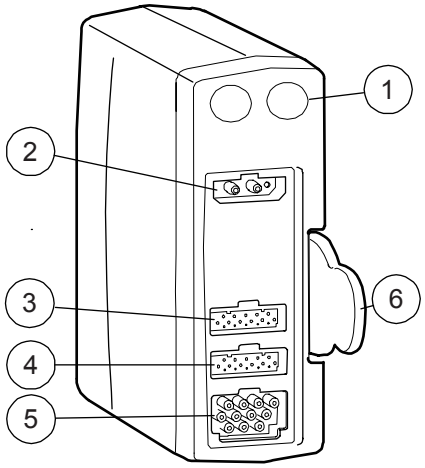


Figure 2-4 Module E-PSMW

(1) Module keys
(2) NIBP connector
(3) Temperature connector: 2-channel measurement
(4) SpO_2 connector
(5) ECG (3/5 lead) and impedance respiration connector
(6) Tab for removing the module

Patient Side Module E-PSMPW

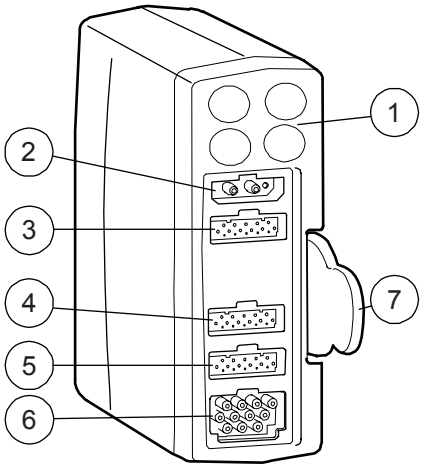


Figure 2-5 Module E-PSMPW

(1) Module keys
(2) NIBP connector
(3) Invasive blood pressure connector: 2-channel measurement
(4) Temperature connector: 2-channel measurement
(5) SpO_2 connector
(6) ECG (3/5 lead) and impedance respiration connector
(7) Tab for removing the module

Module keys

The E-PSM(P)W modules have the following direct function keys:

Auto On/Off — For starting or stopping the NIBP automatic cycling.

Start Cancel — For starting or stopping the NIBP manual cycling.

Zero P1 — For zeroing pressure channel P1
NOTE: with E-PSMPW only.

Zero P2 — For zeroing pressure channel P2
NOTE: with E-PSMPW only.

Extension Module N-FC

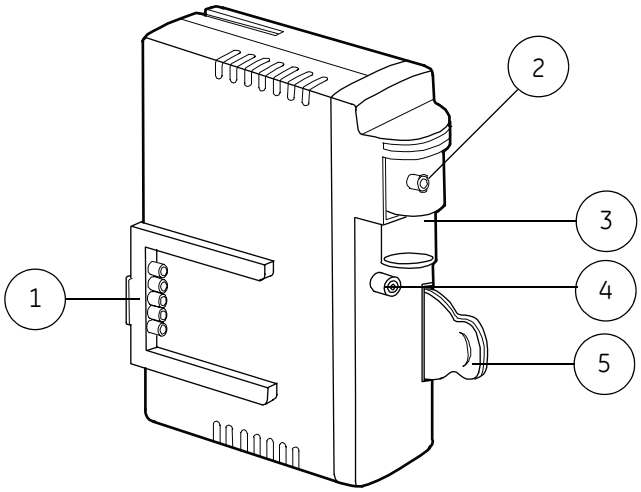


Figure 2-6 Module N-FC

(1) Module insertion guide for attaching an E-PSM(P)W module
(2) Sample gas inlet
(3) Water trap
(4) Gas outlet
(5) Tab for removing the module

Extension Module N-FCREC

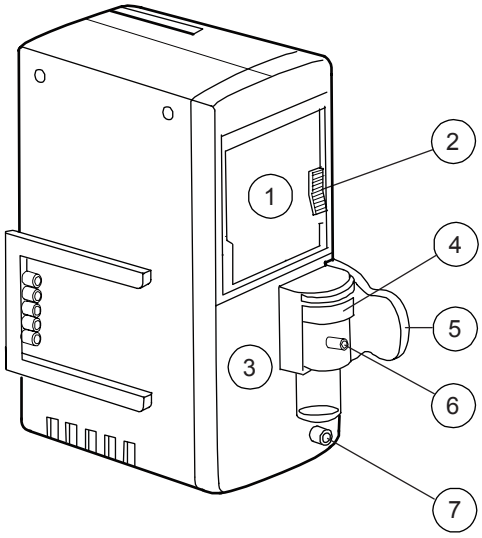


Figure 2-7 Module N-FCREC

(1) Recorder
(2) Paper compartment lever
(3) CO_2 measurement
(4) Water trap
(5) Tab for removing the module
(6) Sample gas inlet
(7) Gas outlet

Extension Module N-FREC

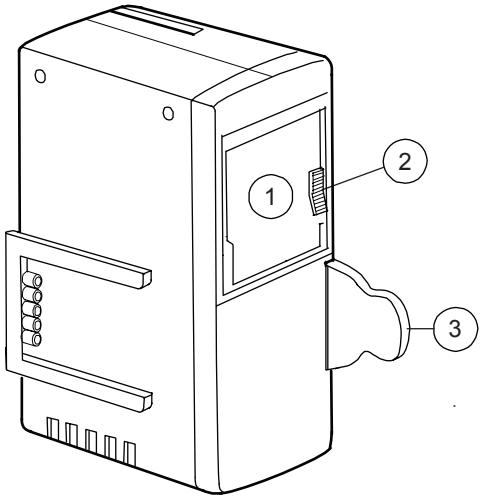


Figure 2-8 Module N-FREC

(1) Recorder
(2) Paper compartment lever
(3) Tab for removing the module

General module description

The modules are plugged into the monitor. They can be removed or inserted during monitoring.

Inserting and removing a module

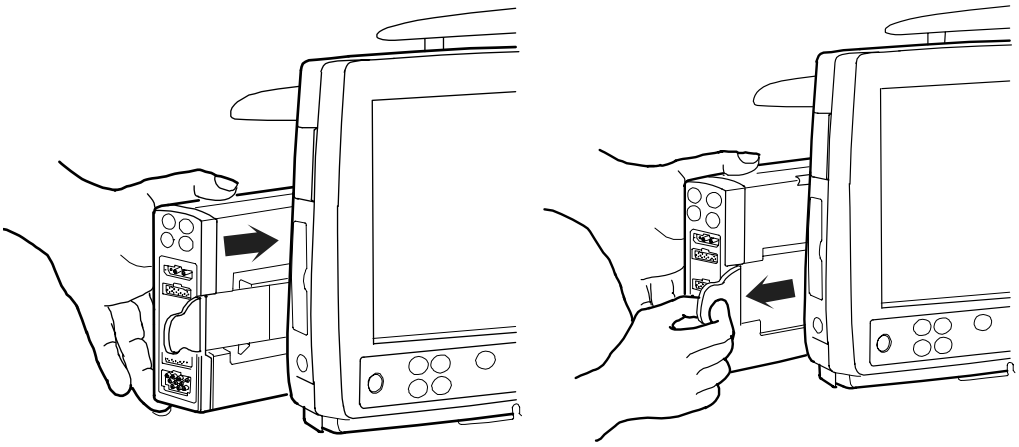


Figure 2-9 Inserting and removing a module

To insert a module:

1. Align the module with the insertion guide. E-PSM(P)W and N-Fx modules are all inserted the same way.
2. Push the module into the monitor frame until it clicks.

To remove a module:

Pull the module out using the tab.

WARNING **When detaching modules, be careful not to drop them. Always support with one hand while pulling out with the other.**

Using two modules

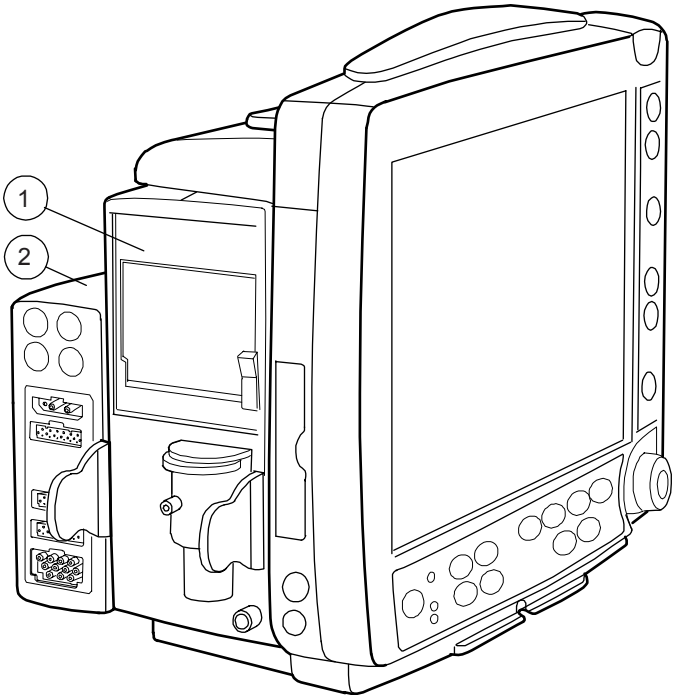


Figure 2-10 Using two modules

NOTE: You can use one E-PSM(P)W and/or one N-Fx module in the monitor at a time.

To install an E-PSM(P)W and an N-Fx module:

1. Insert the N-Fx module first, see "Inserting and removing a module" page 2-8.
2. Attach the E-PSM(P)W to the N-Fx.

Keyboards

You can control monitoring through the keys on the Command Board and side panel, module. For more information, see section "Monitoring basic."

Command Board keys

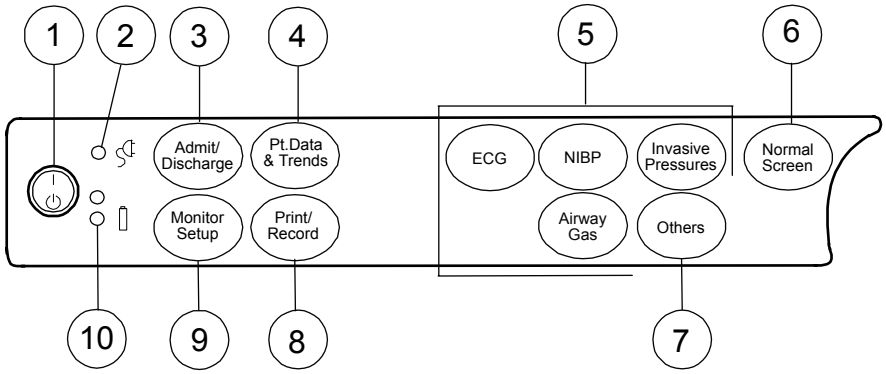


Figure 2-11 Command Board keys and LED indicators

(1) ON/standby key

(2) Mains power ON (lit) or OFF (dark): indicates mains or external DC power

(3) For admitting or discharging a patient; for selecting user modes

(4) For viewing trends and alarm history

(5) For activating parameter specific menus. NOTE: All modules do not measure all of these parameters. For more information, see "Module overview" on page 2-4.

(6) For returning the Normal Screen view to the screen

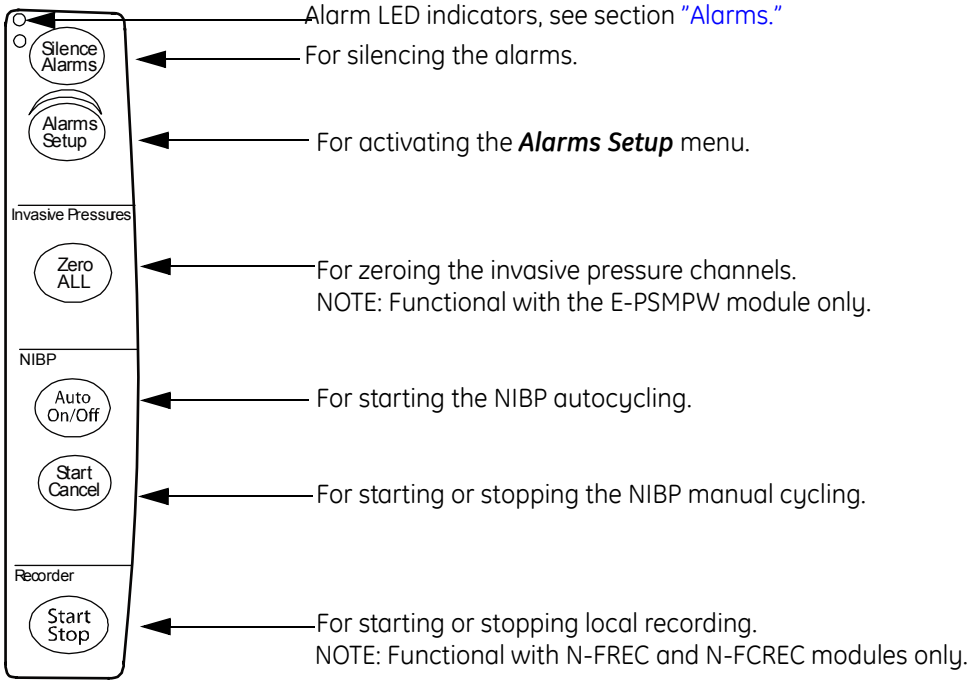
(7) For activating pulse oximetry, impedance respiration and temperature setup menus

(8) For printing and recording different trends and waveforms

(9) For setting up the monitor and for activating the HELP menu

(10) Battery operation LEDs, see "Batteries" on page 2-12.

Side panel


Silence Alarms
Alarms Setup
Invasive Pressures
Zero ALL
NIBP
Auto On/Off
Start Cancel
Recorder
Start Stop
Alarm LED indicators, see section "Alarms."
For silencing the alarms.
For activating the Alarms Setup menu.
For zeroing the invasive pressure channels.
NOTE: Functional with the E-PSMPW module only.
For starting the NIBP autocycling.
For starting or stopping the NIBP manual cycling.
For starting or stopping local recording.
NOTE: Functional with N-FREC and N-FCREC modules only.

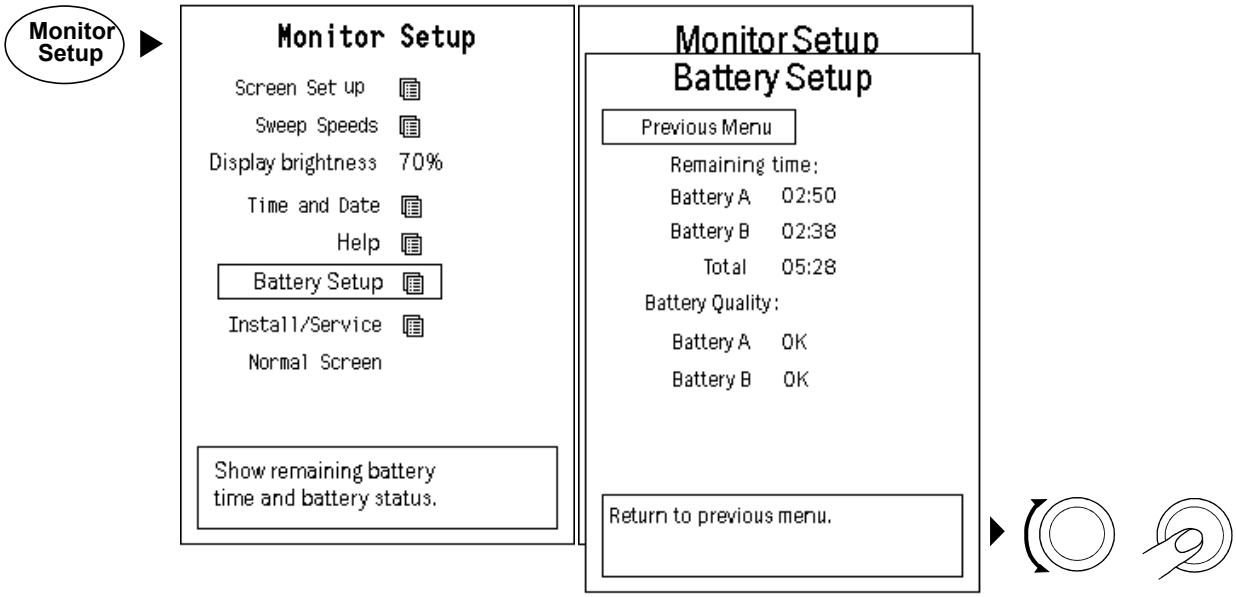
Batteries

The monitor can be run either on mains power or batteries. Battery operation is initiated when the power cord is disconnected or when the mains power is lost during monitoring.

NOTE: Always use the B30 with batteries inserted. Otherwise all trend data and temporary settings are lost if the power cable is detached from the mains.

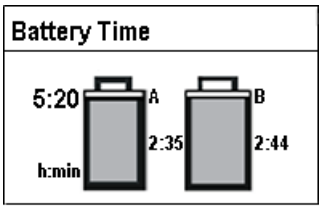
NOTE: Before using the monitor for the first time, charge the batteries to their full capacity. Charging time is two hours per battery pack.

The B30 has two lithium-ion batteries at most, located in the battery compartment. They can be charged separately, and screen symbols and monitor frame LEDs indicate their charging level and possible failure, see below. You can also check the battery status through **Monitor Setup** - ***Battery Setup***. The internal battery capacity is up to 4.5 hours with fully charged batteries.



NOTE: When the monitor is battery powered, the green battery LED is on. When the monitor is mains powered, the green mains LED is on.

If you wish to have the battery charge visible at all times, select it in one of the digit fields: **Monitor Setup** - ***Screen Setup*** - ***Digit Fields*** - ***Battery***. You can now see how much charging time is left for each battery separately both in numbers and as symbols, and the total charging time in numbers.

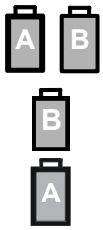


WARNING **Use only manufacturer approved batteries. Contact GE service if you need to order new batteries.**

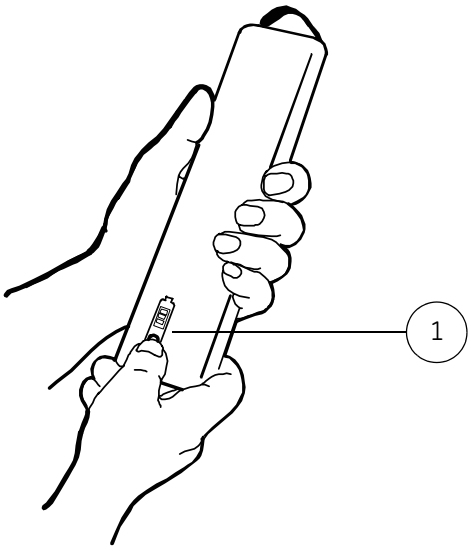
Battery indicators

The B30 messages, screen symbols and front panel LED indicators tell the user about the status of the batteries. For screen symbols, see page 2-15. For LED indicators, consult the table below and for messages, see section “Troubleshooting.”

Table 2-1 Battery indicators

Screen symbol	Explanation	Front panel battery LED indicators	
	Monitor is battery powered. Batteries are fully charged; the size of the green bar indicates the charging level.		green lit orange dark
	Monitor is battery powered. Battery A is empty, battery B charge is ok.		green lit orange dark
	Monitor is battery powered. Battery A failure, battery B is full.		green lit orange flashing
NOTE: If both batteries fail, the green battery LED is dark.			
	Monitor is mains powered. Battery A is being charged (white bar), battery B is already charged.		green dark orange lit
no screen symbol	Monitor is mains powered. 'No battery backup' message on screen. Batteries have failed or they are not inserted.		green dark orange flashing

Checking the battery charge when the monitor is turned off



When the monitor is turned off, you can check the battery charging level by pressing the test button on the battery as indicated in the drawing on the left.

The charging indicator bar (1) lights up and the number of lit segments indicates the charging level: the more lit segments, the higher the charging level.

Figure 2-12 Charging indicator on the battery

Replacing the batteries

Check the monitor indicators regularly to see if either one of the batteries needs to be changed. Battery capacity indicators in the upper right corner tell you when you should replace a battery, and which one is out of charge, missing or not working. You can replace one battery at a time.

To replace a battery:

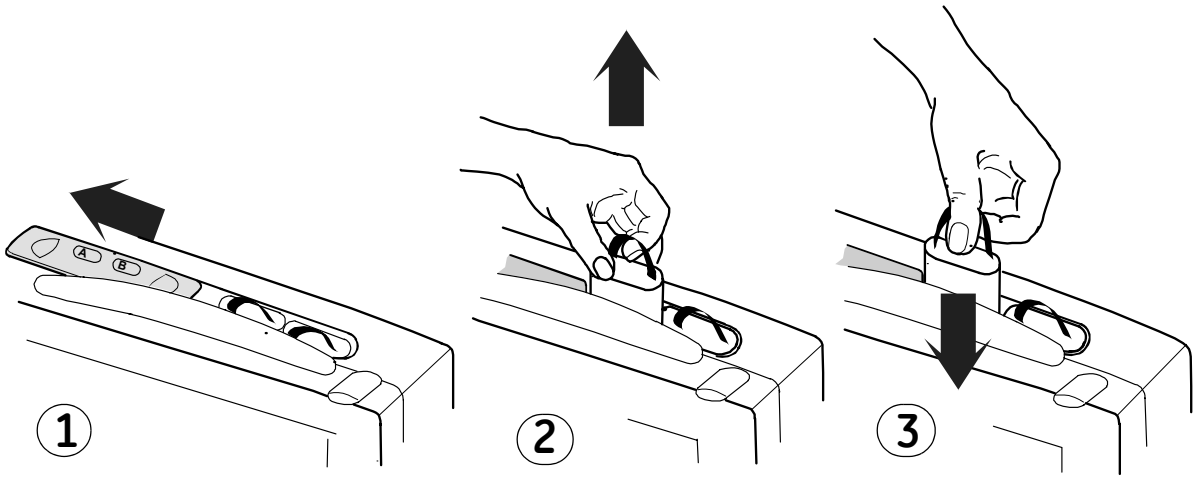


Figure 2-13 Inserting a battery

(1) Open the lid of the battery compartment located behind the handle by sliding it to the left.

(2) Lift up the battery you want to change. Check the indicators and messages on screen to make sure that you change the battery with lower charge.

(3) Push in the new battery. Make sure that the charging indicator is facing forward and push the battery down all the way. Check the monitor indicators.

CAUTION After replacing a battery, always make sure to close the battery compartment by sliding the lid back to the right until it clicks.

WARNING **Do not incinerate a battery or store at high temperatures as it will explode.**

Conditioning a battery

Batteries should be conditioned regularly to maintain their useful life. Condition a battery every six months, when its run time becomes noticeably shorter, or when the message 'Condition Battery x' appears on the screen. Conditioning a battery is best done on an external charger. Please, refer to instructions provided with the charger.

If you do not have an external charger, see section "Cleaning and care":"Conditioning a battery".

Symbols and abbreviations

Equipment safety symbols

- Attention, consult accompanying documents.
- On the modules or frames indicates that modules with identical measurements should not be used in the same monitor. If such modules have been inserted, remove the module that has been most recently connected. You can also remove both modules and re-connect the new module after five seconds.
- On the E-PSM(P)W module indicates that protection against cardiac defibrillator discharge is due in part to the accessories for pulse oximetry (SpO_2), temperature (T) and invasive pressure (P) measurement.
- On the N-FC(REC) module indicates that airway gases should be calibrated every six months in normal use and every two months in continuous use.
- On top of the monitor beside the battery cover: Use manufacturer recommended batteries only. Follow the regional regulations for disposal.
- On the rear panel this symbol indicates the following warnings and cautions:
  * Electric shock hazard. Do not open the cover or the back. Refer servicing to qualified service personnel.
  * For continued protection against fire hazard, replace the fuse only with one of the same type and rating.
  * Disconnect from the power supply before servicing.
  * Do not touch the monitor during defibrillation.
  * Do not use the monitor without manufacturer approved mounting attached.
  * Lithium battery on the CPU board: follow the regional regulations for disposal.
  * Use manufacturer recommended batteries only.

Type BF (IEC 60601-1) protection against electrical shock.

Type BF (IEC 60601-1) defibrillator-proof protection against electric shock.

Type CF (IEC 60601-1) protection against electric shock.

Type CF (IEC 60601-1) defibrillator-proof protection against electric shock.

When displayed in the upper left corner of the screen, indicates that the alarms are silenced. When displayed in the menu or digit fields, indicates that the alarm source has been turned off or alarm does not meet the alarm-specific activation criteria.

ESD warning symbol for electrostatic sensitive devices. Pins of connectors identified with the ESD warning symbol should not be touched. Connections should not be made to these connectors unless ESD precautionary procedures are used. For details, see "ESD precautionary procedures" page 1-2.

Symbol for non-ionizing electromagnetic radiation. Interference may occur in the vicinity of equipment marked with this symbol.

Other symbols

Equipotentiality. Monitor can be connected to potential equalization conductor.

Alternating current

Fuse. Replace the fuse only with one of the same type and rating.

SN

Serial Number

In the front panel: battery.

Battery operation and remaining capacity. The height of the green bar indicates the charging level.

Battery (A) charging (white bar)

Battery (A) failure

Both batteries have failed

Battery (A) is missing

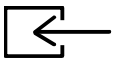
In the front panel: mains or external DC power

Submenu. Selecting an alternative marked with this symbol in a menu opens a new menu.

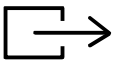
The monitor is connected to Network

A blinking heart next to the heart rate or pulse rate value indicates the beats detected.

A lung next to the respiration rate value indicates that respiration rate is calculated from the impedance respiration measurement.



Gas inlet



Gas outlet

Do not reuse.

Use by. Indicates the last use day.

Date of manufacture

Do not immerse the sensor in liquids.

This symbol indicates that the waste of electrical and electronic equipment must not be disposed as unsorted municipal waste and must be collected separately. Please contact an authorized representative of the manufacturer for information concerning the decommissioning of your equipment.

The separate collection symbol is affixed to a battery, or its packaging, to advise you that the battery must be recycled or disposed of in accordance with local or country laws. To minimize potential effects on the environment and human health, it is important that all marked batteries that you remove from the product are properly recycled or disposed. For information on how the battery may be safely removed from the device, please consult the service manual or equipment instructions. Information on the potential effects on the environment and human health of the substances used in batteries is available at this url: http://www.gehealthcare.com/euen/weeerecycling/index.html

This product consists of devices that may contain mercury, which must be recycled or disposed of in accordance with local, state, or country laws. (Within this system, the backlight lamps in the monitor display contain mercury.)

IPX class Degree of protection against harmful ingress of water as detailed in the IEC 60529:

IPX0	- Ordinary equipment
IPX1	- Protection against vertically falling water drops.
IPX2	- Protection against vertically falling water drops when enclosure tilted up to 15°.
IPX3	
IPX4	- Protected against spraying water.
IPX7	- Protected against splashing water.
IPX8	- Protected against the effects of temporary immersion in water. - Protected against the effects of continuous immersion in water.

Abbreviations

/min	beats per minute, breaths per minute
°C	Celsius degree
°F	Fahrenheit degree
µg	microgram
A	arm (describing location)
A	alveolar
a	arterial
a/AO_2	arterio-alveolar PO_2 ratio
$AaDO_2$	alveolo-arterial oxygen difference
AA	anesthetic agent
AAMI	Association for the Advancement of Medical Instrumentation
ABG	arterial blood gases
ABP	arterial pressure
ADU	Anesthesia Delivery Unit
AEP	auditory evoked potential
AirW	airway temperature
Alpha, Al	alpha frequency band
AM	Anesthesia Monitor
Amp	amplitude
Ant	anterior
APN	apnea
Arrh.	arrhythmia
Art	arterial pressure
ASY	asystole
ATMP	atmospheric pressure
ATPD	atmospheric/ambient temperature and pressure, dry gas
ATPS	ambient temperature and pressure, saturated gas
AV	atrioventricular
aVF	left foot augmented lead
avg	average
aVL	left arm augmented lead
aVR	right arm augmented lead
aw	airway
Axil	axillatory temperature
BAEP	brainstem auditory evoked potential
Bal	balance gas
bar	1 atmosphere
Beta, Be	beta frequency band
Bigem.	bigeminy
BIS	bispectral index
Blad	bladder temperature
Blood	blood temperature (C.O. measurement)

Body	body temperature
BP	blood pressure
Brady	bradycardia
BSA	body surface area
BSR	burst suppression ratio
B-to-B	beat-to-beat
BTPS	body temperature and pressure, saturated gas
c	calculated/derived value
C	chest
$C(a\text{-}v)O_2$	arteriovenous oxygen content difference
C.C.O.	continuous cardiac output
CFI	cardiac function index
C.I.	cardiac index
C.O.	cardiac output
cal.	calibration
Calc	calculated/derived value
Calcs	calculations
CAM	Compact Anesthesia Monitor
CaO_2	arterial oxygen content
Casc.	cascaded (ECG)
cc	cubic centimeter
CCCM	Compact Critical Care Monitor
CCM	Critical Care Monitor
CcO_2	capillary oxygen content
CCU	cardiac (coronary) care unit
CEL	Celsius degree
CFI	cardiac function index
CISPR	International Special Committee on Radio Interference
cmH_2O	centimeter of water
CMRR	common mode rejection ratio
CO	carbon monoxide
CO_2	carbon dioxide
COHb	carboxyhemoglobin
Compl	compliance
Cont.	continuous
Contrl	controlled ventilation
Core	core temperature
Count	count of responses
CPB	cardiopulmonary bypass
CPP	cerebral perfusion pressure
CSA	compressed spectral array
CT	computer tomography
CvO_2	(mixed) venous oxygen content

CVP	central venous pressure
d	day
dB	decibel
DBS	double burst stimulation (NMT)
DEL	delete
Delta, De	delta frequency band
depr.	depression
Des	desflurane
Dia	diastolic pressure
Diagn	diagnostic (ECG filter)
DIFF	difference
DIS	S/5 Device Interfacing Solution
DO_2	oxygen delivery
DO_2I	oxygen delivery index
DSC	digital signal converter
dyn	dynamic
e	estimated
ECG	electrocardiogram
ECG1	first ECG waveform (top)
ECG1/r	real-time ECG
ECG2	second ECG waveform
ECG3	third ECG waveform
ED	emergency department
EDV	end-diastolic volume
EDVI	end-diastolic volume index
EE	energy expenditure (kcal/24h)
EEG	electroencephalogram
EEG1	first EEG waveform
EEG2	second EEG waveform
EEG3	third EEG waveform
EEG4	fourth EEG waveform
EEMG	evoked electromyogram
EEtot	total energy expenditure
elect	electrode
elev.	elevation
EMC	electromagnetic compatibility
EMG	electromyogram
Enf	enflurane
Entr	entropy
EP	evoked potential
ESD	electrostatic discharge
Eso	esophageal temperature

ESV	end-systolic volume
ESVI	end-systolic volume index
ET, Et	end-tidal concentration
EtAA	end-tidal anesthetic agent
EtBal	end-tidal balance gas
$EtCO_2$	end-tidal carbon dioxide
EtN_2O	end-tidal nitrous oxide
EtO_2	end-tidal oxygen
ET-tube, ETT	endotracheal tube
EVLW	extravascular lung water
EVLWI	extravascular lung water index
Exp	expiratory
F	foot (describing location)
FAH	Fahrenheit degree
FEMG	frontal electromyogram
FFT	fast Fourier transform
FI, Fi	fraction of inspired gas
FiAA	fraction of inspired anesthetic agent
Fib	fibrillation
FiBal	fraction of inspired balance gas
$FiCO_2$	fraction of inspired carbon dioxide
FiN_2	fraction of inspired N_2
FiN_2O	fraction of inspired nitrous oxide
FiO_2	fraction of inspired oxygen
Flow	airway gas flow
Freq.	frequent
ft	foot, feet
FVloop	flow volume loop
G	Gauss
g	gram
GEDI	global enddiastolic volume index
GEDV	global enddiastolic volume
GEF	global ejection fraction
Graph.	graphical
h	hour
H	hand (describing location)
Hal	halothane
Hb	hemoglobin
Hbtot	total hemoglobin
HCO3-	bicarbonate
Hemo	hemodynamic

Hemo Calcs	hemodynamic calculations
HHb	reduced hemoglobin
HME	heat and moisture exchanger
HMEF	heat and moisture exchanger with filter
hPa	hectopascal
HR	heart rate
HRdiff	heart rate difference
ht	height
HW	hardware
Hz	hertz
IEC	International Electrotechnical Comission
I:E	inspiratory-expiratory ratio
IABP	intra-aortic balloon pump
IC	inspiratory capacity
ICP	intracranial pressure
ICU	intensive care unit
ID	identification
Imped.	impedance; impedance respiration
in	inch
Inf	inferior
Infl.	inflation (limit)
Insp	inspiratory
Inv.	invasive
Inv. BP	invasive blood pressure
Irreg.	irregular
Iso	isoflurane
ISO	International Standards Organisation
ISM	Industrial, Scientific and Medical
ITBV	intrathoracic blood volume
IVR	idioventricular rhythm
J	joule
K	kelvin
kcal	kilocalorie
kJ	kilojoule
kPa	kilopascal
L	leg (describing location)
L	left (describing location)
L, l	liter
l/min	liters/minute
Lab	laboratory
LAN	local area network
LAP	left atrial pressure

Lat	lateral
lb	pound
LCD	liquid crystal display
LCW	left cardiac work
LED	light emitting diode
LVEDP	left ventricular end diastolic pressure
LVEDV	left ventricular end diastolic volume
LVSW	left ventricular stroke work
LVSWI	left ventricular stroke work index
MAC	minimum alveolar concentration
Max	maximum
mbar	millibar
mcg	microgram
Mean	mean blood pressure
mEq	milliequivalent
MetHb	methemoglobin
MF	median frequency
mg	milligram
min	minute
Min	minimum
ml	milliliter
MLAEP	middle-latency auditory evoked potential
mmHg	millimeters of mercury
mol	mole
Monit	monitoring (ECG filter)
MRI	magnetic resonance imaging
Mult.	multiple
Multif. PVCs	multifocal PVCs
MV	minute volume
MVexp	expired minute volume (l/min)
MVexp(BTPS)	expired minute volume in BTPS conditions
MVexp(STPD)	expired minute volume in STPD conditions
MVinsp	inspired minute volume (l/min)
MVspont	spontaneous minute volume
Myo	myocardiac temperature
N	neutral
N_2	nitrogen
N_2O	nitrous oxide
Na	sodium
Naso	nasopharyngeal temperature
neo	neonate
Net	network

NIBP	non-invasive blood pressure
Ni-Cd	nickel-cadmium
Ni-MH	nickel-metal hydride
NMT	neuromuscular transmission
NO	nitric oxide
NTPD	normal temperature and pressure, dry gas
Num.	numerical
O_2	oxygen
O_2ER	oxygen extraction ratio
O_2Hb	oxygenated hemoglobin
OR	operation room
Oxy	oxygenation
Oxy Calcs	oxygenation calculations
P	partial pressure
P	pressure
P(BTPS)	pressure in BTPS conditions
P(g-a)CO_2	difference between gastrointestinal carbon dioxide and arterial blood carbon dioxide concentration
P(g-ET)CO_2	difference between gastrointestinal carbon dioxide and end tidal carbon dioxide concentration
P(STPD)	pressure in STPD conditions
P1, P2	invasive pressure channel identification on module
PA	pulmonary artery
Pa	Pascal (unit of pressure)
Paced	paced beats
$PaCO_2$	partial pressure of carbon dioxide in the arteries
PAO_2	partial pressure of oxygen in the alveoli
PaO_2	partial pressure of oxygen in the arteries
PAOP	pulmonary artery occlusion pressure
PA	pulmonary arterial pressure
Paw	airway pressure
Pbaro	barometric pressure
PCWP	pulmonary capillary wedge pressure
PE	polyethylene
pedi	pediatric
PEEP	positive end-expiratory pressure
PEEPe	extrinsic positive end expiratory pressure
PEEPe+i	total positive end expiratory pressure (ICU)
PEEPe+PEEPi	total positive end expiratory pressure (ICU)
PEEPi	intrinsic positive end expiratory pressure
PEEPtot	total positive end expiratory pressure (anesthesia)
$PgCO_2$	gastrointestinal carbon dioxide concentration

pH	pH
pHa	arterial pH
pHi	intramucosal pH
pHv	(mixed) venous pH
PIC	patient interface cable
Pleth	plethysmographic pulse waveform
PM	pacemaker
PM non-capt.	pacemaker non-capturing
PM non-funct.	pacemaker non-functioning
Pmax	maximum pressure
Pmean	mean pressure
Pmin	minimum pressure
Ppeak	peak pressure
Pplat	plateau (pause) pressure
PR	pulse rate
Prev.	previous
psi	pounds per square per inch
pt	patient
PTC	post tetanic count (NMT)
pts	patients
PVC	polyvinylchloride
PVC	premature ventricular contraction
PVloop	pressure volume loop
PvO_2	partial pressure of oxygen in (mixed) venous blood
PVR	pulmonary vascular resistance
PVRI	pulmonary vascular resistance index
Px	standard pressure label, x being 1, 2, 3, 4, 5, or 6
QRS	QRS complex
Qs/Qt	venous admixture
R	right (describing location)
RAP	right atrial pressure
Raw	airway resistance
RCW	right cardiac work
RCWI	right cardiac work index
RE	Response Entropy
Rect	rectal temperature
REF	right ventricular ejection fraction
ref.	reference
Resp	respiration rate (total) (set)
Resp Rate	respiration rate (total) (measured)
RF	radio frequency
RMS	average (root mean square) power

Room	room temperature
RQ	respiratory quotient
RR	respiration rate (total) (measured)
rtm	rhythm
RV	residual volume
RVEDV	right ventricular end-diastolic volume
RVESV	right ventricular end-systolic volume
RVP	right ventricular pressure
RVSW	right ventricular stroke work
RVSWI	right ventricular stroke work index
s	second
SA	sinoatrial
SaO_2	arterial oxygen saturation
S.A.R.	specific absorption rate
SD	standard deviation
SE	State Entropy
SEF	spectral edge frequency
SEMG	spontaneous electromyogram
Sev	sevoflurane
SI	stroke index
Skin	skin temperature
SN, S/N	serial number
Spiro	patient spirometry
SpO_2	oxygen saturation
Spont	spontaneous breathing
SQI	signal quality index
SR	suppression ratio
SR	sinus rhythm
SSEP	somatosensory evoked potentials
ST	single twitch (NMT)
ST	ST segment of electrocardiograph
stat	static
STAT	continuous NIBP cuff inflation for five minutes
STBY	standby
Stfilt	ST filter (ECG)
STPD	standard temperature and pressure, dry gas
Surf	surface temperature
SV	stroke volume
SVC	supraventricular contraction
SVI	stroke volume index
SvO_2	(mixed) venous oxygen saturation
SVR	systemic vascular resistance
SVRI	systemic vascular resistance index

SW	software
SVV	stroke volume variation
Sys	systolic pressure
t	time (min)
T	temperature
T	tesla
T(BTPS)	temperature in BTPS conditions
T1%	first stimulus as % of the reference value (NMT)
T1, T2	temperature channel identification on module
Tab.	tabular
Tachy	tachycardia
Tbl, Tblood	blood temperature
Tcorr	temperature correction
Temp	temperature
Theta, Th	theta frequency band
Tinj	injectate temperature
TOF	train of four (NMT)
TOF%	ratio of the 4th to the 1st response (NMT)
Trigem.	trigeminy
TV	tidal volume
TVexp	expired tidal volume (ml)
TVinsp	inspired tidal volume (ml)
Tx	temperature label, x being 1, 2, 3, or 4 or one of the other label choices
Tymp	tympanic temperature
v	venous
V	ventricular
V	volume
V/Q	ventilation/perfusion ratio
V0.5	volume expired during the first 0.5 seconds
V1.0	volume expired during the first second
VA	alveolar ventilation
VC	vital capacity
VCO_2	carbon dioxide production
Vd	dead space
Vd/Vt	dead space ventilation
Vent Calcs	ventilation calculations
VFib	ventricular fibrillation
VO_2	oxygen consumption
VO_2Calc	calculated oxygen consumption*
VO_2CalcI	calculated oxygen consumption index*
VO_2I	oxygen consumption index
Vol	volume

V Run	ventricular run
V Tachy	ventricular tachycardia
WLAN	wireless local area network
wt	weight
X	extreme
yr	year
yrs	years

* with Fick equation

Performance

WARNING **Operation of the monitor outside the specified values may cause inaccurate results.**

Any fluctuations within the specified limits do not affect the performance.

NOTE: Information in this section can be especially useful to clinicians.

Power supply

Rated voltages and frequencies:	100 to 240 V 50/60 Hz
Allowed voltage fluctuations:	±10 %
Maximum power consumption:	150 VA

Battery operation

Batteries:	Exchangeable lithium-ion, 2 pcs max.
Charging time:	2 hours per battery pack
Operation time:	up to 4.5 hours

Environmental conditions

Operating temperature:	
normal operation:	+5 to +40°C (41 to 104°F)
while charging batteries:	+5 to +35°C (41 to 95°F)
Storage and transport temperature:	-20 to +60°C (-4 to 140°F)
Relative humidity:	10 to 90 % noncondensing
Atmospheric pressure:	670 to 1060 mbar (500 to 800 mmHg)

Alarm behavior

The maximum alarm delay of the alarm at the monitor signal output to network: 5 seconds

If the alarm mode is latched, the technical alarms are latched as well. This does not comply with the NIBP (IEC 60601-2-30) and invasive pressure (IEC 60601-2-34) standard requirements.

Silencing alarms for 5 minutes does not comply with the SpO_2 (ISO 9919) standard requirements.

Defibrillator & IABP synchronization connector

Analog output

ECG:

From first user lead (ECG1)

Gain:	1 V/mV ±10%
Delay:	< 15 ms
DC offset:	±100 mV max.
Frequency response:	0.05 Hz to 40 Hz

Invasive blood pressure:

From pressure labeled 'Art'

Gain:	10 mV/mmHg ±2%
Delay:	< 35 ms
DC offset:	±20 mV max.
Frequency response:	DC to 30 Hz

The pacemaker pulses have been replaced with 2 ms ±20% fixed digital pulses at the ECG analog output.

A device that fulfils the requirements of the IEC 60601-1 standard can be connected to the defibrillator & IABP synchronization connector. There are no other limitations, because the signals of the connector are galvanically isolated from patient applied part of the ECG and invasive blood pressure measurements.

Synchronization pulse

Pulse width:	10 ms positive pulse
Delay:	< 35 ms (R-wave peak to leading edge of pulse)
Amplitude:	CMOS compatible
	3.5 V min. at 1 mA sourcing
	0.5 V max. at 5 mA sinking
Output impedance:	50 ohm
Current limit:	10 mA

Hemodynamic modules E-PSM, E-PSMP

ECG [1]

Filter modes:

With 50 Hz power supply frequency:

monitoring filter:	0.5 to 30 Hz
ST filter:	0.05 to 30Hz
diagnostic filter:	0.05 to 150 Hz

With 60 Hz power supply frequency:

monitoring filter:	0.5 to 40 Hz
ST filter:	0.05 to 40 Hz
diagnostic filter	0.05 to 150 Hz

QRS minimum detection level:

Minimum level 0.5 mV with duration between 40 and 120 ms.

Defibrillation protection:	5000 V, 360 J
Recovery time:	<5 s

Heart rate:

Measurement range:	30 to 250 bpm
Measurement accuracy:	±5 % or ±5 bpm

Displays average of 10-second median values[2]

Display update time:	1 s

Maximum response time of heart rate meter to change in heart rate:

Response time 80 to 120 bpm:	6.9 s
Response time 80 to 40bpm:	8.2 s

Maximum Tall T wave amplitude that does not disturb the heart rate calculation time: >1.4 mV

Input impendance: >2.5 Mohm

The heart rate calculation operates with irregular rhythms of IEC 60601-2-27 6.8.2 bb 4, the heart rate after a 20 second stablization period as follows:

Figure 101 A1): 80 bpm
Figure 101 A2): 59 bpm
Figure 101 A3): 122 bpm
Figure 101 A4): 117 bpm

Pacemaker pulse detection:

detection level:	2 to 700 mV
pulse duration:	0.5 to 2 ms

Pacemaker detector may not operate correctly during the use of high-frequency (HF) surgical equipment. The disturbances of HF surgical equipment typically cause false positive pacer detection.

Direct current for leads-off detection
through an active patient electrode: <30 nA

1 The isolation barrier capacitance in the module has been minimized to reduce the hazard of burns in the event of a defect in the ESU return electrode connection.

2 When the heart rate (HR) changes rapidly, the averaging is restarted.

Direct current for leads-off detection
through a reference electrode: <120 nA
The normalized respiration sensing current between RA (R) and LL (F)
or RA (R) and LA (L) or LA (L) and LL (L): <5.0 µA
Frequency of respiration sensing current: 31.25 kHz
Minimizing the effects of the line isolation monitor transients:

Crystal controlled oscillator used as the operating frequency source of the patient isolation power supply.

The average time and time range ( ) to alarm (VFib or VTachy) for tachycardia waveform
are as follows (IEC60601-2-27 6.8.2.bb.6):

Figure 101 B1 halved amplitude: 9.9 s (8.4 to 11.5 s)
Figure 101 B1 normal amplitude: 7.1 s (5.8 to 8.2 s)
Figure 101 B1 doubled amplitude: 4.4 s (4.2 to 4.6 s)
Figure 101 B2 halved amplitude: 7.0 s (6.1 to 7.5 s)
Figure 101 B2 normal amplitude: 5.8 s (4.5 to 7.4 s)
Figure 101 B2 doubled amplitude: 6.1 s (5.1 to 7.0 s)

A clinician should always confirm the rhythm from the ECG waveform.

Direct cardiac application

The display area reserved for the ECG measurement in the screen may not be adequate for displaying the complete ECG amplitude when measuring ECG direct from the surface of the heart. Clipping of the signal can be reduced by adjusting the size of the signal on the screen (for example, from the default 1.0 to 0.2) in the ECG menu.

Impedance respiration

Respiration range: 4 to 120 resp/min
Accuracy: ± 5% or ± 5 resp/min, whichever is greater

The conducted RF immunity of the respiration measurement has been tested with 1 Vrms. The radiated RF immunity of the respiration measurement has been tested with 1 V/m. The impedance respiration measurement technology has been optimized so that the measurement is not sensitive to electrosurgery equipment which is commonly used in the intended environment for the impedance respiration measurement.

NOTE: Impedance respiration measurement is intended for patients ages three years and up.

Invasive blood pressure[1] (E-PSMP module only)

Measurement range: -40 to 320 mmHg (-5.3 to 42.6 kPa)
Measurement accuracy: ±5 % or ±2 mmHg

Pulse rate:

Measurement range: 30 to 250 bpm
Accuracy: ±5 % or ±5 bpm

Transducer sensitivity: 5 µV/V/mmHg

1 The isolation barrier capacitance in the module has been minimized to reduce the hazard of burns in the event of a defect in the ESU return electrode connection.

Temperature[1]

Measurement range:	10 to 45 °C (50 to 113 °F)
Measurement accuracy:	±0.1 °C (25 to 45 °C)
Probe type:	Use only GE Healthcare temperature probes or defibrillator-proof YSI 400 series probes.
Temperature self-check:	At start-up and then every 10 minutes.

Time constant of temperature probes:

Reusable skin temperature probe:	3 s
Reusable adult central temperature probe:	6 s
Reusable pediatric central temperature probe:	4 s
Disposable skin temperature probe:	3 to 6 s
Disposable central temperature probe, 12F:	5 to 8 s
Disposable central temperature probe, 9F:	5 to 8 s

NIBP

Measurement range:	adult 25 to 260 mmHg (3.3 to 34.7 kPa) child 25 to 190 mmHg (3.3 to 25.3 kPa) infant 15 to 140 mmHg (2.0 to 18.7 kPa)
Typical measuring time:	adult less than 30 s, infant less than 25 s
Overall system accuracy:	Meets or exceeds SP10-2002 AAMI standards[2]

The ESU does not cause a burn hazard through the NIBP cuff, because there is no electrical connection between the cuff and the NIBP measuring electronics.

NOTE: NIBP measurement is intended for patients who weigh 5 kg (11 lb) and up.

NOTE: The cuff pressure measurement range is equal to cuff nominal and cuff indication ranges.

Pulse oximetry

SpO_2[1]

Automatic scaling of plethysmographic waveform.

Measurement and display range:	0 to 100 %
Calibration range:	70 to 100 %

Calibrated against functional oxygen saturation.

Measurement accuracy [3] :	100 to 70 %, ±2 digits 69 to 0 %, unspecified
Display resolution:	1 digit (1% of SpO_2)

Wavelength of SpO_2 probe LEDs:

Infrared LED	940 nm
Red LED	660 nm

Maximum energy of SpO_2 probe LEDs:

Infrared LED	42 µJ/pulse
Red LED	62 µJ/pulse

Pulse rate:

Measurement and display range:	30 to 250 bpm
Measurement accuracy[4]:	±5 % or ±5 bpm, whichever is greater

1 The isolation barrier capacitance in the module has been minimized to reduce the hazard of burns in the event of a defect in the ESU return electrode connection.

2 According to SP10-2002 AAMI 4.4.5.2.B, Intra-arterial method as the reference standard, mean difference of the test system and the comparison system shall be ± 5 mmHg or less with standard deviation of 8 mmHg or less

3 Accuracy is based on deep hypoxia studies with volunteered subjects during motion and non-motion conditions over a wide range of arterial blood oxygen saturations as compared to arterial blood CO-Oximetry. Accuracy may depend on the sensor used, please refer to the instructions for use in the accessory package. The accuracy is expressed as rms. This means that approximately two-thirds of the data will fall within the accuracy range.

Default alarm limits [1]:

SpO_2 high Off, low 90%

PR high 160, low 40

NOTE: For each SpO_2 accessory, refer to the instructions for use in the accessory package for patient weight limits and accuracy.

Modules with CO_2 measurement, N-FC and N-FCREC

Sampling rate:	150 ±25 ml/min (sampling line 2 to 3 m, normal conditions)
Maximum sampling line length:	6 m
Sampling delay:	2.1 s typical with a 3-m sampling line
Total system response time:	2.4 seconds typical with a 3-m sampling line, including sampling delay and rise time (typically 3.7 seconds with a 6-m sampling line)
Warm-up time:	1 min for operation, 30 min for full specification
Autozeroing interval:	4, 15, 30 and 60 minutes after start-up, then every 60 minutes

Automatic compensation for barometric pressure.

Gas values are measured in ATPD conditions (ambient temperature and pressure, dry). When CO2 is displayed as a partial pressure (kPa, mmHg), the value can be alternatively shown as wet (BTPS, body temperature and pressure saturated).

Non-disturbing gases are those with a maximum effect on the CO_2 reading at 5.0 vol% < 0.2 vol%. The effect is valid for specific concentrations shown in parentheses of the non-disturbing gas:

Ethanol C_2H_5OH (<0.3%)

Acetone (<0.1%)

Methane CH_4(<0.2%)

Nitrogen N_2(0 to 100%)

water vapor (0 to 100%)

Dichlorofluoromethane (<1%)

Tetrafluoroethane (<1%)

Disturbing gases and their effect on the CO_2 reading at 5.0 vol-% CO_2 are shown below. Errors listed reflect the effect of specific concentrations (shown in parentheses) of an individual disturbing gas and should be combined when estimating the effect of gas mixtures:

Halothane (4%) increases < 0.3 vol%

Isoflurane(5%) increases < 0.4 vol%

Enflurane(5%) increases < 0.4 vol%

Desflurane(24%) increases < 1.2 vol%

Sevoflurane(6%) increases < 0.4 vol%

Helium (50%) decreases < 0.3 vol%

If O_2 compensation is not activated:	O_2 (40 to 95%) decreases < 0.3 vol%
If O_2 compensation is activated:	O_2 (40 to 95%) error < 0.15 vol%
If N_2O compensation is not activated:	N_2O (40%) decreases < 0.4 vol%
If N_2O compensation is activated:	N_2O (40 to 80%) error < 0.3 vol%

4 The reported SpO_2 pulse rate accuracy is the product specification. SpO_2 pulse rate accuracy tests with a simulator yielded a PR error of less than 2 bpm (rms) over the whole measurement range.

1 Limits are adjustable: OFF to 51% for SpO_2 high
50 to 100% for SpO_2 low
250 to 35 bpm for PR high
30 to 245 bpm for PR low

Default alarm limits [1]:

$EtCO_2$ high 8%, low 3%

$FiCO_2$ high 3%, low Off

Carbon dioxide (CO_2)

Measurement range:		0 to 20 vol %
Resolution:		0.01%
Measurement rise time:		< 300 ms with nominal flow
Accuracy:	0 to 15 vol%	± (0.2 vol % + 2% of reading)
	15 to 20 vol%	± (0.7 vol % + 2% of reading)

Valid for respiration rate < 40 1/min at I:E ratio of 1:1. (Relative error is typically 10% for respiration rate 80 1/min at I:E ratio of 1:1.) The accuracy is specified in simulated ventilation. With higher respiration rates and with varying ventilation methods the specifications may not be met.

Respiration rate

Breath detection:	1% change in CO_2 level
Measurement range:	4 to 80 breaths/min
Accuracy:	±1 breath/min in the range 4 to 20 breath/min, ±5% in the range 20 to 80 breath/min
Resolution:	1 breath/min

NOTE: CO_2 measurement is intended for patients who weigh over 5 kg (11 lb).

Modules with recorder, N-FREC and N-FCREC

Power consumption	3 W
Recorder type:	Thermal array
Print resolution:	vertical 8 dots/mm horizontal 24 dots/mm
Paper width:	50 mm, printing width 48 mm
Traces:	Selectable 1, 2 or 3 waveforms
Print speed:	1, 6.25, 12.5, 25 mm/s

1 Alarm limits and their adjustment range may vary depending on the mode used.

Table of contents

3 Monitoring basic

Principles

You can control monitoring of the B30 patient monitor through the keys on the Command Board, side panel and modules.

Module keys and side panel keys control a set of the most often used functions while the Command Board keys give access to all functions.

Modules and module Keys

The module keys start or end a function immediately. They are designed to make the most common monitoring tasks easier and quicker to use.

The accessories have to be plugged to the respective module before module keys become operative.

Refer to "System description" on page 2-1 for detail modules and keyboards instructions.

Using menus

A menu is a list of functions or commands displayed on the monitor screen.

To display a menu, press one of the Command Board keys.

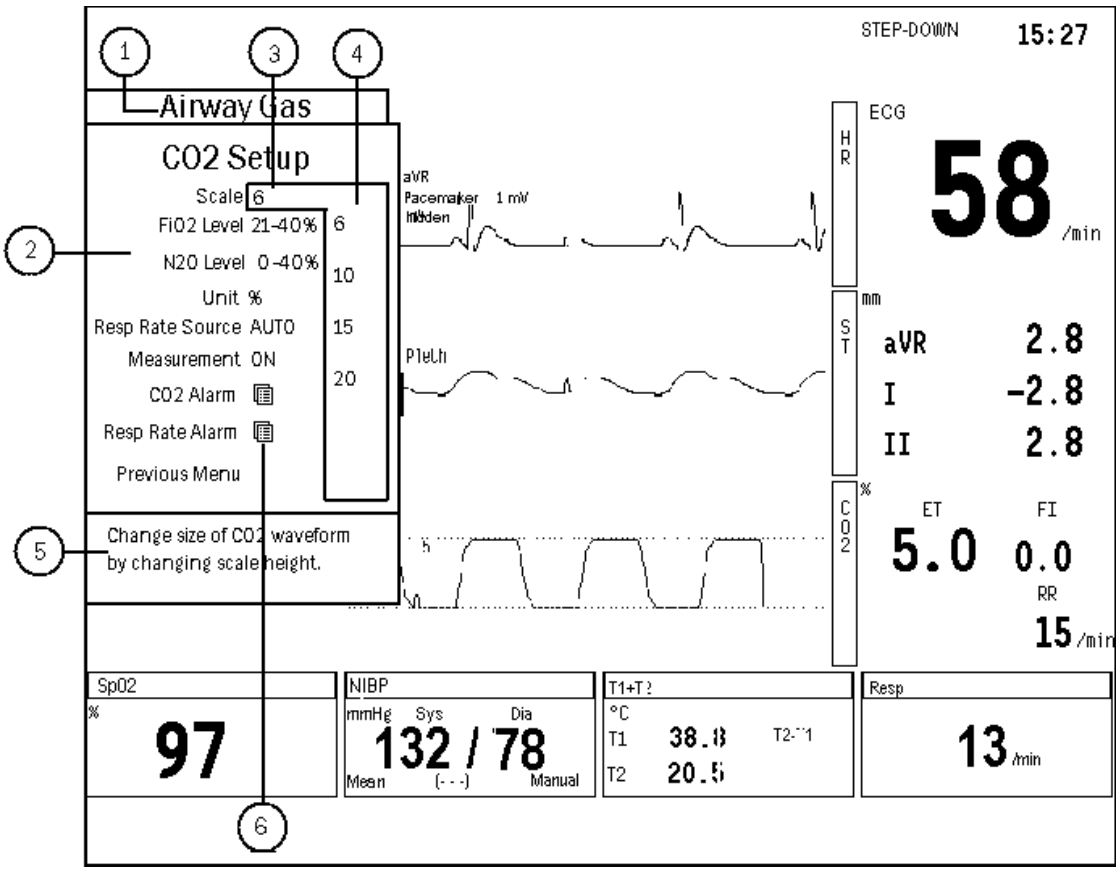
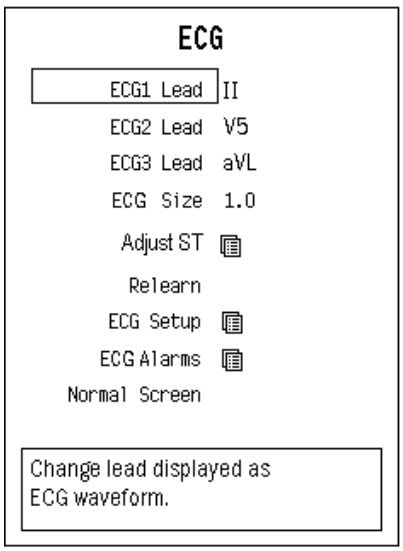


Figure 3-1 Example of a menu

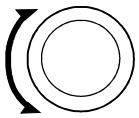
(1) Menu header
(2) List of menu selections
(3) Indicates the present selection
(4) Adjustment window with other options
(5) Short instructions
(6) Entry indicator to submenus

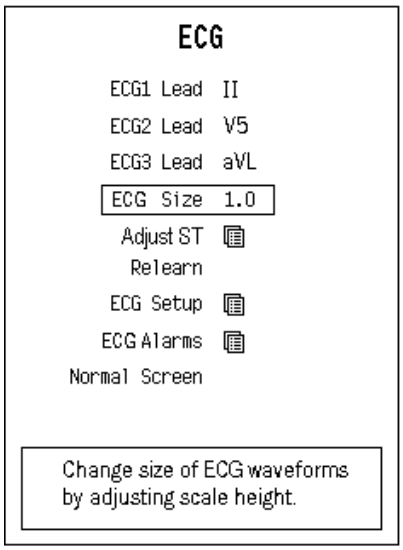
Select items in the menus with the ComWheel. For example, to change what is displayed in the ECG display:

Select the desired function by pressing the menu key.

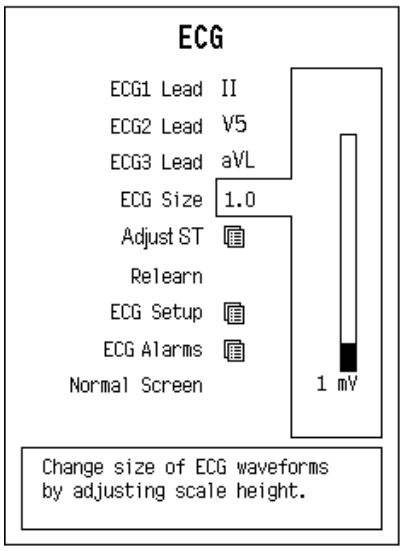


Turn the ComWheel to move the highlight down in the menu to the desired selection.

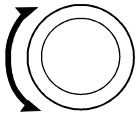




Push the ComWheel to enter an adjustment window or a submenu



Turn the ComWheel to choose the desired option or selection in the window.



Push the ComWheel to confirm the selection.

Press the **Normal Screen** key to return to normal monitoring display.

Submenus are indicated by a symbol  . They function just like the main menus and contain less frequently used functions.

Starting and ending

WARNING **Always make sure that necessary alarm limits are active and set according to the patient's clinical condition when you start monitoring a patient.**

WARNING **After transferring or reinstalling the monitor, always check that it is properly connected and all parts are securely attached. Pay special attention to this in case of stacked mounting.**

WARNING **Do not use the monitor without manufacturer approved mounting attached.**

WARNING **If you accidentally drop the monitor or modules, have them checked by authorized service personnel prior to clinical use.**

Preparations

1. Check that the monitor, accessories and monitor parts are clean and intact.
2. Plug in the desired measurement modules.
3. Turn on the monitor from the ON/standby key. The monitor performs a self-test to ensure correct functioning.
4. If necessary, change the user mode:
   – Press the **Admit/Discharge** key and select ***Select Mode***.

The mode defines what is displayed on screen and in the trends. Note that changing the mode also changes settings such as alarm limits.

The monitor automatically reconfigures the display when modules are inserted. Reconfiguration of the display may take up to 5 seconds.

Starting monitoring

1. Prepare the patient connections according to the setup picture in the measurement section.
   Use only approved supplies and accessories, see the “Supplies and Accessories” catalog.
   The alarms and parameter default settings become active.
2. Check that you have the desired waveforms and digits in the fields. If necessary, adjust the selections:
   – Press the **Monitor Setup** key.
   – Select ***Screen Setup.***
   – Select ***Waveform Fields*** or ***Digit Fields***.
3. Zero invasive blood pressure lines.
4. Check the alarm limits.
   – Press the **Alarms Setup** side panel key.
   The alarms are operative and the parameter default settings are active when the patient is connected to the monitor.
5. Start the measurement according to the instructions in the measurement section.
   For example, zero the invasive pressure channels by pressing the **Zero Px** module keys, and start NIBP measurement to get reference values.
6. Enter or load patient data, see next page.

Entering and loading patient data

Press the **Admit/Discharge** key and do one of the following:

– To continue with a patient already admitted on the same monitor, select ***Contin. Previous***.

– To admit a new patient, select ***Admit Patient***.

The patient admission also happens automatically when the monitor receives vital signs.

Always observe the monitor and the patient carefully during start-up periods and when inserting modules.

During monitoring

- If you need to avoid audible alarms, press the **Silence Alarms** key.
- Empty the water trap container of the N-FCREC or N-FC module whenever it is more than half full.

Automatic discharge of the patient

The monitor will discharge a patient automatically after 24 hours when vital signs for some parameters (ECG, Art, NIBP, SpO_2, Resp and CO_2 (with N-FCREC and N-FC only)) are not available. When this happens, all trend data will be cleared and alarm limits will be set to default values.

Ending monitoring

1. Print necessary data.
   – Press the **Print/Record** key.
2. Wait until the printing is finished. Then clear patient data and return settings, including alarm limits, to their defaults by discharging the patient:
   – Press the **Admit/Discharge** key.
   – Select ***Discharge*** and ***Yes***.
3. Turn off the monitor from the ON/standby key if the monitor will not be used.
4. Clean the monitor according to the instructions, see section "Cleaning and care."

Using modes

The B30 monitor has six user modes. These user modes are predefined combinations of settings. They determine, for example, what is displayed on the screen and in trends and what the alarm limits are. In other words, by choosing a specific mode you get suitable settings on the screen without having to choose all features one by one.

Modes can be hospital specific. The monitor starts in start-up modes, which is one of the user modes chosen during configuration. The default modes are ***STEP-DOWN, ED, PACU, CCU, NEURO*** and ***PEDIATRIC.*** Please refer to the "Default Configuration Worksheet" delivered with the monitor for more information.

For more information about the installation settings and using modes, see section "Monitor setup."

Setup monitor before use

For more information about the how to setup monitor, see section "Monitor setup."

Table of contents

4 Alarms

Overview

When an alarm for the monitored parameter becomes active:

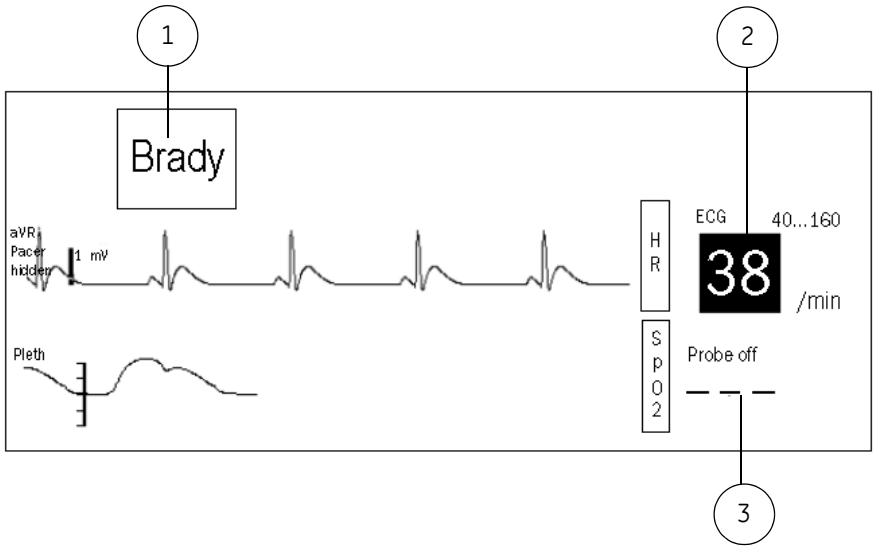


Figure 4-1 View of alarms

(1) Alarm messages appear in the message field in the order of priority.

(2) The measurement value flashes. The color (red, yellow) indicates the alarm category (high priority, medium priority). If the alarm is a low priority (white) note, the measurement value is not flashing.

(3) In some cases a message in the digit or waveform field gives more detailed information using the color of the parameter.

An audible alarm is also triggered, and the alarm LEDs on the monitor side panel indicate the alarm level. If enabled, also the alarm light flashes red (high priority) or yellow (medium priority) according to alarm levels. Refer to “Default Configuration Worksheet“ for more information about priorities and escalating.

Points to note

WARNING **When the alarms are silenced, observe the patient frequently.**

WARNING **Always make sure that the audio alarm volume level is adequate in your care environment.**

Alarm indications

- When the monitor is turned on, you will hear a beep: this tells you that the alarm audio signal is working. Also the alarm LED indicators are lit up for a few seconds. To check them, see section "Functioning of the alarms." You can also check the functioning of the audio signal and alarm light through **Alarms Setup - *Alarm Volume*** or ***Alarm Light***.
- If alarms are turned off and a power interruption occurs when there is no battery backup, or if the monitor is turned off for up to 15 minutes, check the alarm status before you start monitoring again.
- If the monitor is connected to the network, the alarms can be heard and seen on the Central as well. Please, consult the "iCentral User's Reference Manual: Alarms" for details.
- If the monitor is connected to the network, the alarms can also be silenced using the Central if this feature has been enabled in Central configuration.

Alarm categories

The alarms are classified into three categories according to the priority: HIGH PRIORITY/RED ALARM, MEDIUM PRIORITY/YELLOW ALARM, and LOW PRIORITY/WHITE NOTE (white color).

NOTE: Asystole and ventricular fibrillation alarms are always high priority alarms.

The priority of an alarm depends primarily on the cause and the duration (generally minimum 20 seconds) of the alarm condition, the priority increasing with the duration and according to the physiological significance. Thus, for example, brady advances rapidly to high priority, whereas apnea is allowed a slightly longer duration.

The monitor has three options for alarm tones and patterns: ISO, ISO2, and General. The ISO2 and ISO patterns are very similar. The difference is the rising sound of the tone pattern. The following frame colors and tones identify the alarm categories:

Table 4-1 ISO pattern

Visual	Tone pattern	Meaning	Side panel LEDs	Alarm light (if enable)
Red	Rising triple + double beep every 5 seconds (except the second tone pattern which is produced 1 second after the first one) -- 5 -- 5 --	For life threatening situations. High priority alarm.	red LED flashing	flashing red
Yellow	Triple beep every 19 seconds -- 19 -- 19 --	For serious but not life threatening problems. Medium priority alarm.	yellow LED flashing	flashing yellow
White	Single beep -	Advisory note. It may be equipment related like 'Leads off'. Low priority alarm.	yellow LED lit	lit yellow

Table 4-2 ISO2 pattern

Visual	Tone pattern	Meaning
Red	Rising triple + double beep every 5 seconds (except the second tone pattern which is produced 1 second after the first one) _–– ––5 _–– ––5	For life threatening situations. High priority alarm.
Yellow	Triple beep every 19.5 seconds _–– 19,5 _–– 19,5 _––	For serious but not life threatening problems. Medium priority alarm.
White	Single beep -	Advisory note. It may be equipment related like 'Leads off'. Low priority alarm.

Table 4-3 General pattern

Visual	Tone pattern	Meaning
Red	Continuous beep	For life threatening situations. High priority alarm.
Yellow	Double beep every 5 seconds -- 5 -- 5 --	For serious but not life threatening problems. Medium priority alarm.
White	Single beep -	Advisory note. It may be equipment related like 'Leads off'. Low priority alarm.

There is also a sound for catastrophic situations: you hear continuous beep if the FiO_2 is less than 18%, or Ppeak is high.

Alarm LED indicators

The B30 has several alarm indicators. There are two LEDs, red and yellow, in the side panel beside the **Silence Alarms** key. For their functioning, see page 4-3. These indicators can be disabled.

Alarm light

In addition to the audible and LED indications, the B30 has an alarm light, located in the upper right corner of the monitor frame. The alarm light can be enabled (default) or disabled, see "Other adjustable features" on page 4-13. When enabled, it flashes red (high priority) or yellow (medium priority) according to the currently active highest priority alarm. You can adjust the brightness of the light in the range 5 to 100 %. To adjust the brightness of the light:

1. Press the **Alarms Setup** key.
2. Select ***Alarm Light*** and adjust with the ComWheel. During adjustment the red light is on to help you determine a suitable brightness level.

Alarm activation

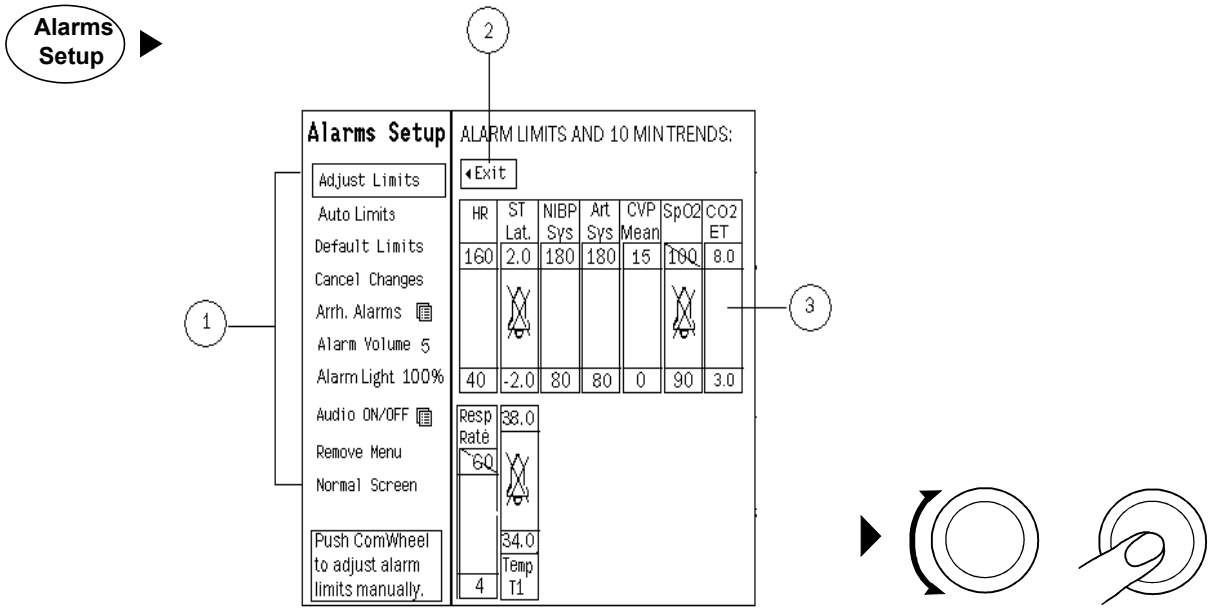
To enable the alarms, connect patient cables. If the alarm source is selected, the alarms are active also when the measurement is not displayed (except the impedance respiration alarms). When an alarm becomes active, messages appear in order of priority. See default settings presented in the "Default Configuration Worksheet."

Individual alarms have their own specific requirements before they become active, for example:

– Apnea requires five breaths to be activated.
– Invasive pressures need to be within alarm limits for 20 seconds after zeroing.

Alarms Setup menu

You can view and adjust patient alarm limits in the ***Alarms Setup*** menu.



(1) List of selections

(2) ***Exit*** from the alarm limit adjustment area back to ***Alarms Setup*** menu

(3) Parameter box with high and low limit values and a 10-minute trend showing the current status

Adjust Limits Adjusts individual measurement alarm limits. You can also access the adjustment menu through each parameter menu.

NOTE: If the monitor is connected to the network, the alarm limits can also be changed using the Central if this feature has been enabled in its configuration.

Auto Limits Auto limits are calculated from the displayed patient reading at the time when auto limits are selected.

Default Limits Sets the alarms to the default alarm limits.

NOTE: Default limits can be changed and saved to modes. For more information, see the "Default Configuration Worksheet."

Cancel Changes Returns all the limits to the ones set before entering the ***Alarms Setup*** menu if you have not exited the menu yet.

Arrh. Alarms Opens a menu to select and adjust ***Severe*** arrhythmia analysis. Alarm priorities can be configured in this menu.

Adjust = defines the alarm priorities (red, yellow, white, off).

NOTE: You can only set the priority for V Tachy.

NOTE: V Tachy alarm cannot be selected OFF.

NOTE: Alarm priorities can also be set using the Central, depending on its configuration.

To redisplay the ***Alarms Setup*** menu, select ***Alarms Setup***.

For more information on arrhythmia alarms, please see section "ECG."

Alarm Volume Adjusts the volume of the audio alarms. The range is from 1 (soft) to 10 (loud).

NOTE: Audible alarms cannot be totally silenced with the ***Alarm Volume*** function.

Alarm Light

Adjusts the brightness of the alarm light if the light has been enabled (default) through **Monitor Setup** - ***Install/Service - Installation - Alarm Options - Alarm Light- YES***. The range is from 5 to 100%. The light is on during the adjustment to help determine a suitable brightness.

Audio ON/OFF Opens a menu to select ***Silence Apnea***, ***Silence ECG***, ***Silence Apn & ECG*** or ***Silence All***.

NOTE: The silencing selections that is, all other selections than the ***Activate Alarms***) are available only if alarm silencing has been enabled by selecting **Monitor Setup** - ***Install/ Service - Installation - Alarm Options - Show Audio ON/OFF - Yes***. By default, it is disabled. For more details, see "Enabling or disabling alarm silencing" page 4-14.

Activate Alarms = Activates silenced alarms. This selection is always available for activating alarms that have been permanently silenced using the Central.

Silence Apn = Silences apnea and disconnection alarms as well as CO_2, respiration rate.

Silence ECG = Silences arrhythmia alarms and also HR limit alarms.

Silence Apn & ECG = Silences both of above.

Silence ALL = Silences permanently all alarms except FiO_2<18%, Ppeak >70 cmH_2O.

Remove Menu Clears the menu selections from the display so that only 10 minute trends and limits are displayed (push the ComWheel to return the selections on the screen).

Adjusting alarm limits

Adjusting limits

1. Press the **Alarms Setup** side panel key.
2. Select ***Adjust Limits***.
3. Turn the ComWheel to highlight the measurement. If the desired measurement is not displayed in the window, select ***Next Page***.
4. Push the ComWheel to open an adjustment window.
5. Turn the ComWheel to change the limits and accept them by pushing it. Move between selections by turning the ComWheel.
6. To return to the ***Alarms Setup*** menu to select more measurements, push the ComWheel until the cursor is in the adjustment menu, then select ***Previous Menu*** or ***Alarms Setup***.
7. Press the **Normal Screen** key to return to normal monitoring view.

You can enter the alarm limit adjustment window also through the measurement menus. When you are in an XX parameter menu, select ***XX Alarm*** or enter ***XX Setup*** and then select ***XX Alarm***.

NOTES:

- ST high/low alarms will reach the white (low priority) level only.
- In NIBP measurement, the alarm limits change automatically according to the cuff hose type used.
- If the monitor is connected to the network, the alarm limits can also be adjusted using the Central if this feature has been enabled in its configuration. If alarm limits are adjusted using the Central, the message 'Alarm settings changed from Central' is displayed in the bedside monitor.

Choosing automatic limits

To activate automatic patient-specific alarm limits enabling close patient control, select *Auto Limits* in the *Alarms Setup* menu. Limits are then calculated from the displayed patient reading at the point of time when auto limits are selected.

Returning to default limits

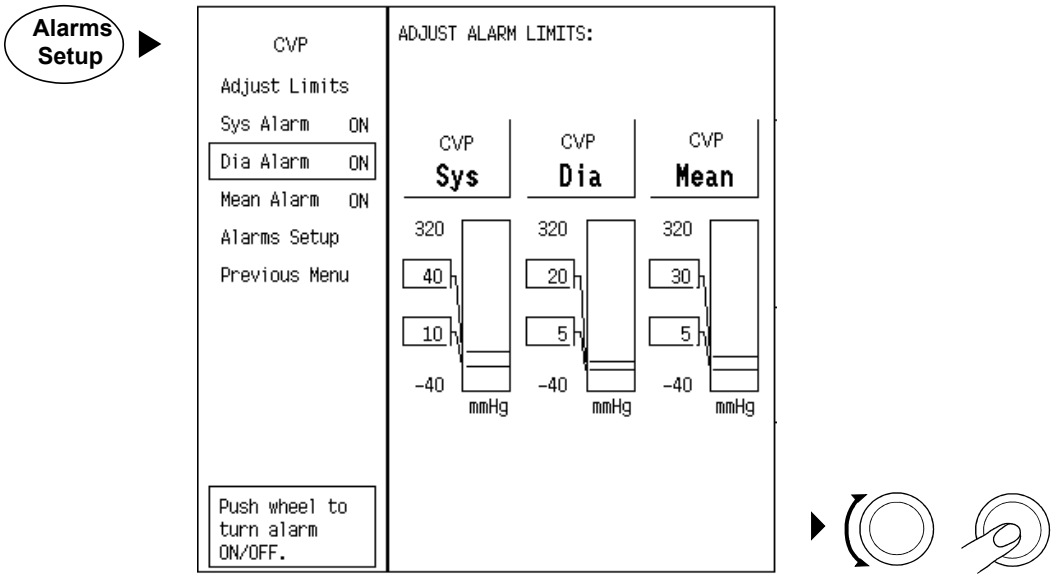
Select *Default Limits* to set the alarms to the default alarm limits. The factory default alarm limits are listed in the "Default Configuration Worksheet."

Changing alarm sources

For NIBP, P1 and P2 (with E-PSMPW), you can select which measured values trigger the alarm. One or several alarm sources may be active at a time.

Parameters	Alarm triggered off by
Blood pressure (NIBP, P1, P2)	Systolic, diastolic and/or mean pressure or off (with off, there is no 10 minute trend on display)

1. Press the **Alarms Setup** side panel key.
2. Select ***Adjust Limits***.
3. Select the measurement. If the desired measurement is not displayed, select ***Next Page***.
4. Push the ComWheel. An adjustment window is displayed.
5. In the adjustment window, turn the ComWheel to get from the limit setting to the menu selections.
6. Select ***X Alarm*** and push the ComWheel to change the selection ***OFF*** or ***ON.***



Silencing alarms

Silencing audible alarms temporarily

NOTES:

- The bedside alarms can also be silenced and acknowledged from the Central if this feature has been enabled in the Central configuration. In this case, the message 'Alarms silenced from Central' or 'Alarms acknowledged from Central' is displayed on the bedside monitor display.
- If the monitor is connected to the network and the network connection is lost, the silenced alarms are reactivated and the volume level is automatically set to 7.

Pressing the Silence Alarms key once

- To silence all alarms for two minutes, press the **Silence Alarms** side panel key once.
- To silence all alarms for five minutes, keep the **Silence Alarms** key pressed for more than five seconds.

NOTE: NOTE: FiO_2<18%, high Ppeak alarms are always silenced only for 20 seconds.

Pressing the **Silence Alarms** key once silences the alarms that are currently active, and presilences the upcoming alarms of other measurements. If the alarms are not active when you press the **Silence Alarms** key, they are pre-silenced for 2 or 5 minutes.

The crossed bell symbol with a countdown timer is displayed in the upper left hand corner of the screen to indicate that the alarms are silenced, and the message field is cleared of all the previous alarm and note messages. The visual alarms in the digit and waveform fields remain as long as they are valid. During silencing, all new alarms for the same reason and all alarms for a different reason are indicated visually. Apnea alarms are activated after five breaths.

Pressing the Silence Alarms key twice

- To silence an individual alarm that is currently active, press the **Silence Alarms** key twice. This does not pre-silence the upcoming alarms.

The message 'Alarms acknowledged' is displayed to indicate that the alarms that were silenced by pressing the **Silence Alarms** key twice remain silent, whereas other upcoming alarms will have an audible sound.

Reactivating alarms

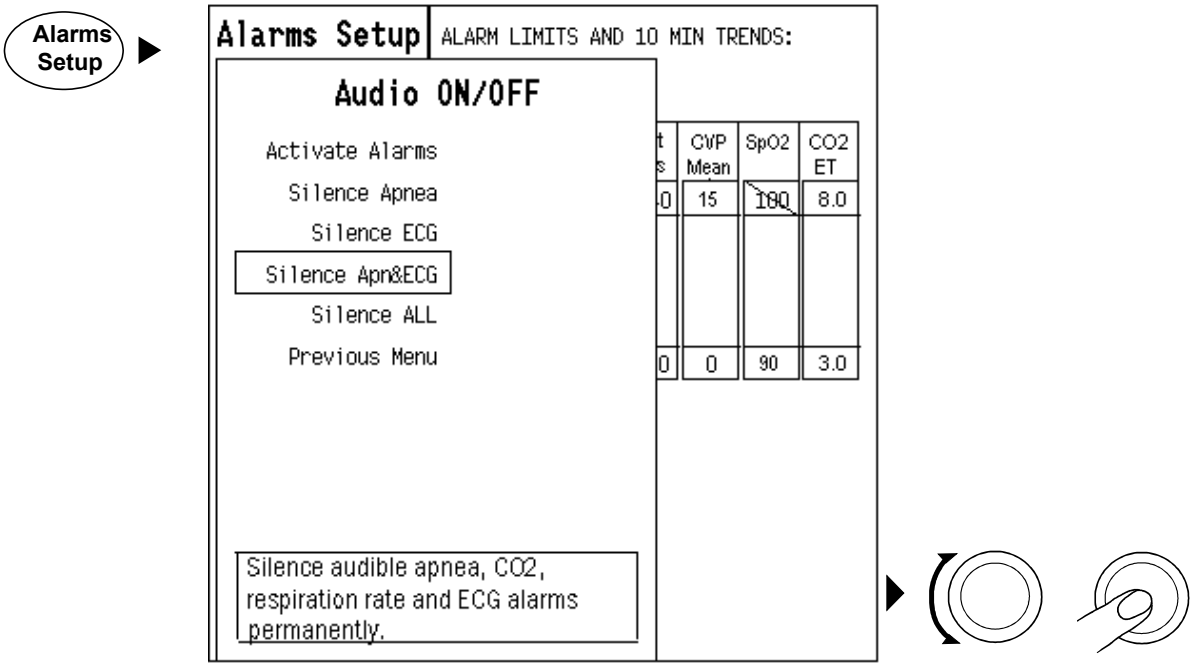
You can reactivate the alarm sounds of new upcoming alarms by pressing the **Silence Alarms** key once again during the silencing period. The alarms that were active when the key was first pressed will not sound before the original silencing period is over.

Silencing audible alarms permanently

Silencing certain audible alarms entirely may be desirable for special cases.

NOTES:

- The following silencing selections (that is, all other selections than ***Activate Alarms*** are available only if alarm silencing has been enabled (**Monitor Setup** - ***Install/Service - Installation - Alarm Options - Show Audio ON/OFF - Yes***). By default, it is disabled. You need a password to enter the ***Install/Service*** menu. (For details, see "Changing alarm options" page 5-4.)
- If the monitor is connected to the network, the bedside alarms can also be silenced using the Central if this feature has been enabled in its configuration.



Select one of the following:

- ***Silence Apnea*** = Silences apnea and disconnection alarms as well as CO_2, respiration rate, low Ppeak, PEEP, and minute volume limit alarms permanently.
- ***Silence ECG*** = Silences arrhythmia alarms and also HR limit alarms.
- ***Silence Apn & ECG*** = Silences both of the above.
- ***Silence ALL*** = Silences permanently all alarms except FiO_2<18%, Ppeak >70 cmH_2O.

Selecting a choice displays a warning symbol, for example 

.

If an active alarm is silenced, the monitor gives a reminder beep every two minutes. You can adjust the volume of the reminder beep through **Monitor Setup** - ***Install/Service*** - ***Installation*** - ***Alarm Options*** - ***Reminder Volume*** (a password is required for this operation). For more information, see "Reminder volume" page 4-16.

Reactivating alarms

- Select **Alarms Setup** - ***Audio ON/OFF - Activate Alarms*** to turn on audible alarms.

Deactivating alarms

You can set the alarm limits temporarily to OFF for the following parameters: HR, SpO_2 and respiration rate. This way, you can silence a parameter without having to adjust the alarm limits.

1. Press the **Alarms Setup** key.
2. Select ***Adjust Limits***.
3. Turn the ComWheel to highlight the measurement.
4. and push the ComWheel to change the selection ***Off***.

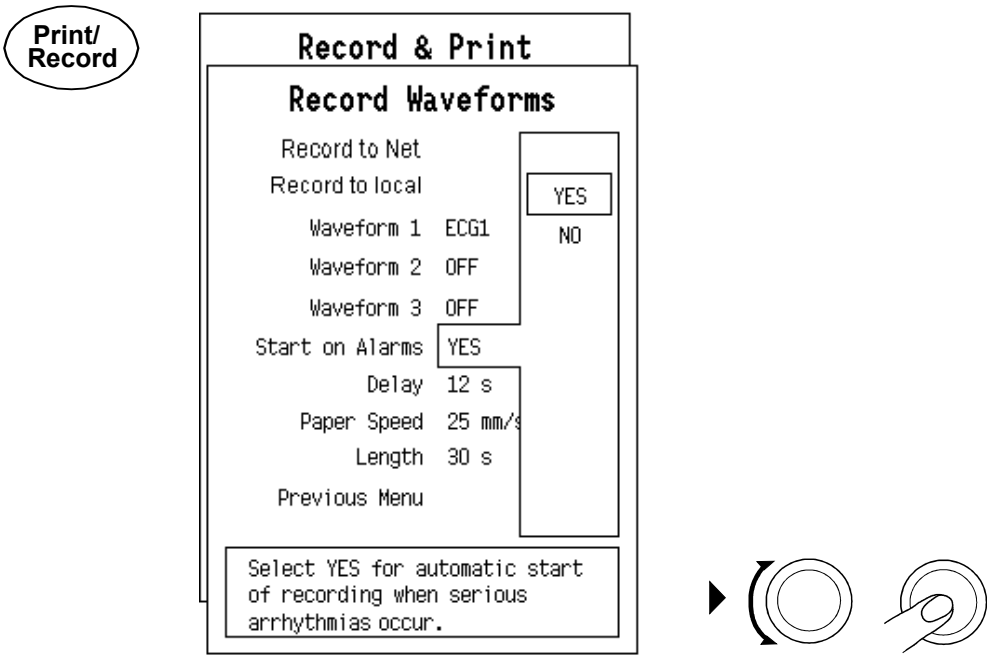
The symbol  appears in the digit field.

When you select the alarm limit ON again, the previous alarm limits will be active.

Automatic recording on alarms

An automatic local recording is possible when Asystole, Tachy/Brady, Art High/Low, V Fib or V Tachy alarms reach the red alarm level. When the red alarm level is reached, the recorder prints the ECG + Art waveforms.

1. Press the **Print/Record** key.
2. Select ***Record Waveforms***.
3. Select ***Start on Alarms*** and ***Yes***.



Recording time is 30 seconds consisting of 12 seconds recording from the recorder memory and 18 seconds real-time recording. The alarm source is always marked to the alarm recordings. The following alarms start the recording:

Alarm	Recorded parameters
Asystole	ECG1 + Art waveforms, 25 mm/s
Tachy/Brady	ECG1 + Art waveforms, 25 mm/s
Art High/Low	ECG1 + Art waveforms, 25 mm/s
V Fib	ECG1 + Art waveforms, 25 mm/s
V Tachy	ECG1 + Art waveforms, 25 mm/s
V Run >3	ECG1 + Art waveforms, 25 mm/s

Alarming level	Alarms which start the recording
Severe	Asystole, Tachy/Brady, Art High/Low, V Fib, V Tachy

Showing alarm history

- Press the **Pt. Data & Trends** key and select ***Alarm History***. This displays a list of the last 20 alarms that have reached the yellow or the red alarm level. The time and type of occurrence are displayed next to the alarm list items.

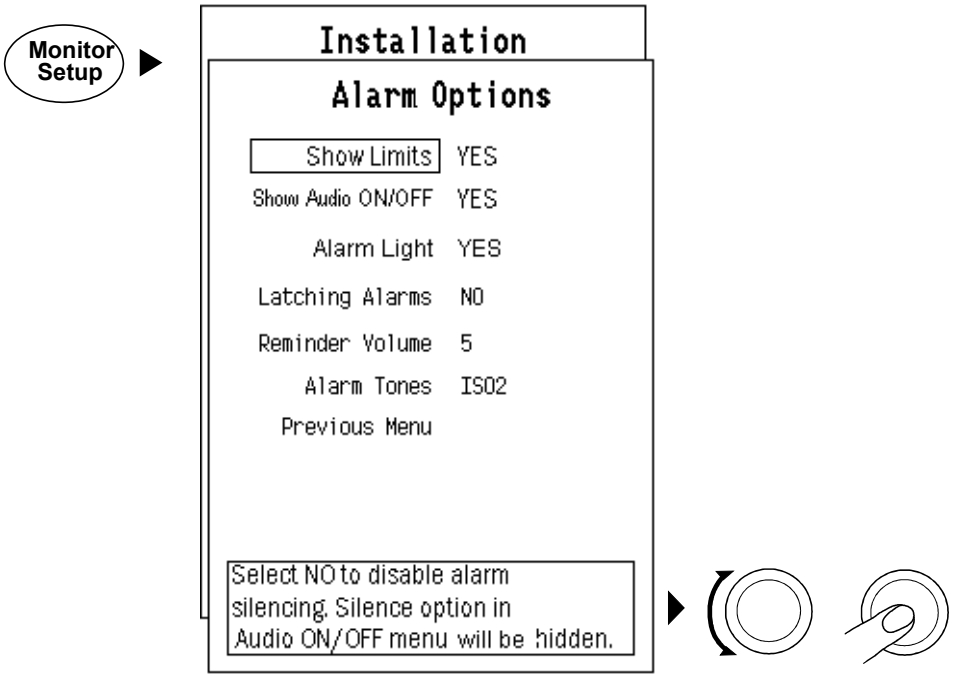
Other adjustable features

NOTE: This section describes the rest of the adjustable features regarding the alarms. You can adjust each feature if you know the required password for entering the ***Install/Service*** menu. If you wish to adjust the settings, we recommend that you contact the person responsible for the entire configuration.

Displaying limits

You may select the alarm limits to be displayed next to the numerical parameter value.

1. Press the **Monitor Setup** key.
2. Select ***Install/Service*** and enter the password.
3. Select ***Installation - Alarm Options.***
4. Select ***Show Limits*** and ***YES*** or ***NO***.

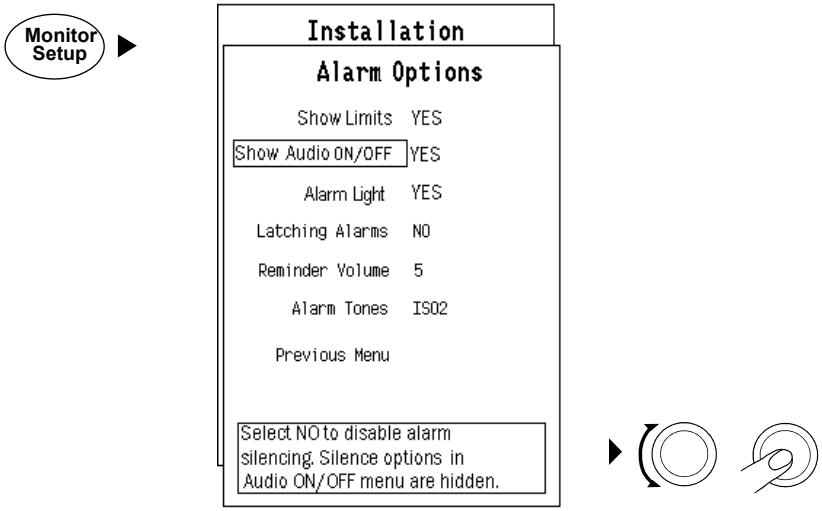


The alarm limits become visible when patient monitoring begins and the monitor receives patient data.

Enabling or disabling alarm silencing

With this selection, you can determine whether the audible alarms can be turned off or not.

1. Press the **Monitor Setup** key.
2. Select ***Install/Service*** and enter the password.
3. Select ***Installation - Alarm Options***.
4. Select ***Show Audio ON/OFF*** and ***YES*** to enable alarm silencing or ***NO*** to disable it.

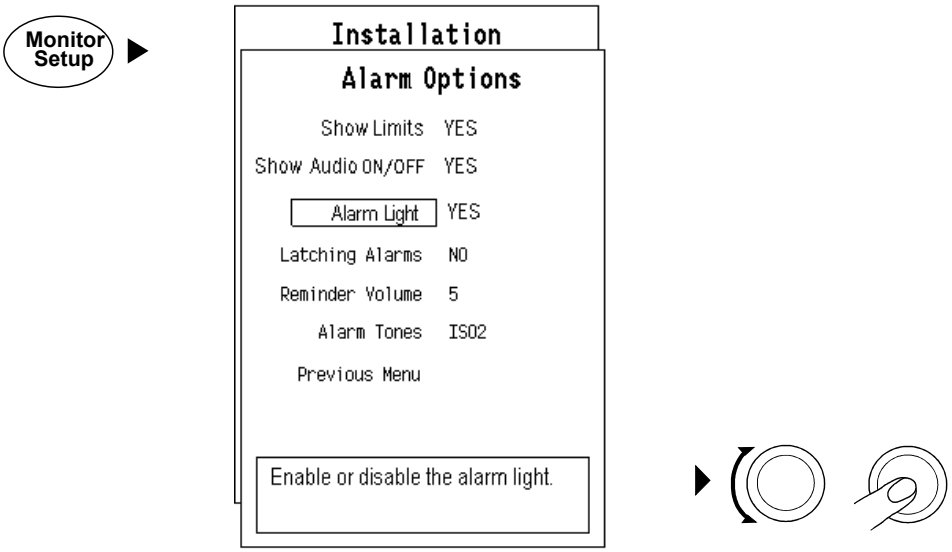


Disabling the alarm light

By default, the ***Alarm Light*** has been enabled. The light flashes red or yellow according to the currently active alarm. If several alarms are active at the same time, the color follows the highest priority alarm.

To disable the alarm light:

1. Press the **Monitor Setup** key.
2. Select ***Install/Service*** and enter the password.
3. Select ***Installation*** - ***Alarm Options***.
4. Select ***Alarm Light*** - ***NO***.



Latching alarms

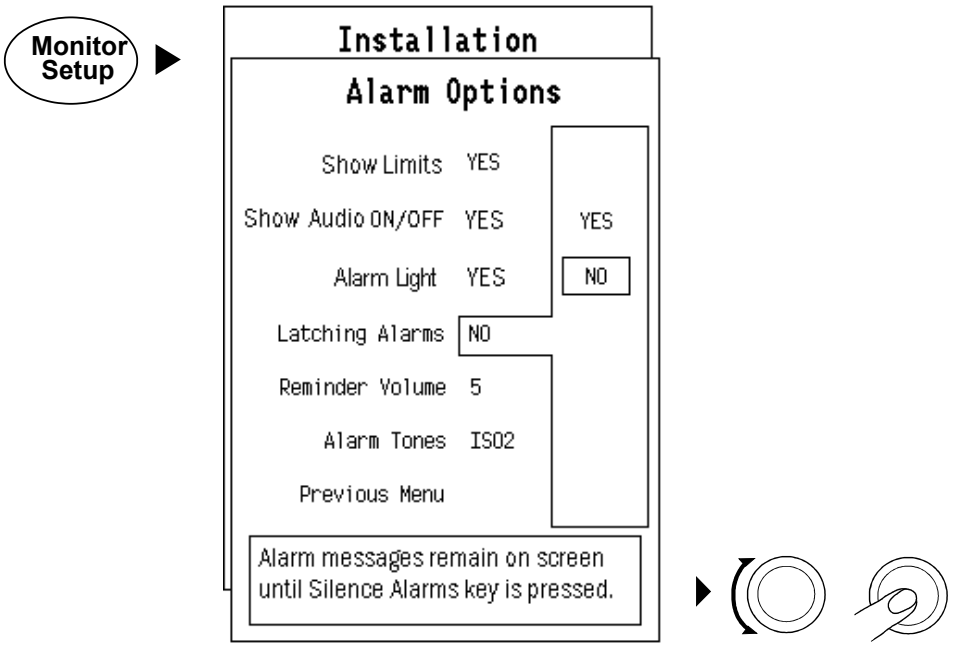
If the ***Latching Alarms*** selection is active, the alarm messages stay on the screen even if the initial alarm condition goes away. This enables unattended monitoring. You will also hear a reminder beep every 10 seconds.

To clear the message field of the no-longer active alarm messages and to clear the beep, press the **Silence Alarms** key once.

To clear the message field of all the alarms, enabling only new upcoming alarm messages, press the **Silence Alarms** key twice.

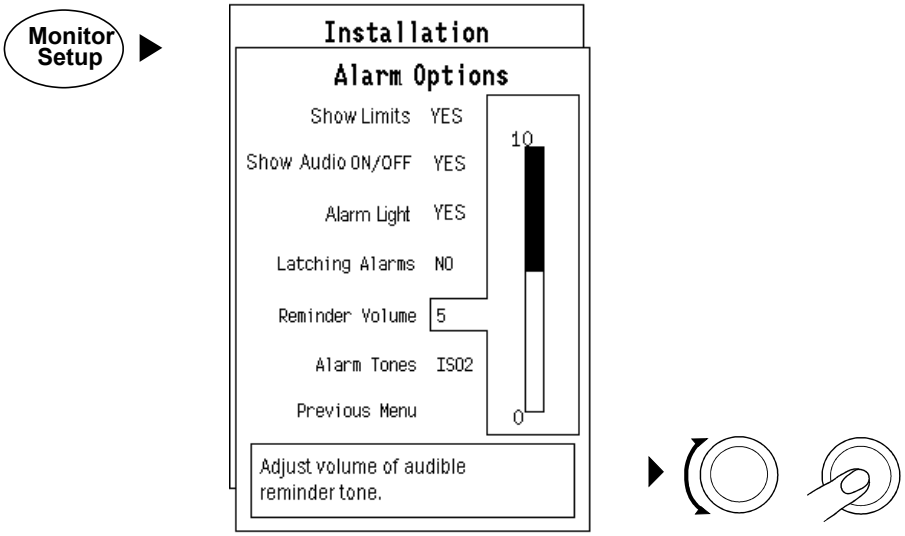
To select latching alarms:

1. Press the **Monitor Setup** key.
2. Select ***Install/Service*** and enter the password.
3. Select ***Installation*** - ***Alarm Options***.
4. Select ***Latching Alarms*** - ***Yes***.



Reminder volume

1. Press the **Monitor Setup** key.
2. Select ***Install/Service*** and enter the password.
3. Select ***Installation - Alarm Options***.
4. Select ***Reminder Volume*** and adjust the alarm reminder volume with the ComWheel.



Changing the tone pattern

The monitor has three choices of alarming tone patterns: ***ISO***, ***ISO2*** and ***General***.

To change the tone pattern:

1. Press the **Monitor Setup** key.
2. Select ***Install/Service*** and enter the password.
3. Select ***Installation*** - ***Alarm Options***.
4. Select ***Alarm Tones*** and ***ISO***, ***ISO2*** or ***General***.

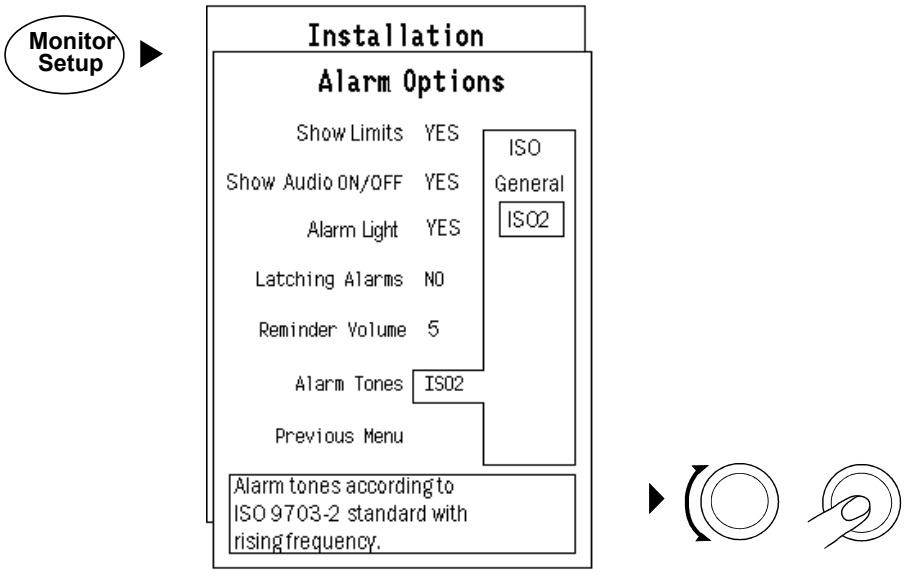


Table of contents

5 Monitor setup

Overview

The B30 monitor has numerous setup options for screen, parameters, alarms, etc. There are two types of settings:

– **User mode settings:** Some of the monitor setup options are preconfigured to be effective. The preconfigured default settings, so called factory settings, form six sets of user modes. The monitor starts in the startup mode, which is one of the user modes. You can change to another user mode, see "Changing the user mode" page 5-6.
The changes you make in the user mode settings are valid only temporarily until you discharge the patient or change a mode, or until more than 15 minutes has elapsed from the turn-off of the monitor. The changes need to be saved in the mode to become permanent.

– **Monitor installation settings:** the monitor installation settings are the same in all user modes. The changes are permanent and preserved until changed again.

Before starting to use the monitor, check the monitor installation settings and what is configured in the different user modes, and make necessary changes. You need passwords for making the changes, see "Configuration and passwords" below.

This User's Reference Manual describes most of the configurable features. More detailed lists of the options, and also of the factory settings, can be found in the "Default Configuration Worksheet" delivered with each monitor.

NOTE: If you wish to make permanent changes, we recommend that you contact the person responsible for the configuration, who is familiar with the configuration architecture. When new settings are saved, they should be marked in the "Default Configuration Worksheet."

Configuration and passwords

NOTE: If you want to make changes that require a password, we recommend you contact the system administrator.

– The default password for entering the ***Install/Service*** menu is 16, 4, 34.

Press **Monitor Setup** and select the ***Install/Service*** menu, turn the ComWheel in the opened adjustment window until you hit the desired number, then push the ComWheel to accept and select the number. Continue until all three numbers are selected. After entering the third number the ***Install/Service*** menu is displayed.

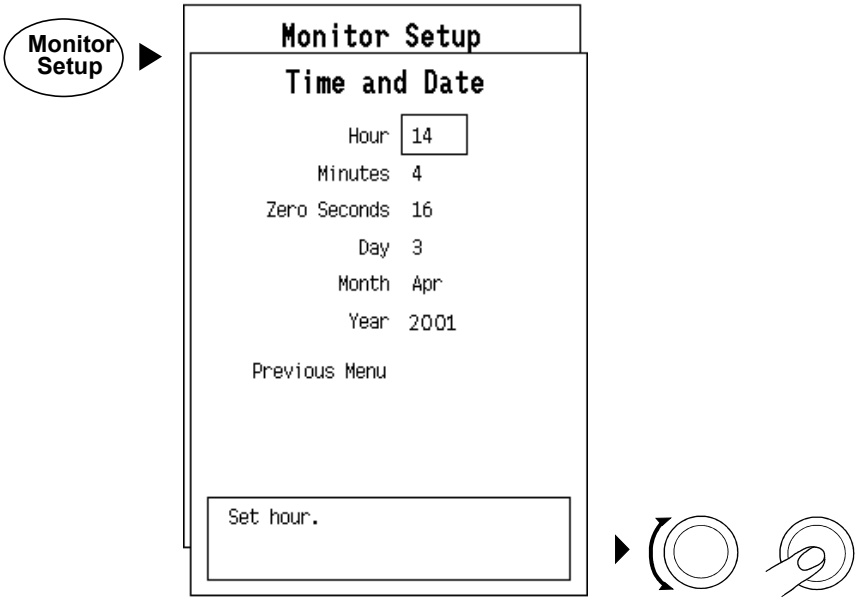
Most of the modifications are valid only temporarily unless you accept them in the ***Save Modes*** menu, which is a submenu of the ***Install/Service*** menu. A password is also required for entering the ***Save Modes*** menu.

– The default password for entering the ***Save Modes*** menu is 13, 20, 31.

Setting time and date

The time is shown in the upper right corner of the screen. Turning off the monitor does not affect the clock.

1. Press **Monitor Setup** and select ***Time and date***.



2. Turn and push the ComWheel to set the time and date:
   - Hours, minutes and seconds.
   - Day, month and year.

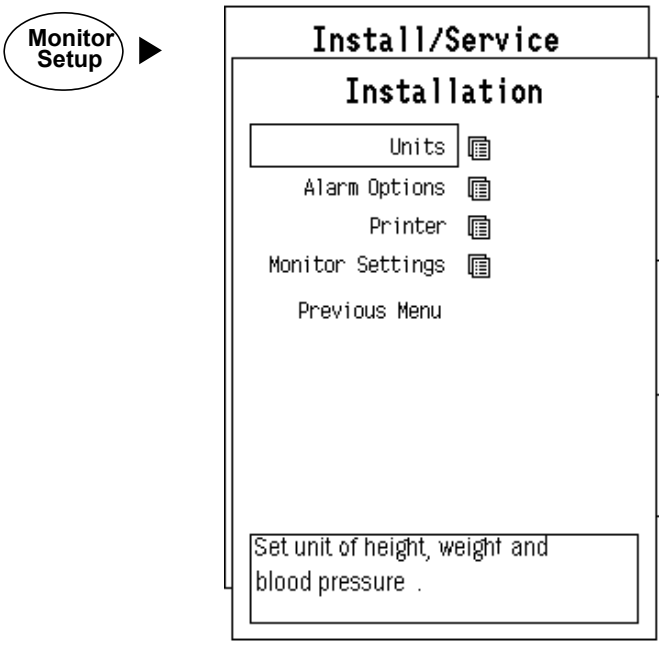
NOTE: If the monitor is connected to the Central, the monitor follows the Central's time settings and the ***Time and date*** menu is not available.

Battery setup

Through this menu you can check the battery status:

1. Press the **Monitor Setup** key.
2. Select ***Battery Setup***. Battery information is now available.

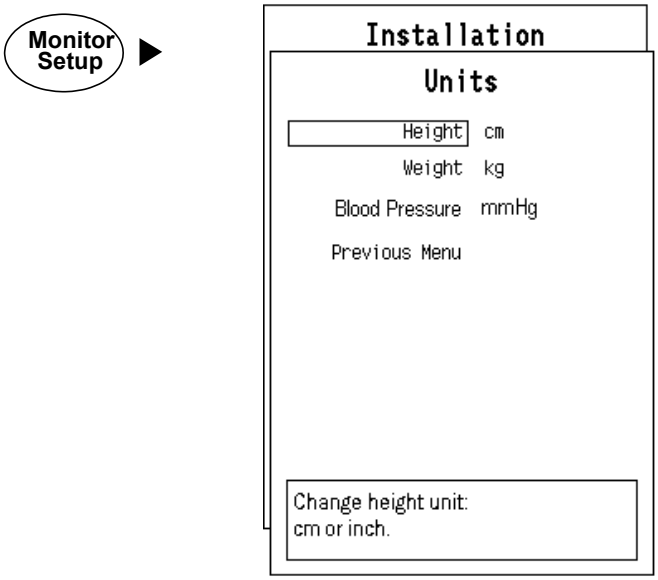
Changing monitor installation settings



Changing units

You can change units for height, weight and blood pressure. You can change temperature units through **Others** - ***TempSetup*** and CO_2 units through **Airway Gas** - ***CO2 Setup***. The changes are permanent. To change the units:

1. Press the **Monitor Setup** key.
2. Select ***Install/Service*** and enter the password.
3. Select ***Installation*** - ***Units***.



4. Set the units for height, weight and blood pressure.

Changing alarm options

1. Press the **Monitor Setup** key, select ***Install/Service*** and enter the password.
2. Select ***Installation - Alarm Options***.
   - Select ***Show limits*** and ***YES*** to show alarm limits in digit fields. ***NO*** is the default.
   - Select ***Show Audio ON/OFF*** (default) and ***YES*** to enable alarm silencing. Selecting ***NO*** disables silencing options in the ***Audio ON/OFF*** menu in ***Alarms Setup***.

NOTE: The ***Show Audio ON/OFF*** setting should be changed only by the system administrator.

- Select ***Alarm Light*** and ***YES*** (default) to enable the alarm light or ***NO*** to disable it.
- Select ***Latching Alarms*** and ***YES*** to keep alarm messages on screen until **Silence Alarms** key is pressed. ***NO*** is the default.
- Select ***Reminder Volume*** and adjust the volume of the audible alarm reminder tone.
- Select ***Alarm Tones*** and ***ISO***, ***ISO2*** or ***General***.

Other alarm settings (alarm limits, alarm light brightness and alarm volume) can be changed in the ***Alarms Setup*** menu. To make the changes permanent, save them in user modes, see section "Saving changes in user modes."

Changing printer settings

1. Press the **Monitor Setup** key.
2. Select ***Install/Service*** and enter the password.
3. Select ***Installation - Printer***.
   - Select ***ECG Printout Type*** and ***2x6-25 mm/s*** (2 columns, 6 lines, 25 mm/s; default), ***2x6-50 mm/s*** (2 columns, 6 lines, 50 mm/s) or ***3x4-25 mm/s*** (3 columns, 4 lines, 25 mm/s).
   - Select ***Printer Connection*** and ***Net1...Net16***/***None*** (default).
   - Select ***Paper Size*** and ***A4*** (default) or ***Letter***.

NOTE: Network printer only.

Other printer settings can be changed in the ***Print & Record*** menu. To make the changes permanent, save them in user modes.

Changing the monitor settings

1. Press the **Monitor Setup** key.
2. Select ***Install/Service*** and enter the password.
3. Select ***Installation - Monitor Settings***.
   - Select ***Parameter Settings*** and select:

   Humidity compensation type: ***CO2 Numbers - Dry*** (default), ***Wet***.

Changing the user modes

You can change the settings in each user mode to suit your specific needs. User modes are predefined combinations of settings that include both general and measurement specific settings. A user mode defines, for example, what is displayed on the screen and in the trends. General settings can be changed in the ***Monitor Setup*** menu, other settings in the parameter setup menus. You need a password to make changes through ***Monitor Setup*** - ***Install/Service*** menus and to enter the ***Save Modes*** menu; for details, see "Configuration and passwords" page 5-1.

This section describes the following changes that can be saved in user modes:

"Changing the Normal Screen layout" on page 5-8

"Changing sweep speeds" on page 5-12

"Displaying pulse rate" on page 5-12

"Changing parameter colors" on page 5-12

"Changing the recorder and printer settings" on page 5-13

Saving changes in user modes

The modifications are valid only temporarily unless you accept them by saving them in the modes:

1. Select **Monitor Setup** - ***Install/Service***. Enter the password.
2. Select ***Save Modes.*** Enter the password (see page 5-1).
3. Select the mode from the list and select ***Save***.

   Temporary modifications are valid until you discharge the patient or change a mode or until more than 15 minutes has elapsed from the turn-off of the monitor.

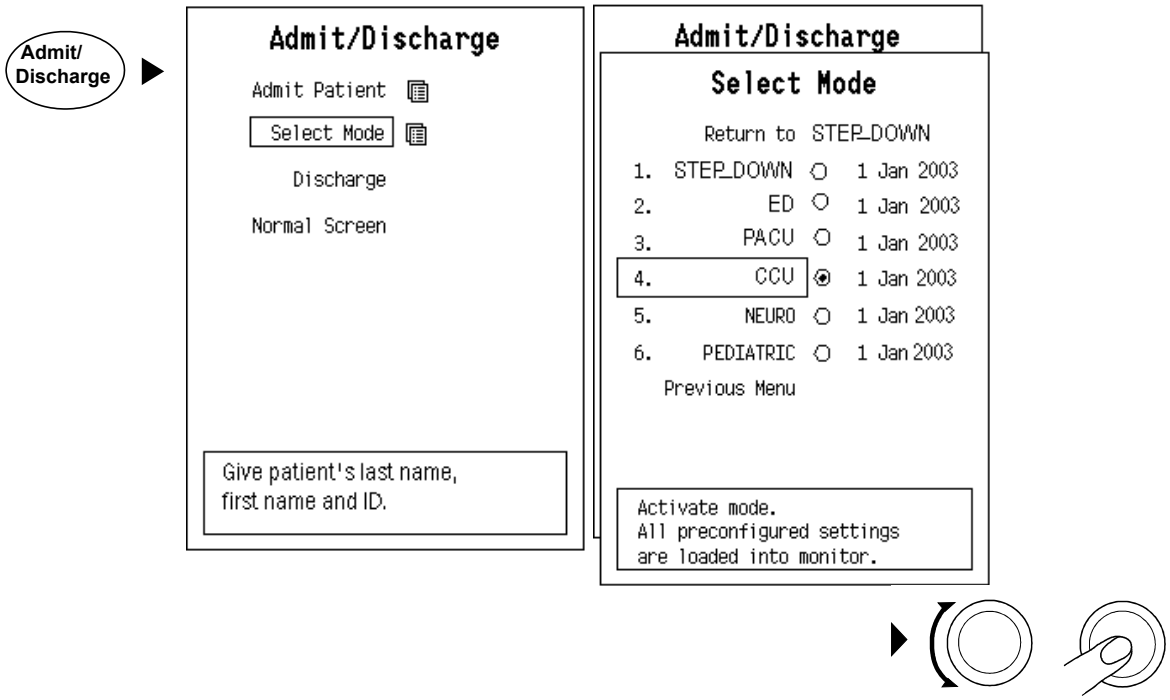
Changing the user mode

The monitor always starts in startup mode. The startup mode is one of the user modes, and it is chosen during configuration.

To change from the startup mode to another mode:

1. Press **Admit/Discharge** and select ***Select Mode***.
2. Select one of the following modes:

STEP-DOWN	Mode for intermediate care
ED	Mode for emergency care
PACU	Mode for post-anesthesia care
CCU	Mode for ECG and ST care
NEURO	Mode for neurological monitoring
PEDIATRIC	Mode for pediatric ICU monitoring



The selected mode is marked with a circle. You can return to the previous mode by selecting ***Return to X***.

During monitoring, you can make additional changes to the mode settings and, to make the changes permanent, save them through the ***Save Modes*** menu.

Changing the startup mode

1. Select **Monitor Setup - *Install/Service - Save Modes***. Enter the password.
2. Select ***Startup Mode - 1, 2, 3, 4, 5,*** or ***6***.

Renaming a mode

1. Select **Monitor Setup - *Install/Service - Save Modes***. Enter the password.
2. Select the mode, select ***Name*** and give a new name.

Loading modes

1. Select **Monitor Setup - *Install/Service - Save Modes***. Enter the password.
2. Select ***Load Modes*** and one of the following:
   - ***From Network***: Loads all modes from network and saves them in monitor's permanent memory.
   - ***To Network:*** Copies all modes from monitor's permanent memory to network. This selection is available only if saving modes to network is enabled in Central

Changing the Normal Screen layout

At startup, the screen is arranged according to the startup mode definitions. Parameters that are not used are not displayed and no space is reserved for them. You can decide which waveforms and numerical information are displayed, and where on the screen they are arranged. You can do this for the duration of monitoring or save the changes in the user mode. To make the changes permanent, save them in the user mode through **Monitor Setup - *Install/Service - Save Modes***.

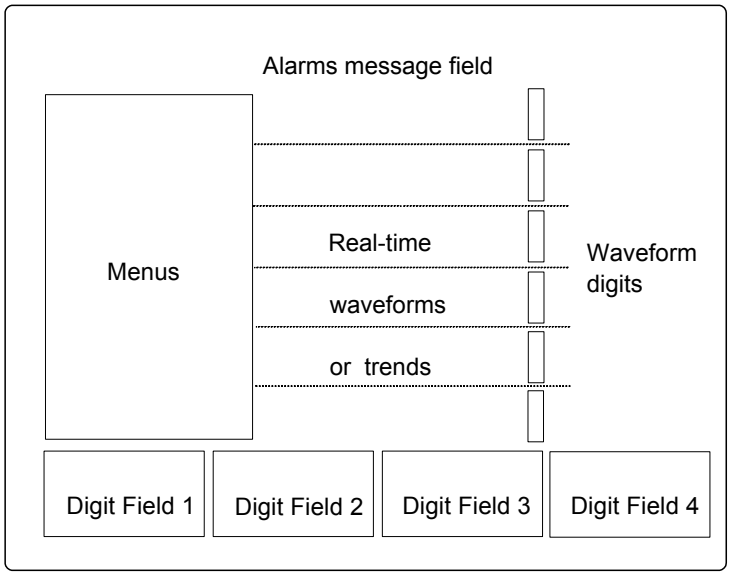
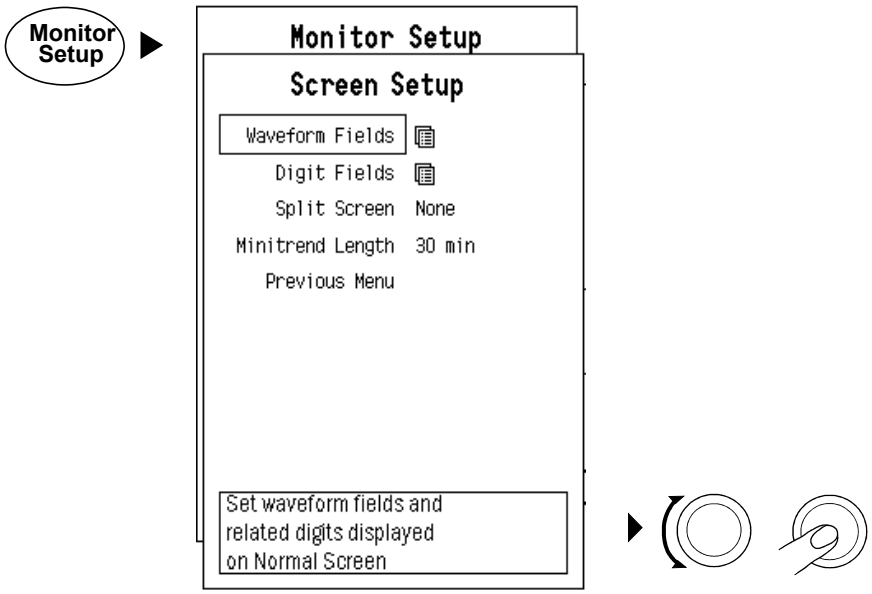


Figure 5-1 Display fields

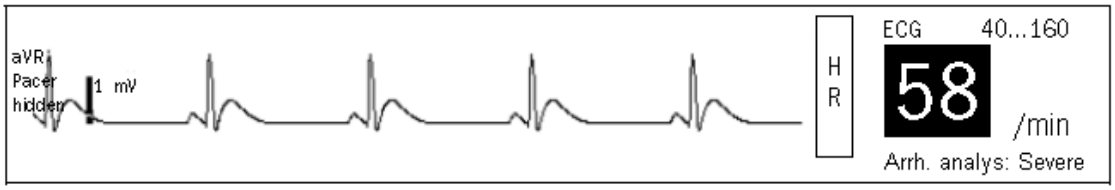
To change the Normal Screen page:

1. Press the **Monitor Setup** key.
2. Select ***Screen Setup***.
3. Select ***Waveform Fields, Digit Fields,split Screen*** or ***Minitrend Length***.



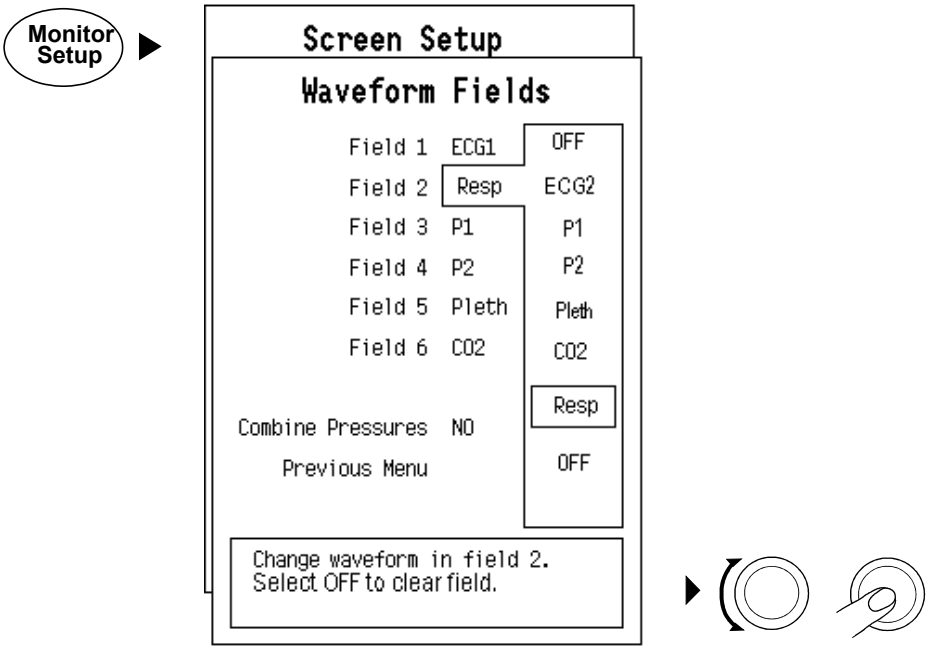
NOTE: Choosing the same parameter in the waveform and digit field makes the previously chosen field disappear.

Modifying waveform fields



1. Press the **Monitor Setup** key.
2. Select ***Screen Setup***.
3. Select ***Waveform Field.***

Up to six waveforms can be displayed at a time.



When waveforms are configured to be displayed, they appear and disappear automatically when modules are connected or disconnected. The invasive pressure waveforms are displayed only when the transducer is connected to the module.

Waveforms are always evenly spread to fill the entire waveform area. Whenever there are less than 6 waveforms configured on the screen, the remaining waveforms are enlarged.

Changing the waveform to another also changes the numerical field to the right of the waveform. It may also change the digit fields at the bottom: if you choose the same measurement in the waveform field that is currently in the digit field, the digit field disappears.

Selecting ***Combine Pressures*** in the ***Waveform Fields*** menu displays invasive pressures in the same waveform field with individual scales.

When you use 5-lead ECG measurement, up to three different ECG leads can be displayed simultaneously in different fields.

Modifying digit fields

Patient data may be displayed in up to four digit fields, located in the lower part of the screen. The fields are numbered from left to right.

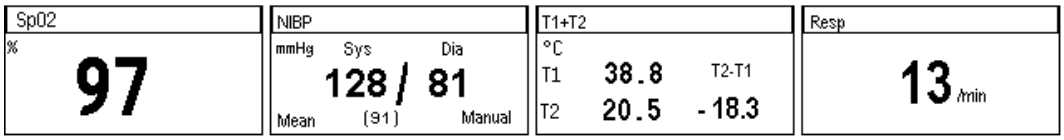
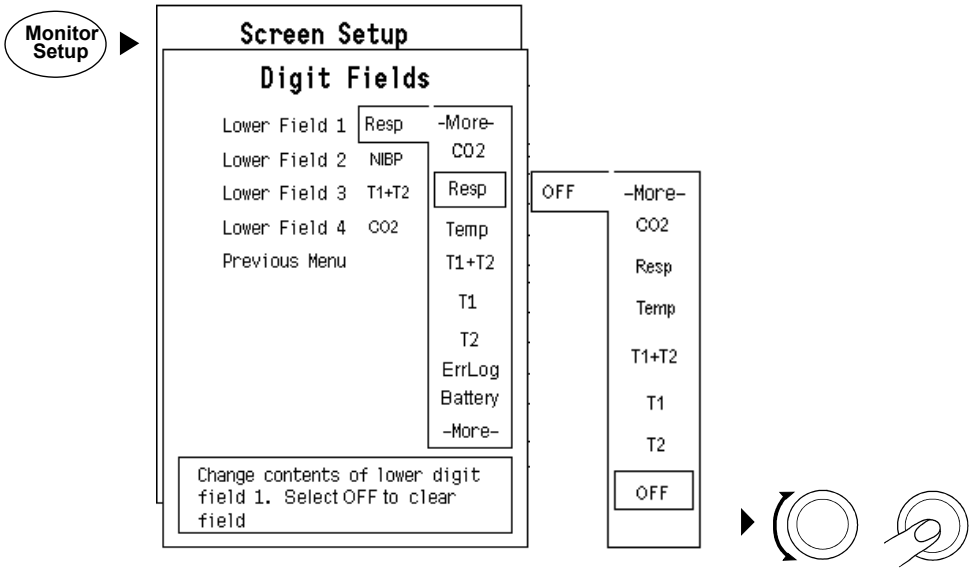


Figure 5-2 Digit fields

You may change the contents of each field, or turn them off individually. Before modifying the digit fields remember to check that the desired parameter module is plugged in.

1. Press the **Monitor Setup** key and select ***Screen Setup***.
2. Select ***Digit Fields*** and change the field contents.



Changing the digit field may also change the waveform field setup. If you choose the same measurement in the digit field that is currently in the waveform field, this measurement is removed from the waveform field.

If a digit field is turned ***OFF***, the remaining digit fields are enlarged to fill the space.

Modifying split screen

You can split Normal Screen so that one part continuously displays trend data.

To select a split screen view:

1. Press the **Monitor Setup** key.
2. Select ***Screen Setup***.
3. Select ***Split Screen*** and choose from the options: ***Trend*** or ***None***.

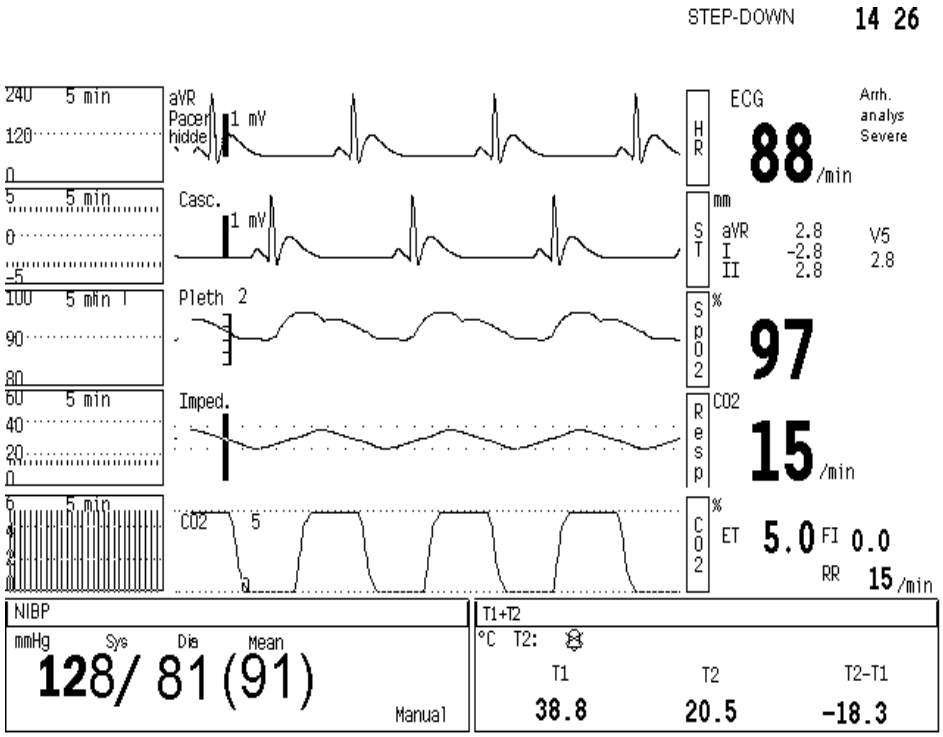


Figure 5-3 Split screen view

Modifying the minitrend length

You can choose to view minitrend data from the last 5-minute or 30-minute period next to the parameter's waveform field. The 5-minute minitrend is updated every 10 seconds, and the 30-minute minitrend once every minute.

To modify the minitrend length:

1. Press the **Monitor Setup** key.
2. Select ***Screen Setup***.
3. Select ***Minitrend Length*** and choose ***5 min*** or ***30 min***.

Other adjustable screen features

Changing the display brightness

1. Press **Monitor Setup** and select ***Display brightness***.
2. Select from ***10*** to ***100 %***.

Changing sweep speeds

You can change the speed of the waveforms on the screen. Selections are ***Fast*** (6.25 mm/s) and ***Slow*** (0.625 mm/s). For hemodynamic parameters, the selections are 12.5, 25 and 50 mm/s. Slow waveforms have a sweep speed one tenth of normal, for a full screen sweep. Slow waveforms show amplitude changes better than fast waveforms.

1. Press the **Monitor Setup** key.
2. Select ***Sweep Speeds***, select the parameter and adjust the value.

Displaying pulse rate

Combined heart rate and pulse rate can be displayed next to the ECG waveform. The current HR source is displayed with bigger font and the heart rate symbol flashes next to it.

1. Press the **ECG** key.
2. Select ***ECG Setup***.
3. Select ***Display with HR*** and ***PR, PVC*** or ***None***.

Changing parameter colors

You can select the color of each parameter to be yellow, white, green, red or blue. For some parameters, also violet is possible. To change the color:

1. Press the **Monitor Setup** key.
2. Select ***Install/Service*** and enter the password.
3. Select ***Colors***.
4. Select the desired parameter and the color.

Changing the recorder and printer settings

Recorder settings

1. Press **Print/Record.**
2. Select ***Record Waveforms.***
   - Select ***Waveform 1*** and select a parameter or select ***OFF***. Then select ***Waveform 2*** and ***3*** and their parameters. You can record up to three waveforms simultaneously. If you wish to record only one waveform, select the other waveform fields ***OFF***.
   - Select ***Start on Alarms*** - ***Yes*** to start automatic strip chart recording when the following alarms reach the red alarm level (***NO*** is the default):
     – with L-DICU08 software license: bradycardia, tachycardia, asystole, Art high/ low, V Fib, V Tachy
   - Select ***Delay*** and ***OFF*** or ***12 s***. If the recording delay is ***OFF***, the recording starts when an event occurs and continues for 30 seconds or until manually stopped, or until the recorder runs out of paper. If the delay is ***12 seconds*** (default), the recording starts when an event occurs and the 12 seconds prior to the event are recorded from the recorder memory. The recording continues for 18 seconds if the length has been set to 30 seconds or until the recorder runs out of paper.
   - Select ***Paper Speed*** and ***1***, ***6.25***, ***12.5*** (default), or ***25 mm/s***.
   - Select ***Length*** and choose ***30 s*** (default) or ***Cont***.
3. Select ***Record Trends***.
   - Select ***Trend Resolution*** and every ***1 min***, ***5 min***, ***10 min*** (default) or ***30 min***. This setting is for numerical trends.
   - Select ***Num Trend Type*** and ***Num.*** (default) or ***Tab.*** as the format of the numerical trend recorded.
   - Select ***Graphic. Trend 1*** and select the parameter and then do the same for ***Graphic Trend 2***. These settings define the graphical trends recorded in upper field and lower field. You can record graphical trends of two parameters.

Printer settings

1. Press **Print/Record.**
2. Select ***Print Graphical***.
   - ***Hours/Page*** and select to print ***1***, ***2*** (default), ***4***, ***6***, ***8***, ***10***, ***12***, ***24***, ***36***, ***48*** or ***72*** hours on one page.
   - Select ***Trend Length*** and select ***1***, ***2***, ***4***, ***6***, ***8*** (default), ***10***, ***12***, ***24***, ***36***, ***48*** or ***72*** hours.

Configuring trends

Configuring trend pages

You can change the parameters on the trend fields:

1. Press the **Monitor Setup** key.
2. Select ***Install/Service*** and enter the password.
3. Select ***Trends*** and select ***Graphical Trends***.
4. Select the trend page that you want to change.
5. Select graphical parameters for each field.

The field numbers start from the top of the screen. Select one parameter for each field on the trend page, or turn the field ***OFF***. When all the fields are ***OFF***, the page is displayed with empty fields. The time scale and page number appear at the bottom of the page.

If several similar fields are selected on top of each other, they form one higher field. Equal fields cannot be defined separate to each other.

NOTE: You cannot make changes in numerical trend page configuration.

Setting trend length

1. Press **Pt. Data & Trends**.
2. Select ***Trends - Graphical - Time Scale*** and select ***20min***, ***1h***, ***2h*** (default), ***4h***, ***6h***, ***8h***, ***10h***, ***12h***, ***24h***, ***36h***, ***48h*** or ***72h***.

Setting trend scales

You can change the scale for HR, ST, PVC, SpO_2 and temperature trends.

1. Press **Pt. Data & Trends**.
2. Select ***Trends*** - ***Graphical - Trend Scales*** and adjust the scales.

Setting the default trend

You can select graphical or numerical trends to be displayed by default:

1. Press the **Monitor Setup** key.
2. Select ***Install/Service*** and enter the password.
3. Select ***Trends***.
4. Select ***Default Trend*** and ***Graph*** or ***Num***.

Table of contents

6 Trends

Overview

The monitor displays two types of trend data: graphical and numerical. The monitor collects graphical and numerical trend data automatically from trended variables. You can select the trend time between 20 minutes and 72 hours.

You can view the trends through **Pt.Data & Trends** - ***Trends***, or you can select graphical minitrends to be displayed continuously next to the waveform fields (**Monitor Setup – *Screen Setup – Split Screen***).

Trended parameters

- Electrocardiography (HR, ST)
- Invasive pressures
- Non-invasive blood pressure
- Oxygen saturation (Pleth, SpO_2)
- Gases (CO_2, Resp)
- Impedance respiration (Resp)
- Temperatures

Trend data is stored in the memory for 15 minutes after the power has been turned to standby.

Most common tasks

Displaying trends and activating the Trends menu	• Press the **Pt.Data & Trends** key and select ***Trends***. The most recently displayed trend (graphical or numerical) is displayed together with the ***Trends*** menu.
Scrolling time with trend cursor	1. Turn the ComWheel to move the cursor to the time you want. 2. Numeric measurement values of that time are displayed in the graphical trend next to the cursor. 3. Push the ComWheel to return to the menu.
Scrolling pages to see more parameters	• Select ***Scroll Pages*** and turn the ComWheel to move from one page to the other.
Changing the time scale	1. Select ***Time Scale***. 2. Select the trend time (***20 min*** or ***1***, ***2***, ***4***, ***6***, ***8***, ***10***, ***12***, ***24***, ***36***, ***48***, ***72 hours***).
Selecting numerical or graphical trends to the screen	• Select ***Graphical*** or ***Numerical***.
Changing trend scales	• Select ***Trend Scales***.
Printing trends	• To print the currently viewed trend data, select ***Graphical*** or ***Numerical*** and then ***Print Page***. • To print all the graphical trend data, press the **Print/ Record** key and select ***Print Graphical*** – select page - ***Print Graphs***.
Recording trends	• To record numerical trends, press the **Print/Record** key and select ***Record Trends*** - ***Record Numerical***. • To record graphical trends, press the **Print/Record** key and select ***Record Trends*** - ***Record Graphical***.
Erasing trend history	1. Press the **Admit/Discharge** key. 2. Select ***Discharge*** - ***Yes***.
Selecting minitrend as split screen option	1. Press the **Monitor Setup** key. 2. Select ***Screen Setup*** and ***Split Screen – Trend***.

Minitrend view

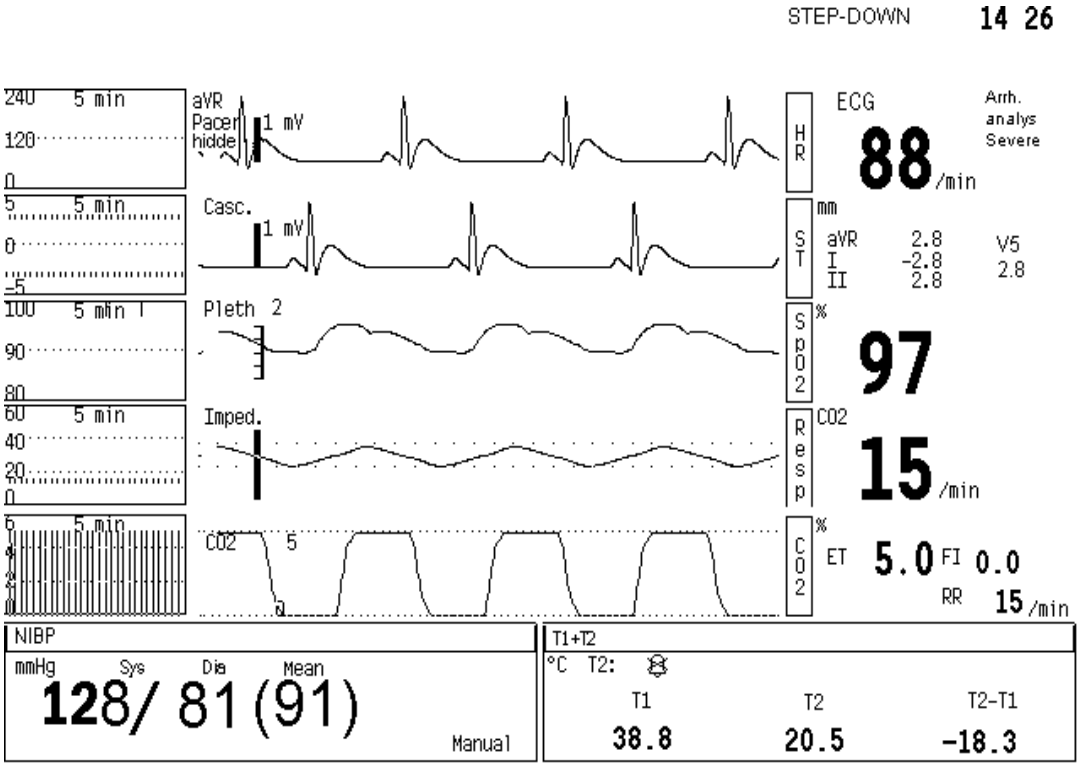
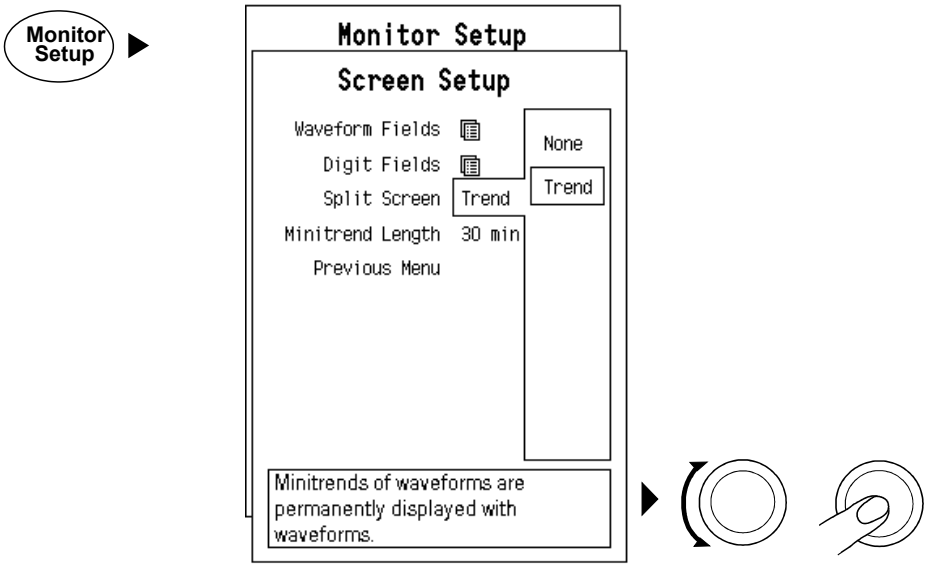


Figure 6-1 Minitrend view

You can split the Normal Screen page so that one fourth of the screen, on the left hand side, continuously shows graphical minitrends beside waveforms. Note that the split screen option is available only when the Normal Screen page shows waveforms.

To select a split screen view:

1. Press the **Monitor Setup** key.
2. Select ***Screen Setup***.
3. Select ***Split Screen*** and ***Trend***.



Minitrend length

You can choose to view trend data from the last five minutes or the last 30 minute period. The five minute minitrend is updated every 10 seconds, the 30 minute minitrend is updated once every minute.

To modify the split screen trend view:

1. Press the **Monitor Setup** key.
2. Select ***Screen Setup***.
3. Select ***Minitrend Length*** and choose ***5 min*** or ***30 min***.

Removing minitrend

To remove the minitrend from the screen:

1. Press the **Monitor Setup** key.
2. Select ***Screen Setup***.
3. Select ***Split Screen*** and ***None***.

Graphical trend view

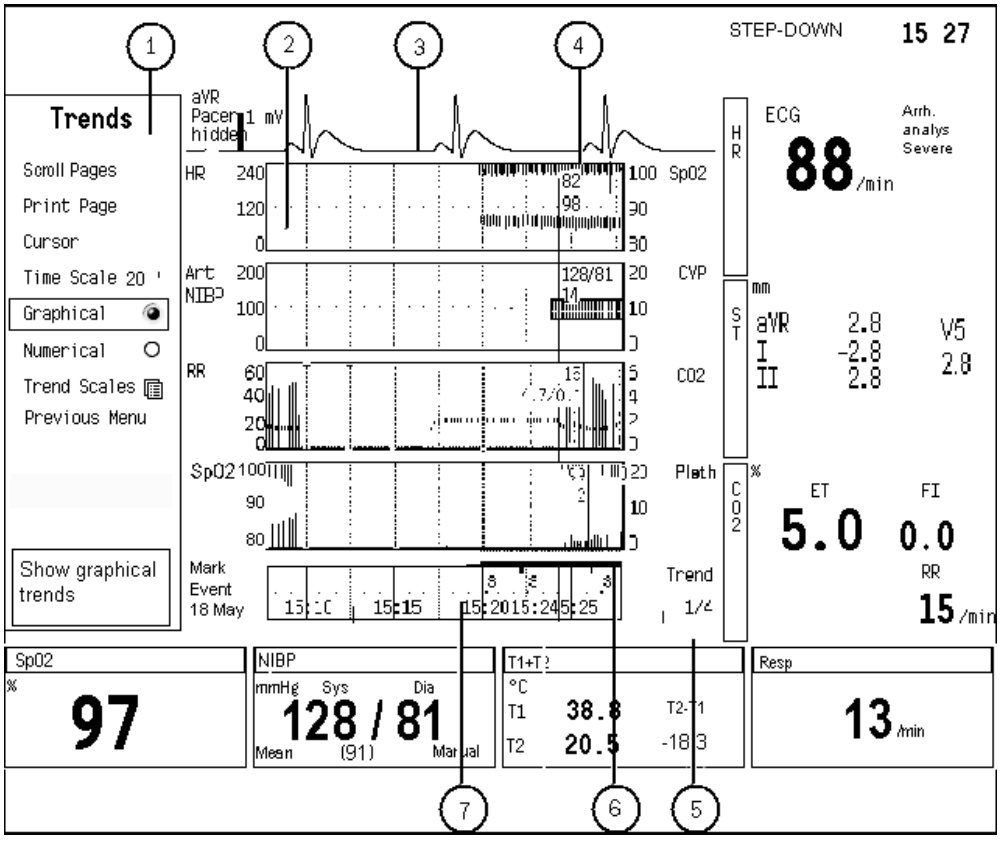


Figure 6-2 Graphical trend page

(1) Trends menu
(2) Measurement trend field
(3) Real time ECG
(4) Numeric value of a measurement at the trend cursor point
(5) Trend page number
(6) Indication of the amount of data gathered and viewed
(7) Time and marker field

Symbols

Trend bar, parameter scale to the left.
The gap shows the blood pressure mean value except in the Paw field where it indicates Pplat.

NIBP trend bar

Dotted vertical line across the trend field indicates change, such as ST relearning or zeroing of an invasive blood pressure channel/ changing a label.

A blue, white or red line above the marker field indicates the following things:

Blue line indicates the amount of data on the screen: the left end of the line shows the starting point of the trend data gathering. The right end of the line shows the last moment the data has been gathered.

White line indicates which proportion of the data you see on the screen. If the line is on the left, there is more data to see after the current view. If the line is on the right, there is more data to see before the current view. If the line is in the middle, there is more trend data to see towards the beginning and the end of the case.

Red line indicates the availability of trend data with 10 second resolution (available for the last 30 minutes only).

Graphical trend pages

Graphical trends contain:

– Four pages

– Six fields on each page

Five fields are usually visible. The lowest (sixth) field is replaced by digit fields on the screen. All six fields are printed.

Scale, label, unit and color of the parameter follow the real time waveform setting for each parameter. For HR, ST, PVC, CPP, SpO_2 and temperature you can select the scale through **Pt.Data & Trends** - ***Trends*** - ***Trend Scales***.

Changing trend length and resolution

1. Press the **Pt.Data & Trends** key.
2. Select ***Trends*** - ***Time Scale***.
3. Select the trend length.

Table 6-1 Trend length and resolution

Trend length on the screen	Resolution	Trended time period
20 minutes	10 seconds	last 30 minutes
1 hour	1 minute	last 24 hours
2 hours	1 minute	last 24 hours
4 hours	2 minutes	last 24 hours
6 hours	3 minutes	last 24 hours
8 hours	4 minutes	last 24 hours
10 hours	5 minutes	last 24 hours
12 hours	6 minutes	last 24 hours
24 hours	12 minutes	last 24 hours
36 hours	18 minutes	last 36 hours
48 hours	24 minutes	last 48 hours
72 hours	36 minutes	last 72 hours

Moving on graphical trend pages

To see more parameters on other pages:

- Select ***Scroll Pages*** in the ***Trends*** menu.

Numeric measurement values for trended parameters are displayed next to the cursor. The cursor indicates the time when these values have been measured. To change the cursor location:

1. In the ***Trends*** menu, select ***Cursor***.
2.  to move the cursor.
3.  to return to the menu.

To scroll the time, move the cursor past the right or left border of the trend.

Recording and printing

Recording

1. Press the **Print/Record** key.
2. Select ***Record Trends***.
3. Select ***Record Graphical***.

The recording time of a trend corresponds to the time scale of the graphical trends. You can choose the time scale (20 minutes to 72 hours) in the trends menu.

To select the parameters for graphical trend recording:

1. Press the **Print/Record** key.
2. Select ***Record Trends***.
3. Select ***Graphic Trend 1*** and choose the parameter in the opened adjustment menu.
4. Select ***Graphic Trend 2*** and choose the parameter in the opened adjustment menu.

Printing

You can print all the graphical trends gathered:

1. Press the **Print/Record** key.
2. Select ***Print Graphical***.
3. Select the page and ***Print Graphs***.

Factory default parameters

The default graphical trend setup varies according to mode types. For details refer to “Default Configuration Worksheet”. To change these settings, see section ”Monitor setup.”

Numerical trend view

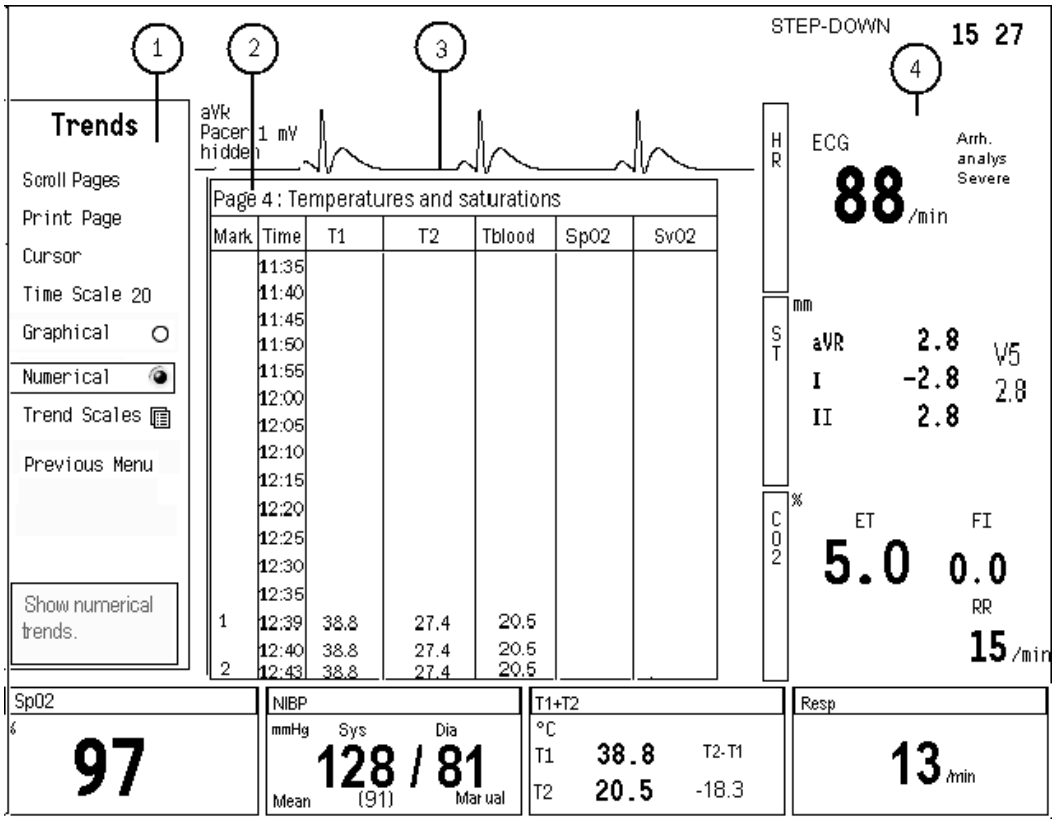


Figure 6-3 Numerical trend page

(1) Trend menu

(2) Page name and number

(3) Real time ECG

(4) Real time digit fields, if the Normal Screen shows waveforms

Numerical trend pages

Numerical trends contain:

– four pages of maximum 72 hours trend information

– real-time ECG on top of each page

Resolution is five minutes.

Moving between numerical trend pages

- Use the ComWheel to scroll the trend in vertical direction.

When the highlight reaches the top or the bottom of the view, next five minutes of information appear.

Recording and printing

Recording

Parameters for recording are chosen during configuration. To change the parameters, see section "Monitor setup."

1. Press the **Print/Record** key.
2. Select ***Record Trends.***
3. Select ***Record Numerical***.

Printing

1. Press the **Pt.Data & Trends** key and select ***Trends***.
2. To print all the numerical trend data, select ***Numerical - Print Page***.

Factory default parameters

You cannot change the contents of numerical trend fields. The parameter units follow the real time waveform settings of each parameter.

Page 1: Vital parameters									
Mark	Time	HR	SpO2	NIBP sys/dia	NIBP mean	Art sys/dia	Art mean	CVP mean	CO2 ET
Page 2: Hemodynamics									
Mark	Time	P1 Art		P2 CVP		C.O.		REF	PCWP
Page 3: Gases									
Mark	Time	CO2 ET/FI				RR			
Page 4: Temperatures and saturations									
Mark	Time	T1		T2		Tblood		SpO2	SvO2

Erasing trend data

Trends are erased when you discharge the patient.

1. Press the **Admit/Discharge** key.
2. Select ***Discharge***.
3. In the opened window, select ***Yes*** to erase the trends and to discharge the patient.

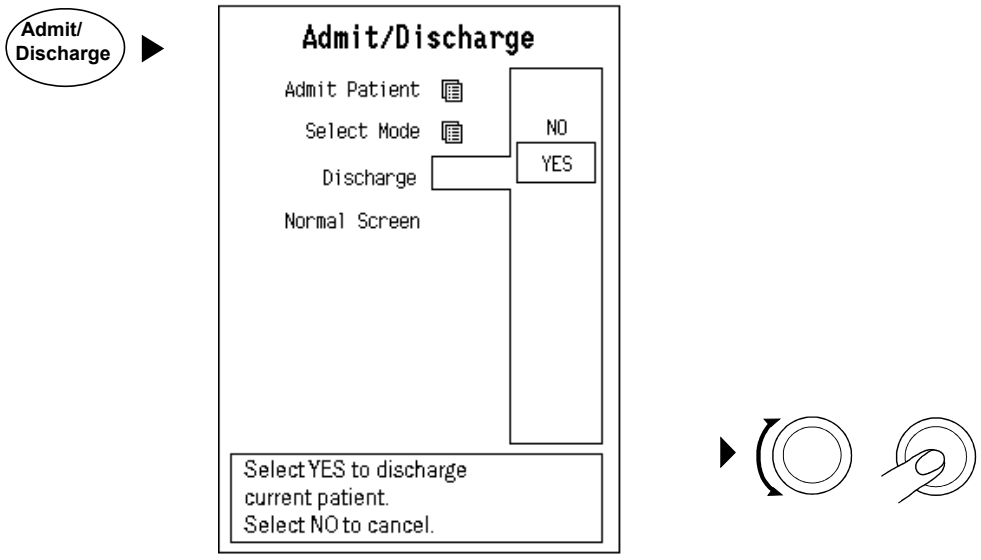


Table of contents

7 Patient data management

Overview

The monitor continuously saves patient data, such as trends. Saving is activated once the patient is admitted. The monitor saves automatically.

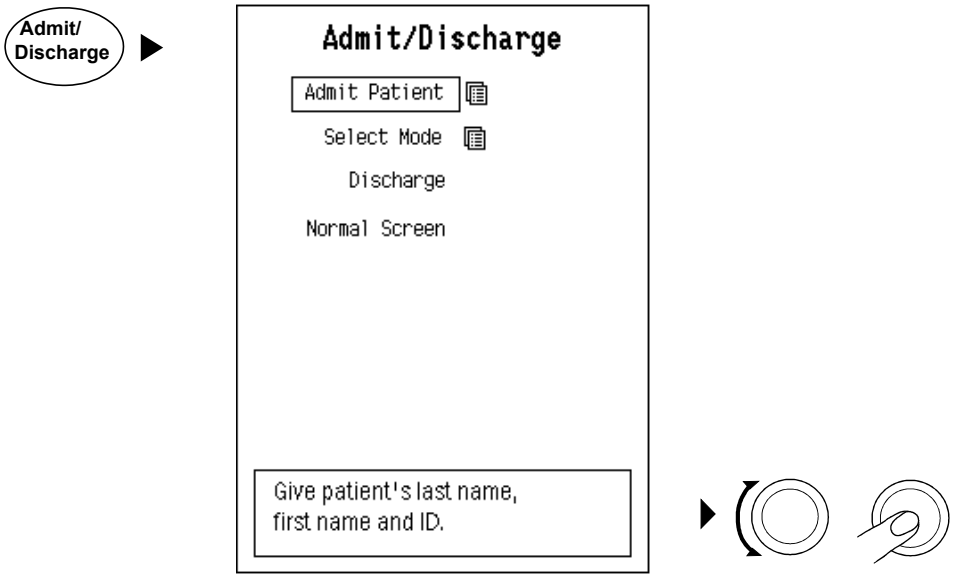
- In the monitor memory the most recent patient data up to 72 hours if the network is not in use.
- In the network the most recent patient data up to 72 hours from 2 to 90 days depending on the configuration.

All the data can be printed through network and saved to the network for monitor memory.

Admitting a patient

Monitoring of a new patient is started by admitting the patient. After the patient has been admitted, you can start monitoring and trend gathering. To admit the patient:

1. **Admit/Discharge** key.
2. Select ***Admit Patient*** and enter the patient data. Select letters and numbers by turning and pushing the ComWheel (max. 14 characters or numbers for each name and ID).



NOTE: Always observe the monitor and the patient carefully during start-up periods.

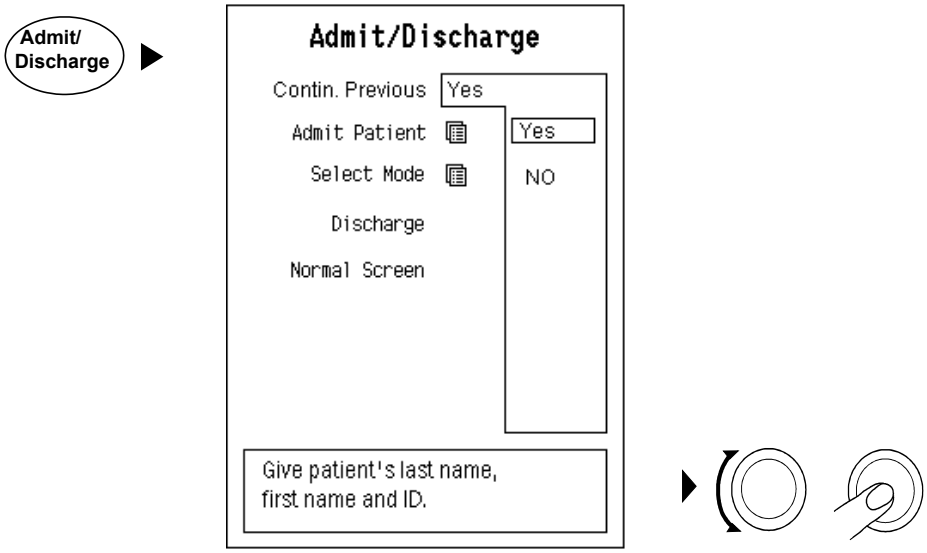
Adding demographics

1. **Admit/Discharge** key.
2. Select ***Admit Patient*** - ***Demographics***.
3. Enter patient data: ***Height*** is adjustable from 15 to 250 cm (5 in to 8 ft 2 in), ***Weight*** is adjustable from 1 to 250 kg (2 to 555 lb).

   The body surface area, ***BSA***, is calculated automatically by using du Bois formula. The body surface area is used in calculating index values of some parameters.

Loading previous data

If the patient has already been admitted on the same monitor and this monitor has been restarted, the ***Contin. Previous*** will be appeared.



Contin. Previous

Select this to load the most recent patient trends from the monitor memory when less than 15 minutes has elapsed from the turn-off. If the patient has been discharged but the monitor has been on, you can retrieve approximately the last 24 hours.

NOTE: This selection is available if the patient is already admitted on this monitor.

Automatic saving of patient data

The monitor continuously and automatically collects and saves patient data such as trends., Saving is activated once the patient is admitted or the monitor receives vital data.

If the monitor is not connected to the network, patient data is saved to the monitor memory.

If the monitor is connected to the network patient data is automatically saved to the network. The network saves data from up to 2 to 90 days. The amount depends on the network configuration.

Discharging the patient

When you end monitoring, discharge the patient. The monitor erases screen layout, trend data and alarm and parameter settings that were active during monitoring, and returns to the starting mode and its settings.

1. Press the **Admit/Discharge** key.
2. Select ***Discharge*** - ***Yes***.

NOTE: Please wait the message “discharged“ appear in the screen, then turn off the monitor if you need, and please wait about 30 seconds at least to power on.

Table of contents

8 Printing and recording

Overview

You can manage recording and printing via the ***Print/Record*** menu. For recordings, you need a module with the built in recorder, N-FCREC or N-FREC, and for printouts you need a laser printer (PCL5 compatible, min. 2 MB memory). The monitor can be connected to a laser printer via network.

You can record and print waveforms, measurement values. If you need to record or print just one view of trends, on one page, you can do that in the corresponding measurement menu. If you need to record or print several pages or all the data gathered and about several parameters, you need to enter the ***Print&Record*** menu.

Recording

The recorder:

– records up to three real-time waveforms simultaneously

– displays recordings of numerical information in horizontal and vertical plane

– prints up to 72 hours or graphical and numerical trend data

NOTE: Printings on thermal paper may be destroyed when exposed to light, heat, alcohol, and so on. Take a photocopy for your archives.

Recorder description

Module with recorder, N-FREC or N-FCREC

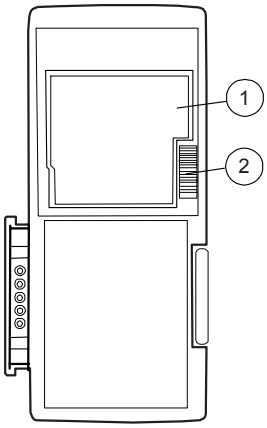


Figure 8-1 N-FREC module with built-in recorder

(1) Recorder

(2) Paper compartment lever

Side panel key

Use the **Start Stop** side panel key to start and stop local recording immediately. Note that this key is functional only when N-FREC or N-FCREC modules are used.

Recording waveforms

You can record three waveforms to a local recorder:

1. Press the **Print/Record** monitor key and select ***Record Waveforms*** - ***Record to Local.***
2. ***Stop Waveforms***.

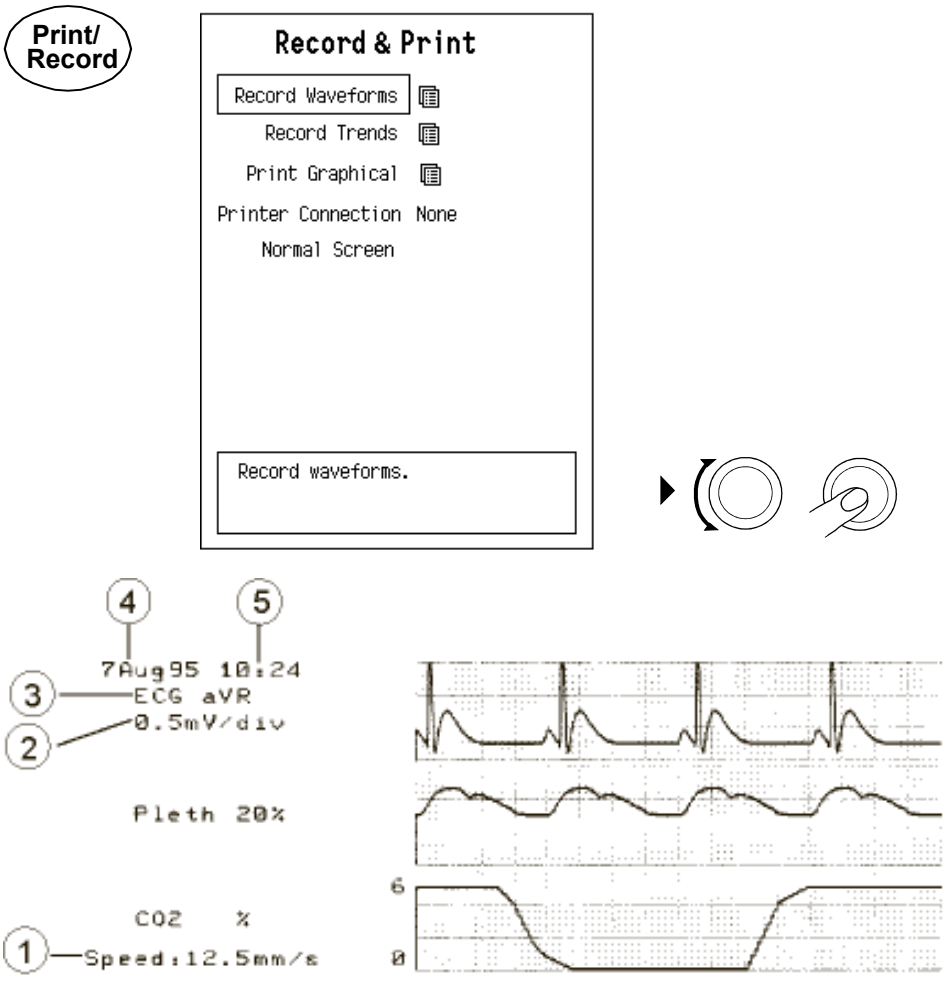


Figure 8-2 Sample of recording

(1) Recorder speed
(2) Scale
(3) Selected waveform
(4) Date
(5) Time

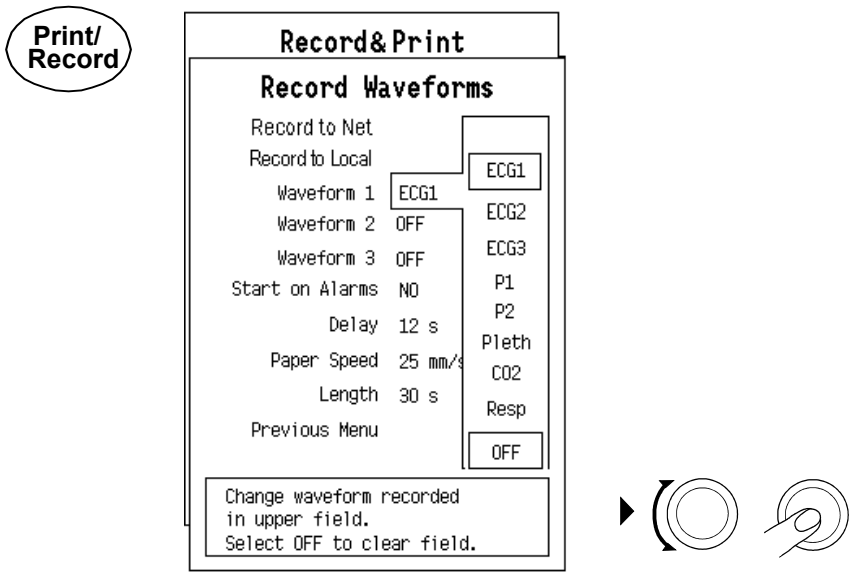
NOTE: Waveform scaling follows the displayed parameter scaling, when applicable.

Selecting waveforms for recording

You can select which waveforms and how many of them you want to record.

1. Press the **Print/Record** key.
2. Select ***Record Waveforms***.
3. Select ***Waveform 1*** and a parameter for it (see the list below), or select ***OFF***.
4. Select ***Waveform 2*** and ***3*** and their parameters.

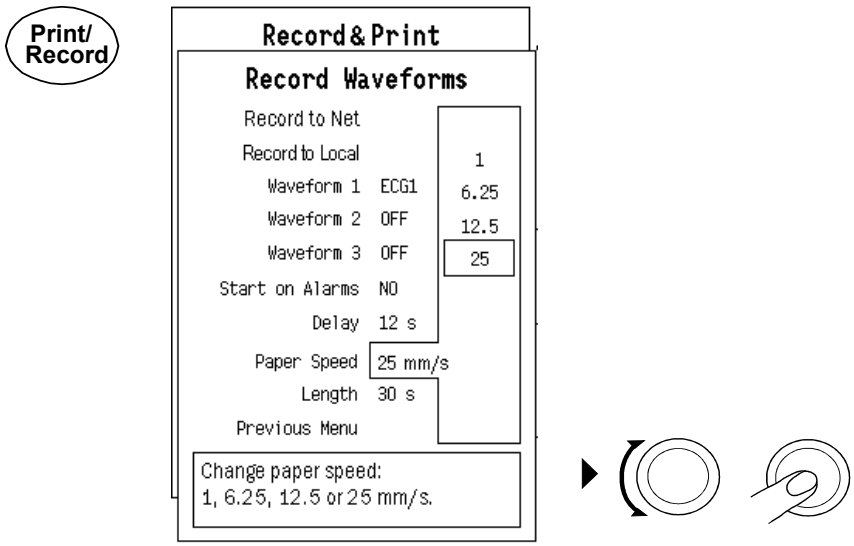
You can record simultaneously up to three waveforms. The following menu figure shows which parameters have recordable waveforms.



Changing the paper speed

To see the waveforms more clearly or more generally, you can change the paper speed. The recorder speed can be 1, 6.25, 12.5, or 25 mm/second.

1. Press the **Print/Record** key.
2. Select ***Record Waveforms***.
3. Select ***Paper Speed***.



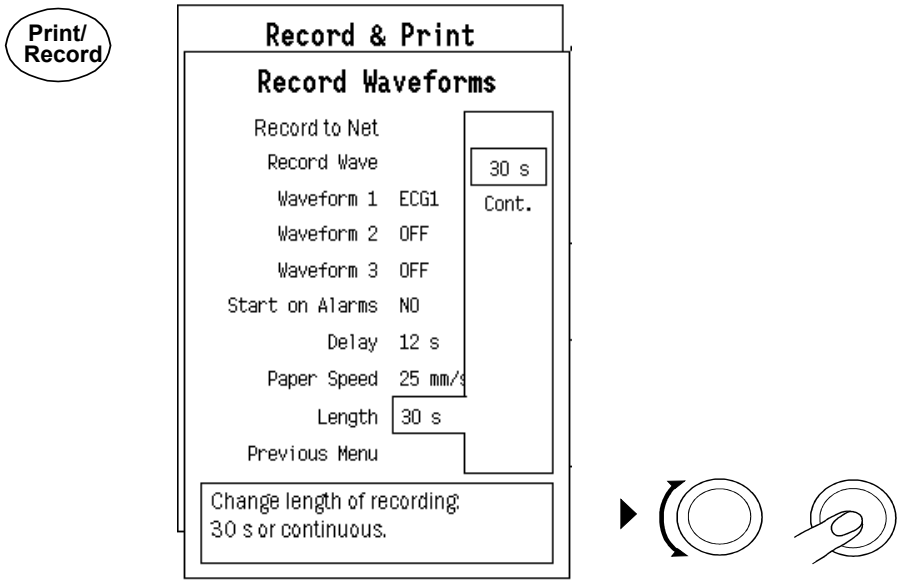
Controlling the recording time

You can adjust the recording time to be 30 seconds or continuous, which means that the recording continues until the recorder runs out of paper.

1. Press the **Print/Record** key.
2. Select ***Record Waveforms***.
3. Select ***Length*** and choose ***30 s*** or ***Cont***.

The default setting for the recording time is 30 seconds.

NOTE: When recording is activated by alarms, the recording time is always 30 seconds.



Selecting the recording delay time

If the recording delay time is set to OFF, the recording starts when an event occurs and continues for 30 seconds or until it is manually stopped, or until the recorder runs out of paper (see "Controlling the recording time" on page 8-4). If the delay time is set to 12 seconds (default), the recording starts when an event occurs and the 12 seconds prior to the event are recorded from the recorder memory. The recording continues for 18 seconds if the length has been set to 30 seconds (see "Controlling the recording time" on page 8-4) or until the recorder runs out of paper.

To change the delay:

1. Press the **Print/Record** key.
2. Select ***Record Waveforms***.
3. Select ***Delay*** and ***OFF*** or ***12 s***.

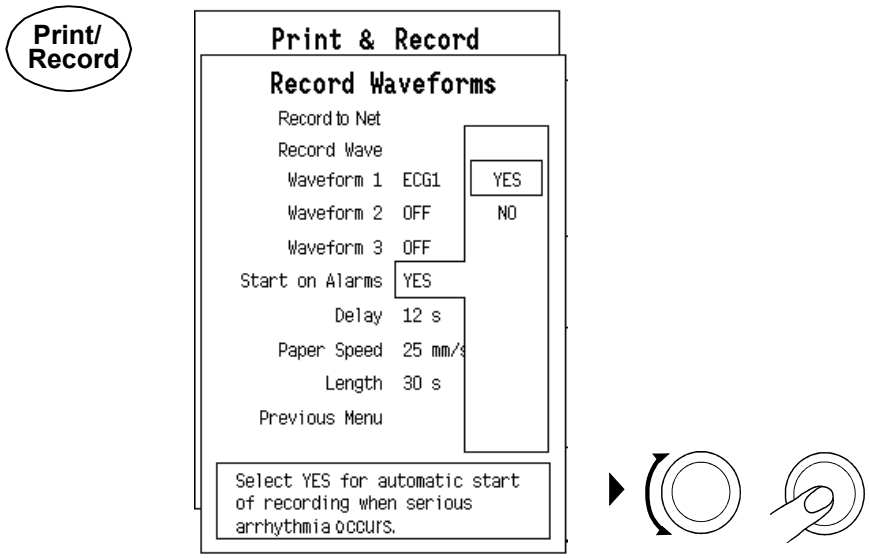
The recording can be started manually, or automatically when certain alarms occur. The automatic alarm recording is explained in the following.

NOTE: When recording is activated by alarms, the delay is always 12 seconds.

Recording on alarms

An automatic strip chart recording is activated when the following alarms reach the red level: Asystole, Tachy, Brady, Art High, Art Low, V Fib, and V Tachy. When recording is activated by alarms, the recording time is always 30 seconds and the delay always 12 seconds.

1. Press the **Print/Record** key.
2. Select ***Record Waveforms***.
3. Select ***Start on Alarms*** and ***Yes***.



The following alarms start recording:

Alarm	Recorded parameters
Asystole	ECG1 + Art waveforms, 25 mm/s
Tachy/Brady	ECG1 + Art waveforms, 25 mm/s
Art High/Low	ECG1 + Art waveforms, 25 mm/s
V Fib	ECG1 + Art waveforms, 25 mm/s
V Tachy	ECG1 + Art waveforms, 25 mm/s

Arrhythmia analysis	Alarms which start the recording (if the alarm is set on/level red)
Severe	Asystole, Tachy/Brady, Art High/Low, V Fib, V Tachy

All alarm recordings are marked with the alarm source.

Recording trends

To record trends:

1. Press the **Print/Record** monitor key.
2. Select ***Record Trends*** – ***Record Numerical*** or ***Record Graphical***.
3. Stop recording by selecting ***Stop Numerical*** or ***Stop Graphical***.

You can record numerical, graphical or tabular trends.

Recording numerical trends

Since the contents of the numerical trends are preconfigured, you cannot choose the parameters or change their order.

The following parameters are printed in the numerical trend record:

Parameter	Printed values and units
HR and SpO2	bpm/SpO2
NIBP	Sys/dia or mean mmHg
P1 “Art“	Sys/dia or mean mmHg
P2 “CVP“	Sys/dia or mean mmHg
T1/T2	Celsius or Fahrenheit
CO2	ET/FI %, kPa or mmHg
Resp. Rate	Breaths per minute

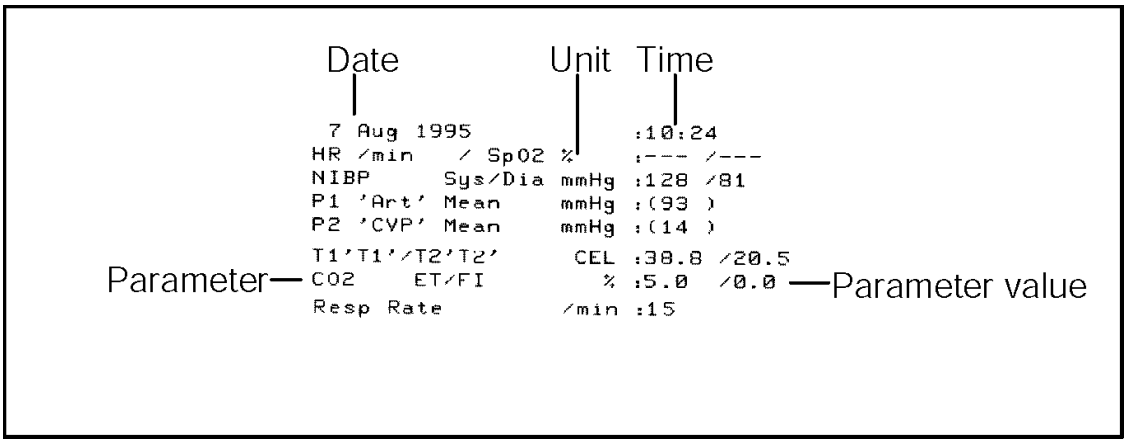


Figure 8-3 Numerical trend printout

For pressures, either Sys/Dia or Mean are recorded depending on the digit format selected in the pressure setups. PCWP is measured from the pressure channel labeled PA.

Selecting the format for the recorded numerical trends

You can select the format for the recorded numerical trend to be either ***Num.*** (vertical) or ***Tab.*** (horizontal):

1. Press the **Print/Record** key and select ***Record Trends***.
2. Select ***Num Trend Type*** and ***Num.*** or ***Tab***.

Changing resolution

To select the resolution of a numerical or tabular trend record:

1. Press the **Print/Record** key and select ***Record Trends***.
2. Select ***Trend Resolution***. Choices are: every 1 minute, 5 minutes, 10 minutes, 30 minutes.

Tabular trend format

Tabular trend printout	
Parameter	**Printed values and units**
HR	bpm
SpO_2	%
NIBP or Art	sys/dia mmHg
CO_2	Et%, mmHg or kPa

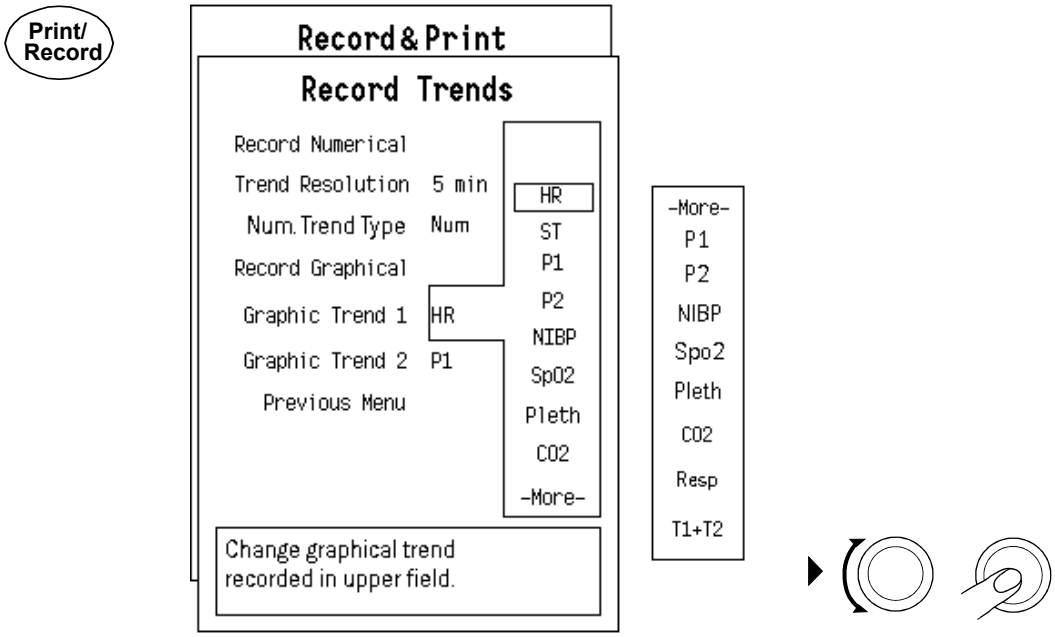
Selecting graphical trends

You can record graphical trends of two parameters.

To select the parameters for the graphical trends:

1. Press the **Print/Record** key.
2. Select ***Record Trends***.
3. Select ***Graphic Trend 1*** or ***Graphic Trend 2***.

The following figure shows which parameters have graphic trends that you can record.



Inserting recorder paper

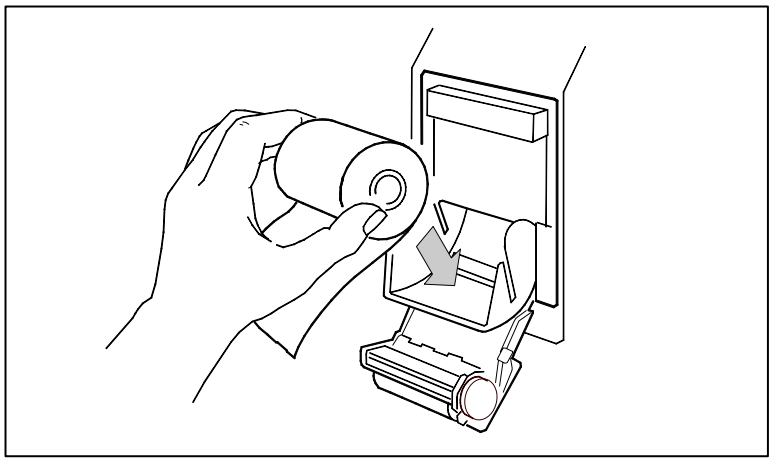


Figure 8-4 Inserting recorder paper

Printing

NOTE: Before you start printing, check that the printer is operational.

You can print to a laser printer:

– Graphical or numerical trends

You can print several pages or trend data through the ***Print/Record*** menu.

Printing currently displayed screen contents

To print a trend view

1. Press the **Pt.Data & Trends** key.
2. Select ***Trends*** - ***Graphical/Numerical***.
3. Select the desired trend page with ***Scroll Pages***.
4. Select ***Print Page***.

Printing all the information

To print several pages of graphical trend data:

1. Press the **Print/Record** key.
2. Select ***Print Graphical***.

Changing the printer

If you need to change the printer connection:

1. Press the **Print/Record** key.
2. Select ***Printer Connection***.
3. Select the printer from the list.

The default printer is set during configuration, see section "Monitor setup."

Other adjustable features

To adjust the ECG printout type, default printer connection or default paper size, please, see section "Monitor setup."

Table of contents

9 Cleaning and care

Overview

For safe and reliable function and operation of the monitor, regular care has to be carried out according to the instructions in this manual and to the maintenance procedures described in the "Technical Reference Manual"."

WARNING **Use only approved accessories, including mounts and batteries, and defibrillator-proof cables and invasive pressure transducers. For a list of approved accessories, see the "Supplies and Accessories" catalog delivered with the manual. Other cables, transducers and accessories may cause a safety hazard, damage the equipment or system, result in increased emissions or decreased immunity of the equipment or system or interfere with the measurement.**

If the monitor does not function as it should and troubleshooting cannot solve the problem, contact your service or sales representative. Do not perform any other cleaning or maintenance procedures than those described in the monitor manuals.

NOTE: Refer to the accessory package for detailed cleaning instructions.

Preventive maintenance

Daily and between the patients

- Wipe the monitor and module surfaces.
- Wipe the ECG trunk cable and leadwires, NIBP cuff and cables and SpO_2 sensors. Avoid excessive use of liquids.
- Change or sterilize all airway and invasive patient accessories.
- Clean, disinfect or sterilize reusable temperature probes.
- Empty the D-fend water trap whenever half full.
- Check that all accessories, cables and monitor parts are clean and intact.
- Clean the device as described in the "Cleaning" part of this section.
- When you start monitoring, check that the module is firmly in place, the accessories are intact and properly connected, and that you have selected desired parameters to be displayed in digit and waveform fields.
- Check/note the following points regarding different parameters.

Regular checks

When you start monitoring, check that:

- The module is firmly in place.
- Accessories are intact and properly connected.
- You have selected desired parameters to be displayed in the digit and waveform fields.

ECG and impedance respiration

- Check that the message 'Leads off' disappears and the waveforms are displayed when the cable is connected to the patient.

Pulse oximetry

- Check that the red light is lit in the sensor.
- Check that the SpO_2 value is displayed and the message 'SpO_2 probe off' disappears when the sensor is connected to the patient.

Temperature

- Check that the temperature value is displayed when the probe is connected to the patient.

InvBP

- Check that the monitor recognizes cable connections (activates the display) for all the pressure channels used and the pressure values are shown.
- Make sure all transducers are zeroed correctly.

NIBP

- Ensure that you are using correct cuff size and have selected correct inflation limits. For children and when using hoses without identification, the inflation limit must be set manually.
- Check that the cuff hose detection works properly.
- Check that the pressure values are displayed.
- Start the Venous Stasis mode and check that the pump is not restarting during the measurement. If it does, the cuff may be leaking.

Airway gas (CO_2)

- Check that the water trap is empty.
- Occlude the sampling line and check that the message ‘Sample line blocked’ appears within 30 seconds and gas waveforms are showing zero at the same time.

Functioning of the alarms

- Set a parameter value outside the alarm limits. For example, connect the SpO_2 sensor and adjust the SpO_2 High limit under the measured SpO_2 values. The alarms go from medium priority (Yellow) to high priority (red) according to sequence given in the alarm categories table, see section ”Alarms.”

  Check that the yellow and red LEDs function as indicated in the table. To check audible alarms and alarm light, see section ”Alarms.” NOTE: Although SpO_2 may not be the best example because it is often off by default, it is easy to use for alarm checking.

  If the monitor does not work as described, see section ”Troubleshooting.”

Safety checks for software

The GE Healthcare software design controls include performance of a risk analysis using methods consistent with ISO 14971 Medical devices - Application of risk management to medical devices.

The monitor software employs watchdog timers, self-monitoring activities (memory, communication and sensor checks and so on), and power-on self-diagnostics (for example, memory checksums). For example, for SpO_2 the software continuously monitors the SpO_2 sensor and, if excessive sensor current is detected, the message 'Faulty probe' is displayed in the SpO_2 number field and 'SpO2 Faulty' in the monitor message field, and the old SpO_2 data is removed from the display.

Every six months

Gas calibration

Perform gas calibration for airway gas monitoring according to the instructions in the relevant section. If gas measurement is in extensive use, calibration is recommended every two months.

NOTE: Do not wash or disinfect calibration gas sampling lines.

Conditioning the batteries

Condition batteries regularly to maintain after their useful life. This is best done on an external charger. Condition a battery every six months or when the message 'Replace Battery x' appears status. You can also check the status through **Monitor Setup** - ***Battery Setup***.

If you do not have an external charger, proceed according to the following instructions. NOTE: You cannot condition batteries during patient monitoring. Always disconnect the modules first.

1. Continue normal battery use until the green bar of a battery charge indicator is less than 3/4 of the full height. After this, remove the battery. Continue monitoring with one battery until its charge is less than 3/4 of the full capacity.
2. Insert both batteries and connect the monitor to the power supply. The monitor starts charging both batteries, and the capacity indicators scroll accordingly. Keep charging the batteries until both capacity indicators are full height.
3. Continue charging for another two hours. After this, check that the orange battery LED in the front panel is no longer on. If it is, continue charging until it goes off.
4. Disconnect the monitor from the power supply and leave it on until the batteries run out and the monitor switches off. Wait for another 15 minutes.
5. Reconnect the monitor to the power supply and turn it on. Continue charging the batteries until both capacity indicators are full height and no longer scrolling.
6. Keep charging for another two hours. After this, check that the orange battery LED in the front panel is no longer on. If it is, continue charging until it goes off to indicate that the battery conditioning is complete.

Every 12 months

Preventive maintenance check

The annual check according to detailed instructions of the "Technical Reference Manual" requires trained service personnel and appropriate testing tools and equipment.

Calibration check of temperature, NIBP and invasive blood pressures

Calibration check of temperature, NIBP and invasive blood pressures should be performed at least once a year by qualified service personnel as a part of the Planned Maintenance, see "Technical Reference Manual".

Power interruption

NOTE: Always use the monitor with batteries inserted. Otherwise all trend data and temporary settings are lost if the power cable is detached from the mains. If the monitor is turned off, trend data and the latest user-made settings remain in the monitor memory for 15 minutes even if the mains power is interrupted. If not, contact service personnel. After 15 minutes, trend data is lost and the monitor returns to the user default settings (startup mode).

Changing fuses

1. Remove the power cord if used.
2. Remove the fuse holder by pushing the locking pin and pulling the holder gently out.
3. If a fuse is blown, replace it with a fuse of the correct type and rating.

NOTE: Only a qualified medical personnel allow to operate.

Cleaning

The appropriate cleaning procedure depends on where and how the part or accessory is used and on the patient's condition.

WARNING **Before cleaning, disconnect the monitor from the power supply.**

WARNING **After cleaning, ensure that every part of the system is dry before reconnecting it to the power supply.**

WARNING **If liquid has accidentally entered the system or its parts, disconnect the power cord from the power supply and have the equipment serviced by authorized service personnel.**

CAUTION Do not immerse any part of the device in liquids or allow liquid to enter the interior.

CAUTION Do not autoclave the device or its parts.

CAUTION Do not use hypochlorite-, acetone-, phenol- or ammonia -based cleaners, abrasive material or harsh chemicals as they may damage the surfaces of the device.

Permitted detergents and disinfectants

- Mild hospital detergents
- Ethanol
- Isopropyl alcohol
- Chlorite compounds
- Glutaraldehyde

Monitor casing

- Wipe with mild hospital detergent solution. Make sure not to leave any liquid spills on any metal part.
- Let dry completely before connecting to power source.
- Check ventilation holes and clean if necessary.

Modules

- Wipe the front panel as any monitor casing.
- Do not wash or immerse module in any liquid.

The internal sampling system of the airway module does no cleaning nor sterilization. The water trap functions as a bacteria filter and there is no reverse flow back to the patient. If the measuring chamber is suspected to be contaminated (for example, gas zero error), the airway module should be serviced by authorized service personnel.

Display

- Wipe all splashes immediately with a dry cloth.
- Wipe the LCD display after use with a cloth moisturized with mild detergent solution.

ECG cables

- Wipe the cables with mild detergent solution.
- Avoid excessive use of liquids.
- Disinfect when necessary.
- Allow the product to dry completely after cleaning.

Pulse oximetry sensors

The GE Healthcare pulse oximetry sensors are latex-free. Take possible patient allergies into account also when selecting the cleaning agent.

1. Detach the sensor from the patient and the monitor.
2. Wipe the sensor with mild detergent solution. Allow it to dry completely before use.

Sensors can be disinfected with chlorite compounds.

The sensors may be sterilized using an ethylene oxide mixture at 50 to 60°C / 120 to 140°F.

NOTE: After ethylene oxide sterilization, sensors must be well aerated in a ventilated place.

WARNING **A damaged sensor or a sensor soaked in liquid may cause burns during electrosurgery.**

WARNING **To prevent erroneous readings, do not use physically damaged sensors or sensor cables. Discard a damaged sensor or sensor cable immediately. Never repair a damaged sensor or cable; never use a sensor or cable repaired by others.**

WARNING **Allow the sensor and cable to dry completely after cleaning. Moisture and dirt on the connector can affect the measurement accuracy.**

Temperature probes

- Clean with mild detergent solution and rinse with water.
- Disinfect or sterilize when necessary.

NIBP cuff hose

- The cables and hose can be wiped with mild detergent solution.
- Disinfect when necessary.

NIBP cuff

The NIBP cuffs listed in the “Supplies and Accessories” catalog are latex-free. Take possible patient allergies into account also when selecting the cleaning agent.

- Clean only when necessary. Wash the cuff in mild detergent solution. Do NOT use alcohol.

Invasive blood pressure cables

- Wipe the cables with sterile alcohol-based detergent. After cleaning rinse surfaces by wiping them with a cloth damped with sterile water. Dry with a dry cloth.

Invasive blood pressure transducer

WARNING **Mechanical shock to the invasive blood pressure transducer may cause severe shifts in zero balance and calibration, and cause erroneous readings.**

Airway adapter

- Replace the single use adapter after each patient.

A reusable adapter can be disinfected with glutaraldehyde or alcohol.

If you want to clean the adapter before use: submerge the adapter in 70% alcohol solution for 30 seconds and rinse carefully with water.

Make sure that all traces of alcohol or detergent are rinsed away or dried before connecting to the patient.

Sampling line

- Do not reuse the sampling line. Reusing a cleaned sampling line may affect measurement results.

NOTE: Do not wash or disinfect calibration gas sampling lines.

Water trap

The water trap is based on a hydrophobic membrane, which prevents water and secretions from entering the measuring chamber. Condensed water and saliva are collected into a washable container.

Replace the water trap every 24 hours or when the message “Sample line blocked“ or “Replace D-fend“ persists.

The water trap container can be cleaned with disinfecting solutions or sterilized using cold chemicals or ethylene oxide.

CAUTION Do not disinfect or open the water trap cartridge. Do not touch the water trap membrane. The hydrophobic membrane is damaged if any cleaning is attempted other than rinsing with water.

To lengthen the lifetime of the monitor and minimize downtime:

- Empty the water trap container whenever it is more than half full.
- Do not open, wash or sterilize the water trap cartridge.
- After washing or disinfecting the water trap container, make sure there is no alcohol nor detergent left when used again. Traces of alcohol or other organic cleaning solutions may affect measurement.
- Do not force air or oxygen through the water trap.
- Do not allow smoke and dust to enter the water trap.
- While administering nebulized medication, disconnect the gas sampling line from the patient circuit for 30 minutes.

If the message ‘Sample line blocked’ alarm occurs:

- Replace the sampling line.
- Empty the water trap container. It may be full.

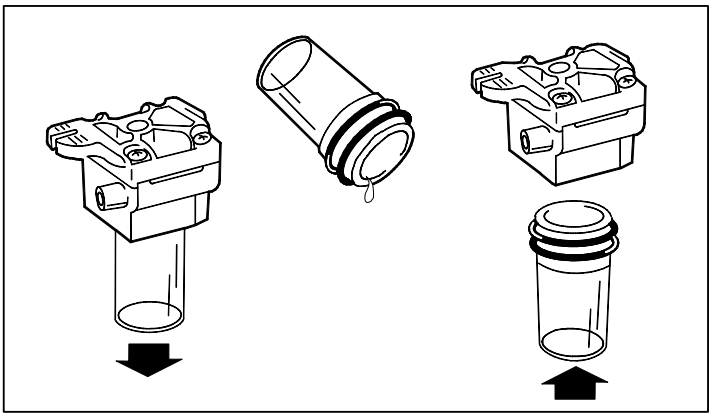


Figure 9-1 Emptying the water trap container

To remove the water trap, push the trigger above the water trap. The water trap is spring-loaded. The message 'Check D-fend' is displayed.

- Detach the container from the water trap cartridge by pulling it carefully downward.
- Empty and clean the container.
- Attach the container tightly back into the cartridge.
- Push the whole unit into its housing on the front panel until the latch is set.
- Press the **Normal Screen** key to restart monitoring. Check that the message 'Check D-fend' disappears.

Other accessories

See the accessory package for instructions for how to clean and check them. Do not reuse single-use disposable accessories.

Table of contents

10 Troubleshooting

Overview

The troubleshooting section consists of two parts which together should help you resolve the most common monitoring problems. The parts are "Checklist" and "Messages".

Checklist

Check the following things before monitoring to ensure that you have remembered to make all essential preparations, and if any problems occur during monitoring. Parameter-specific checklists can be found in the respective parameter sections.

Check that:

- The monitor and its modules do not have any visual defects such as cracks or loose parts.
- The batteries are inserted and charged.
- The power cord is connected to an electrical wall outlet and to the monitor.
- The modules are pushed properly into the frame and the monitor recognizes the module (parameter is displayed on the screen and menu selections are active).
- Patient connection cables are attached to the module connectors.
- Trends of the previous patient are erased.
- Alarm limits are suitable for the patient.
- The desired measurements have been selected for screen through **Monitor Setup – *Screen Setup - Waveform Fields*** or ***Digit Fields***.
- Disposable accessories are not reused.
- Sensors are not expired.

Power interruption

NOTE: Always use the B30 with batteries inserted. Otherwise all trend data and temporary settings are lost if the power cable is detached from the power supply.

If the monitor is turned off, trend data and the latest user-made settings remain in the monitor memory for 15 minutes even if the power (mains or external DC) is interrupted. After 15 minutes, trend data is lost and the monitor returns to the user default settings (start-up mode).

Messages

Table 10-1 Messages

Message	Explanation	What to do
Air leakage	Air leak in cuff or hose.	• NIBP: Check all connections and test tightness using Venous Stasis.
Alarms acknowledged (from Central)	Silenced alarms remain silent. New alarms will have an audible sound. (Can be done using the Central).	• If required, turn on the alarms through **Alarms Setup – *Audio ON/OFF – Activate Alarms***.
Alarm setup changed from Central	Alarm limits or arrhythmia alarm priorities have been changed using the Central.	• Check the alarm limits and the arrhythmia alarm priorities; see "Alarms" and "Troubleshooting".
Alarms silenced from Central	Alarms have been silenced using the Central.	• If required, turn on the alarms through **Alarms Setup – *Audio ON/OFF – Activate Alarms***.
Apnea	No breath detected for 20 seconds.	• Check the patient status. • Check the ventilator and breathing circuit.
Apnea deactivated	The case has just been started or the measurement has just been activated, and apnea alarm is not active yet. It will activate after 5 breaths.	• The message will disappear after the monitor detects three breaths.
Artifacts	Some artifacts (muscle activity, eye movements etc.). may disturb certain measurements.	• Calm the patient since patient movements, shivering, deep breathing, arrhythmia or irregular beats may cause some measurements to fail. • If applicable, start a new measurement.
Asystole	No QRS detected in ECG.	• Check the patient status. • Check the electrodes.
Battery low	About 20 minutes of battery operation time left.	• Replace the battery or connect the monitor to power outlet.
Brady	HR is equal to or below the lower alarm limit.	• Check the patient status.
Calibr. error	Unsuccessful gas calibration.	• Perform a new calibration.
Check D-fend	The water trap is not attached.	• Check that the water trap is properly attached to the module. If the problem persists, contact authorized service personnel.

Message	Explanation	What to do
Check NIBP	NIBP measurement affected by low blood pressure and pulsation, or a change in patient's condition.	• Check the patient status. • Check the measurement setup. • Check the cuff.
Check sample gas out	Sample gas outlet is blocked.	• Remove blockage from the sample gas outlet.
Check SpO2 probe	SpO_2: There is no detectable SpO_2 signal, the sensor is faulty or it is detached from the patient.	• Check the sensor and connections.
Cuff loose	Cuff is not attached to the patient or it is too loose. The hose is not connected to the module.	• Check cuff and hose.
Cuff occlusion	Tubes or hose are kinked.	• Check tubes and hose.
Cuff overpressure	Cuff is squeezed during measurement and pressure safety limits are exceeded.	• Check cuff, hose and tubes. • Restart measurement.
measurement off	Leads have been disconnected for 15 minutes for impedance respiration check or have just been connected (<15 seconds ago).	• Reconnect the leads or wait to continue the measurement.
EEPROM error or EPROM error	Faulty EEPROM circuit on the CPU board, or failure in CPU software memory.	• Call service to replace CPU.
Faulty ECG cable	The ECG cable is defective. The ECG cable may be electrically damaged or the connectors are wet.	• Change the ECG cable and the lead set. • Change the ECG module if the module connector is wet. Keep the connectors dry. • Avoid excessive use of liquids when cleaning cables and connectors.
Gas measurements removed		• Reconnect the N-FREC or N-FCREC module if you want to restart the CO_2 measurement.
Identical modules	There are two identical modules measuring the same parameter.	• You are trying to use two or more E-PSM(P)W modules or two or more N-Fx modules at the same time. You can only use one E-PSM(P)W and/or one N-Fx module at a time. Remove extra modules.
Infl. limits! Check setup	Adult or child cuff is used but infant inflation mode is selected.	• Check cuff and inflation limits.
InvBP's not zeroed	One or both InvBP channels have not been zeroed.	• Zero the channel indicated or zero both channels.

Message	Explanation	What to do
Lead changed	The monitor automatically switches the ECG1 waveform selection to a measurable ECG Lead (I, II, III, aVR, aVL, aVF or V) if the current ECG1 is not measurable. Note that the ECG waveform changes according to the lead it is measured from.	• Check the lead.
Leads off	ECG trunk cable or any of the leads is disconnected. Offset voltage between two electrodes is too high.	• ECG: Reconnect the disconnected trunk cable, electrode or leadwire. • ECG: Change the trunk cable, leadset and module.
Network down: xxx	Network cable is not connected. The Central is shut down.	• Check the network cable. • Check the Central.
NIBP manual	Autocycling mode is interrupted because of an air leak or loose cuff.	• Check the NIBP setup and restart autocycling.
No battery backup		• Replace the batteries.
Noise	Unreliable HR calculation or distorted waveform, possibly during defibrillation or because of motion artifacts.	• ECG: Check the patient status. • ECG: Check the electrodes. • Ensure that the patient is not shivering. • Poor electrode quality or wrong positioning. • Change the lead. • Remove the ECG cable from the connector and reinsert it.
No P1 transducer	Transducer or channel x cable disconnected.	• Connect the transducer or the cable.
No SpO2 probe	There is no SpO_2 probe.	• Check connection between the SpO_2 sensor and module.
No SpO2 pulse	No SpO_2 pulse can be detected.	• Try other measuring sites.
Poor signal	Signal is not sufficient.	• SpO_2: Change the measuring site.
Printer error	Printer is not working properly.	• Check that the network printer is operational.
Printing...	Printing network printer has started.	• Please wait until the printing is finished.
Printing ready	Monitor has completed sending printing data to the printer.	• Please wait until the printing is finished.
PVC rate limit changed	Limit has changed on the Arrhythmia Workstation	• Check the limit.

Message	Explanation	What to do
RAM error	Faulty RAM circuit on the CPU board.	• Contact authorized service personnel.
Recorder module removed	There is no recorder module.	• Reconnect the N-FREC or N-FCREC module if you need a recorder.
Replace Battery A Replace Battery B	There is hardly any charge left in one of the batteries. Also check the symbol on screen.	• Replace the battery as soon as possible.
Replace D-fend	Water trap is partially blocked. This decreases air flow.	• Replace the water trap.
Sample line blocked	The sampling line inside or outside the monitor is blocked, or the water trap is occluded.	• Change the sampling line and water trap.
Select inflation limits	You are using a hose without an automatic identification. When you try to start the measurement, the monitor goes automatically to the selection **NIBP Setup** - ***Inflation Limits***.	• Select appropriate inflation limits. NOTE: Auto option is not available for these hoses.
Sensor INOP	The gas measuring sensor is inoperative or the temperature in the module has increased.	• Contact authorized service personnel.
Small resp curve	Signal amplitude is less than 0.4 ohms.	
SpO2 probe off	The finger or ear lobe may be too thin or sensor halves are not aligned.	• Check connection between sensor and patient. • Replace the sensor.
SRAM error	Faulty SRAM circuit on the CPU board.	• Contact authorized service personnel.
Tachy	HR is equal to or above the higher alarm limit.	• Check the patient status.
Temperature error	The self-check has found an error in the temperature measurement.	• Contact authorized service personnel.
Unable to measure Dia	Accurate diastolic pressure not achieved because of artifacts, weak pulsation etc.	• Check the patient status. • Check the NIBP cuff placement. • Perform a new NIBP measurement.
Unable to measure Sys	Systolic pressure probably higher than maximum inflation pressure, or artifacts interfere in the systolic area.	• Check the patient status. • Check the inflation limits. • Perform a new NIBP measurement.
Unstable zero pressure	Pressure is unstable at start of the measurement.	• Calm the patient and retry.

Message	Explanation	What to do
Weak pulsation	Weak or unstable oscillation signal due to improper cuff position or attachment, weak or abnormal blood circulation, slow heart rate associated with artifacts, moving or disturbed patient during measurement, small air leak.	• Check the patient status. • Check the NIBP cuff position and attachments. • Check that the cuff is not damaged.
x-Lead off		• Check the leadwires and their connections.
x measurement(s) removed	Measurement module has been removed.	• Reconnect the module if you want to restart the measurement.
x high/low		• Check the patient status. • Adjust the alarm limits.
Zero error	Zeroing during gas calibration failed.	• Repeat the calibration procedure.
<0.6 (displayed in the RQ field)	Gas exchange measurement out of physiological range.	• Check the patient status.

Table 10-2 Other problems related to airway gas measurement

Symptom	Possible cause and solution
Airway gas values are too low	• Check the sampling line and connectors for leakage.

Table 10-3 Other problems related to arrhythmia measurement

Symptom	Possible cause and solution
Extra arrhythmia alarms	The morphology of the ECG signal has changed. • Start relearning manually through the ***ECG*** menu.
Extra Ventricular Fibrillations are detected	Patient's medical condition. • Check the patient status. Low amplitude signal in some ECG leads. • Leads I and II: Select the one with the largest amplitude to ECG1. • After selecting the leads, start relearning manually.

Table 10-4 Other problems related to batteries

Symptom	Possible cause and solution
Battery operation time is markedly shortened	• Condition the batteries according to the instructions in this manual.

Table 10-5 Other problems related to ECG measurement

Symptom	Possible cause and solution
ECG signal is noisy or no QRS is detected	• Ensure that the patient is not shivering. Incorrect ECG filter. • Check the filter through **ECG** - ***ECG Setup*** - ***Filter***. Poor electrode quality or wrong positioning. • Check the electrodes and cables and their placement. See section"ECG" for details. • Change the lead. • Remove the ECG cable from the connector and reinsert it.
Pacer markers are not visible	• Check that: - The pacer markers have been selected ON. - The pacemaker has been adjusted correctly and not above R. - The pacemaker functions correctly: ECG cables, electrodes and setups are correct.
Thick ECG baseline	ECG cable is looped. Other electrical power cables are near the ECG leadwires. Incorrect ECG filter. Incorrect power frequency of the monitor.

Table 10-6 Other problems related to impedance respiration measurement

Symptom	Possible cause and solution
Respiration measurement fails	• Check the electrode quality and positioning. • Adjust the detection limits. During ventilator-supported breathing, the respiration calculation may count only ventilator-produced inspirations and expirations. • Other electrical devices may interfere with the measurement.

Table 10-7 Other problems related to InvBP measurement

Symptom	Possible cause and solution
InvBP readings seem unstable	• Make sure there are no air bubbles in the transducer system. Flush and zero. • Place the transducer on the patient's mid-heart level and zero.

Table 10-8 Other problems related to NIBP measurement

Symptom	Possible cause and solution
NIBP measurement does not work or values seem unstable	• Check that cuff tubings are not bent, stretched, compressed or loose. • Prevent motion artifacts. • Use cuffs of correct size.

Table 10-9 Other problems related to temperature measurement

Symptom	Possible cause and solution
Temperature measurement fails	• Check that you are using a correct probe. • Try another probe.

Table 10-10 Other problems related to SpO_2 measurement

Symptom	Possible cause and solution
SpO_2 signal is poor	• Check the sensor and sensor positioning. • Change the averaging time from slow to normal. • Note that skin pigment causes differences. • Make sure that the patient is not shivering.

Other situations

The following table lists some other situations that may occur during monitoring and possible explanations.

Table 10-11 Other operation problems

Symptom	Possible cause and solution
Printing is not possible	• Printer selection is ***None***; change it through **Print/Record** - ***Printer connection***. • Printer is not connected to the network. Check printer cable.
The measured values are not displayed	• Check that you have selected the desired parameter to a waveform or digit field.
The monitor does not start	• Check that the power cord is properly connected. • Check that all cables are properly connected. • Check the fuses and replace them if necessary.
You cannot perform a measurement or a function	• Check that the measurement module is properly installed. • Check that all cables are properly connected. • Remove the module and reinstall it.

Table of contents

11 ECG

Overview

The electrocardiography, ECG, reflects the electrical activity generated by the heart muscle. ECG monitoring is used for a heart rate measurement, for arrhythmia analysis and for detecting pacemaker function and myocardial ischemia.

In Normal Screen, when measuring 5-lead ECG, you can simultaneously monitor the waveforms of up to three different ECG leads. In 3-lead ECG, the monitor displays one ECG lead.

When monitoring the ECG, the monitor simultaneously analyzes ST segment changes.

Module description

NOTE: You can use only one E-PSM(P)W module in the same monitor at a time.

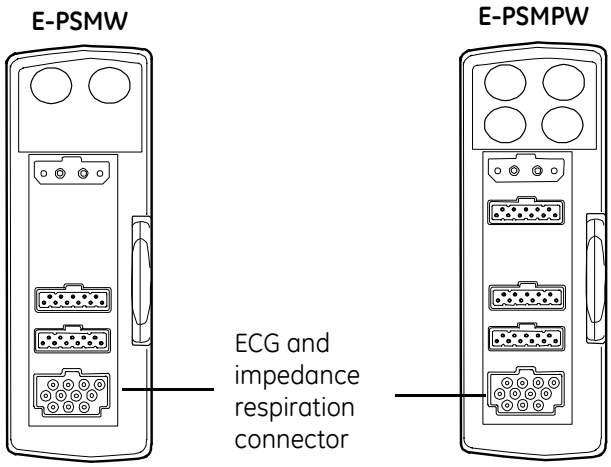


Figure 11-1 Modules for electrocardiographic (ECG) measurement

Displaying ECG and heart rate

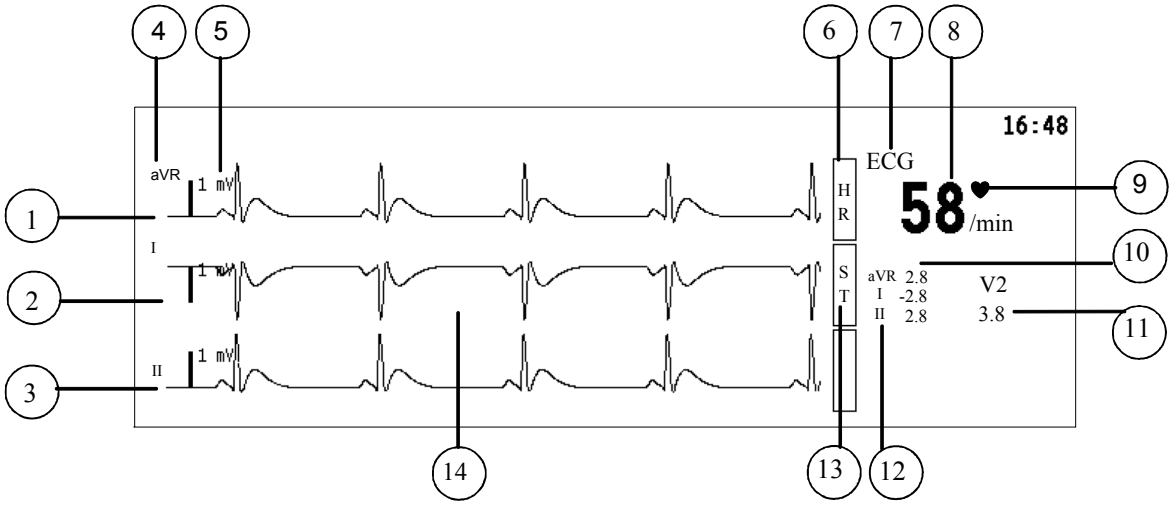


Figure 11-2 Display of ECG and HR

(1) ECG1 is displayed first
(2) ECG2 is displayed below ECG1
(3) ECG3 is displayed below ECG2
(4) Selected lead label
(5) ECG gain bar (1 mV reference)
(6) Heart rate (HR) label
(7) Heart rate/pulse rate source (ECG/Art/ABP/Pleth)
(8) HR/PR value
(9) Heart beat detector is flashing with every detected heart beat
(10) ST values are always displayed next to ECG2
(11) Fourth ST value, showing the largest absolute ST value
(12) Selected ST leads
(13) ST label
(14) Message field for parameter messages

NOTES:

- You can change the number of ECG waveforms on the screen in the ***Monitor Setup*** menu by selecting ***Screen Setup*** and ***Waveform Fields***. The ECG leads can be chosen in the ***ECG*** menu.
- The module input circuits are protected against the effects of electrosurgery and defibrillation. However, the ECG waveform on the monitor screen may be disturbed during electrosurgery.

Preparing the patient and placing the electrodes

Preparing the patient

- Prepare the skin properly to ensure optimal signal quality.
- Shave any hair from the electrode site. Gently rub the skin surface to increase capillary blood flow and remove dead skin cells and oil.
- Clean the skin using a mild soap and water solution.
- Dry the skin completely before applying the electrodes.
- Pre-gelled electrodes are recommended. Check that the electrodes are moist and have not dried out during storage.

Placing the electrodes

When placing the electrodes, avoid bones close to the skin, obvious layers of fat and major muscles.

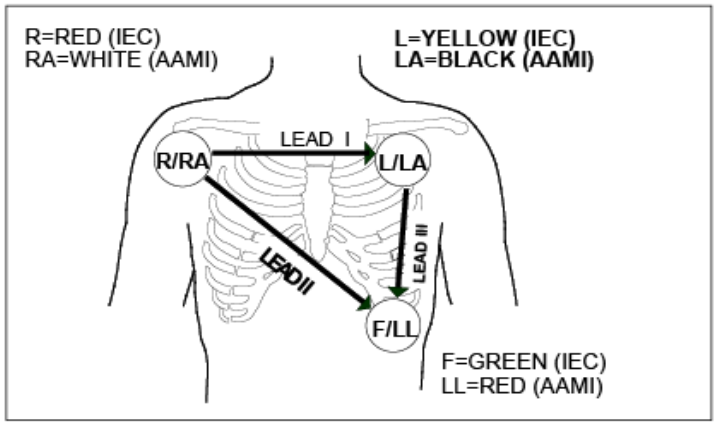


Figure 11-3 Electrode positioning with 3-lead ECG

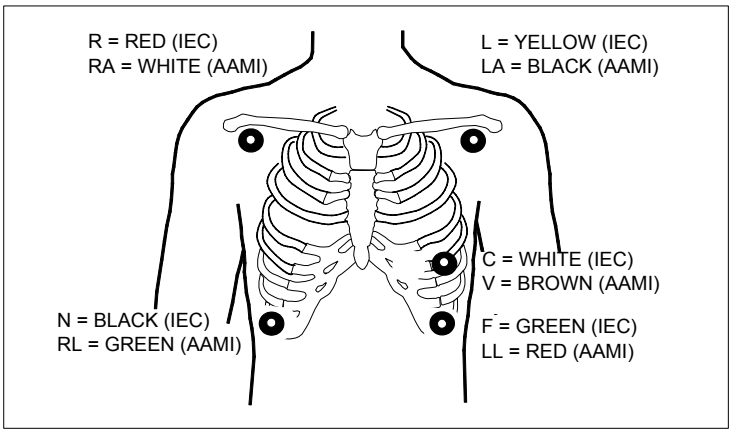


Figure 11-4 Electrode positioning with 5-lead ECG

Patient connection

NOTE: Keep the ECG cable, lead set and connectors dry. Avoid excessive use of liquids when cleaning the cables and connectors.

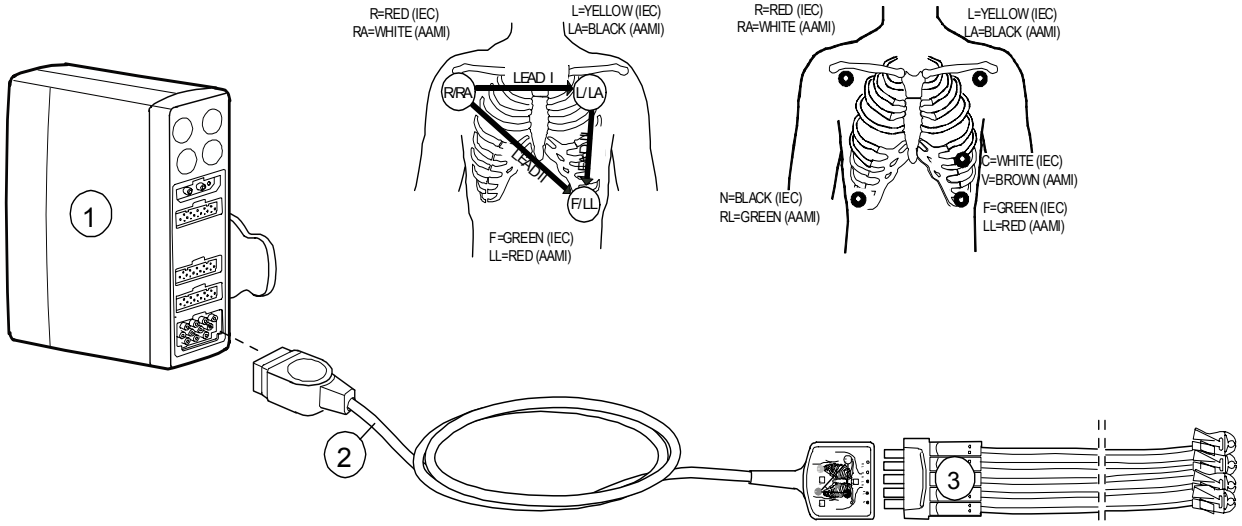


Figure 11-5 Example of the ECG setup with E-PSM(P)W module

(1) E-PSMW or E-PSMPW module

(2) ECG trunk cable, or 3-lead ECG cable with integrated leadwires

(3) 3 or 5 leadwire set

ECG electrodes (pre-gelled electrodes are recommended). Check the expiration data.

NOTE: For a comprehensive list of accessories, see the “Supplies and Accessories“ catalog.

Lead measurement

The following table lists the electrodes needed to measure different ECG leads:

Lead	Electrodes needed
I	R/RA, L/LA + F/LL or N/RL
II	R/RA, F/LL + L/LA or N/RL
III	LL/LA, F/LL + R/RA or N/RL
aVR	N/RL, R/RA, L/LA, F/LL
aVL	N/RL, R/RA, L/LA, F/LL
aVF	N/RL, R/RA, L/LA, F/LL
V5	N/RL, R/RA, L/LA, F/LL, C5

Color and letter coding

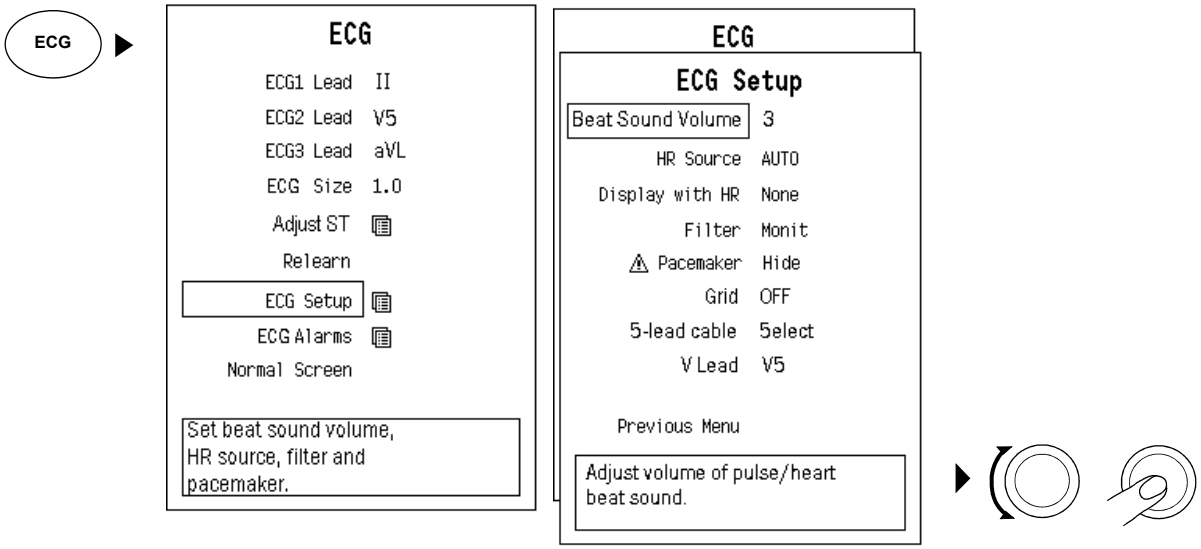
IEC standard

3-lead ECG	Position on body surface	5-lead ECG	Position on body surface	Position on surface
R = red	right arm	R = red	right arm	right arm
L = yellow	left arm	L = yellow	left arm	left arm
F = green	left leg	F = green	left leg	left leg
		N = black	right leg (neutral)	right leg (neutral)
		C = white	chest	4th intercostal space at right border of sternum

AAMI standard

3-lead ECG	Position on body surface	5-lead ECG	Position on body surface	Position on surface
RA = white	right arm	RA = white	right arm	right arm
LA = black	left arm	LA = black	left arm	left arm
LL = red	left leg	LL = red	left leg	left leg
		RL = green	right leg (neutral)	right leg (neutral)
		V = brown	chest	4th intercostal space at right border of sternum

ECG Setup menu



Beat Sound Volume

Adjusts the pulse/heart beat sound volume (0 to 10). When the monitor has detected a QRS complex or a pleth or pressure pulse, a beep tone is produced. You can raise, lower or turn off the volume.

Adjusting beat sound volume affects also the beat sound volume of the HR source (ECG, Art or Pleth).

When Pleth is monitored, the monitor provides a variable pulse beep, so that the tone of the pulse beep rises with increasing oxygen saturation and falls with decreasing saturation. This affects also the ECG tone.

HR Source Selects the heart rate source (***AUTO***, ***ECG, Art***, ***ABP*** or ***Pleth***). When ***ECG*** is selected, HR is always calculated from ECG. If the ECG signal is affected by too much noise for a reliable heart rate calculation, pulse rate can be calculated from pressure (Art and ABP) or plethysmographic pulse waveform. The selected heart rate source is displayed above the numerical display of the heart rate. The color of the heart rate source indicator is the same as that of the source parameter.

The ***AUTO*** selection priorities for heart rate calculation are: ECG, pressure (Art or ABP), plethysmographic pulse waveform. The first heart rate source available is selected.

Display with HR Select ***PR***, ***PVC*** or ***None*** to display combined heart rate and pulse rate or heart rate and PVC rate next to the ECG waveform. The current HR source is displayed with bigger font and the heart rate symbol flashes next to the reading.

Filter Filters the ECG signal high frequency noise and slow respiratory artifacts.

Monit (monitor) filter effectively filters the artifacts caused by, for example, the electrosurgery unit and respiration.

STfilt (ST filter) permits more accurate information of the ST segment. It filters the high frequency artifacts caused by the electrosurgery unit but catches the slow changes in the ST segment. The ST filter is more susceptible to baseline wander than the monitor filter.

Diagn (diagnostic) filter is used if more accurate information of the waveform is needed (for example, of the P wave or AV block). The diagnostic filter is more susceptible to both high frequencies and baseline wander than the monitor filter.

Pacemaker Selects how to display the pacing spike of cardiac pacemaker. The selections are:

Hide = The pacing spike is filtered away from ECG data.

Show = The pacing spike is filtered away from ECG data but the spike is displayed as a constant height marker.

Sensit = This selection uses a more sensitive pacemaker detection. Pacing spike is displayed on ECG.

Grid Selects the ECG gridlines to be displayed or not. If you select ***ON***, you can view the ECG waveforms over gridlines.

5-lead cable Selects five or three electrodes.

V Lead Selects the label for V lead according to the placement of the 5th electrode (see "Placing the electrodes" on page 11-3).

NOTE: Selectable with the 5 lead trunk cable only.

Selecting a lead

The following lead selections are possible:

– with 3 leadwire set: I, II or III

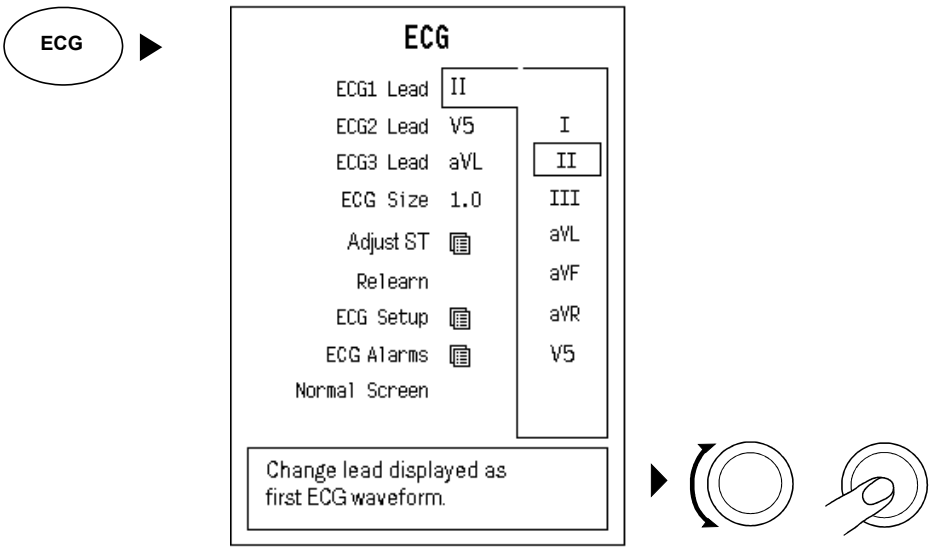
– with 5 leadwire set: I, II, III, aVL, aVF, aVR or V

– For channels ECG2 and ECG3, also a cascaded lead selection (***Casc***.) is available.

To select the ECG1 lead:

- Press the **ECG** key and select ***ECG1 Lead***.

You can select all leads (ECG1, ECG2 and ECG3) in the ***ECG*** menu.



The label of the lead is displayed in the ECG field.

Selecting user leads

1. Press the **ECG** key.
2. Select a lead for ***ECG1 -3 Lead***.

With 3-lead ECG, you can select only one user lead (***ECG1 Lead***). With 5-lead ECG, you can select three user leads.

Viewing a cascaded ECG

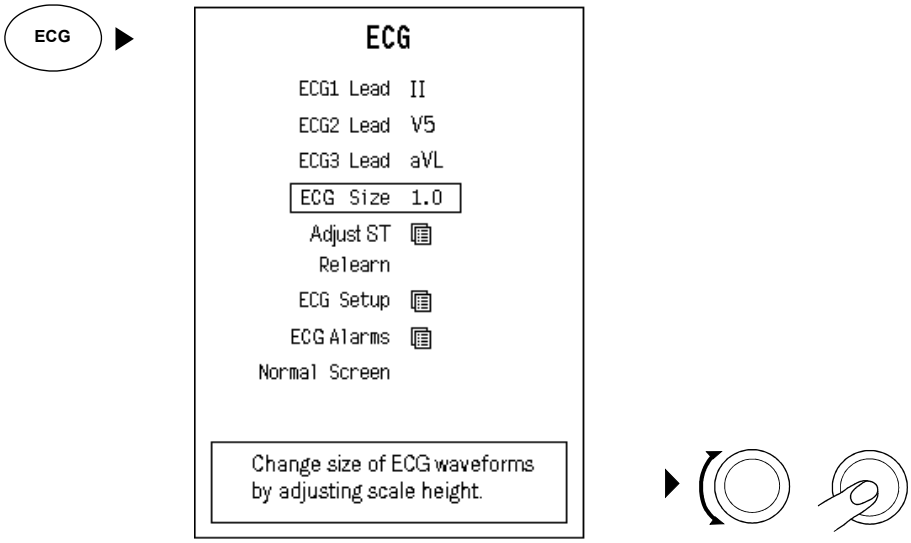
With a 3 leadwire set, ECG2 and ECG3 leads are automatically shown as cascaded. The same ECG will be displayed in each waveform field. Thus more QRS complexes are displayed at the same time.

With a 5 leadwire set either a cascaded ECG or different leads can be displayed. Select the leads in the ***ECG*** menu.

- To cascade a lead, press **ECG** and select ***ECG2/ECG3 Lead - Casc***.

Adjusting the ECG size

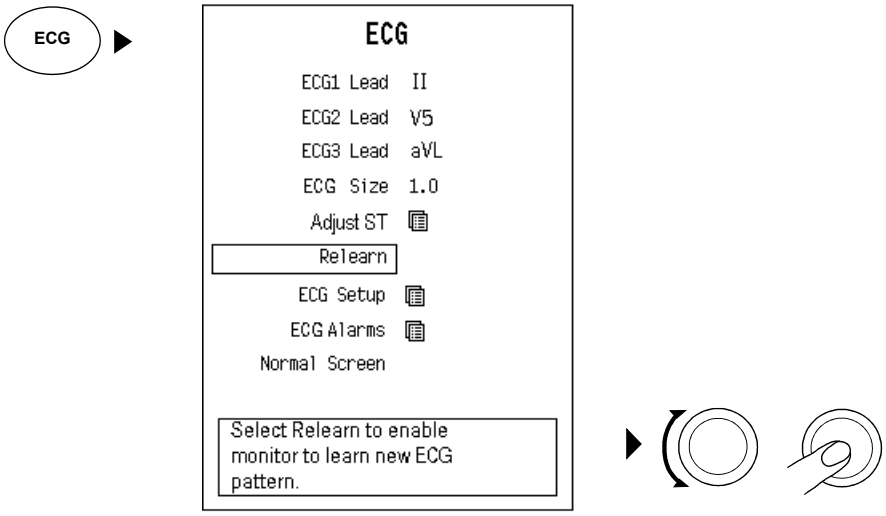
Increasing or decreasing the ECG gain affects the size of the 1 mV bar at the left end of the ECG waveform and the size of the ECG waveform accordingly.



Starting relearning manually

When the patient's ECG pattern changes considerably, the monitor should start relearning a new ECG pattern. The pattern changes, for example, when changing the patient's position. To start relearning manually:

1. Press the **ECG** key.
2. Select ***Relearn***.

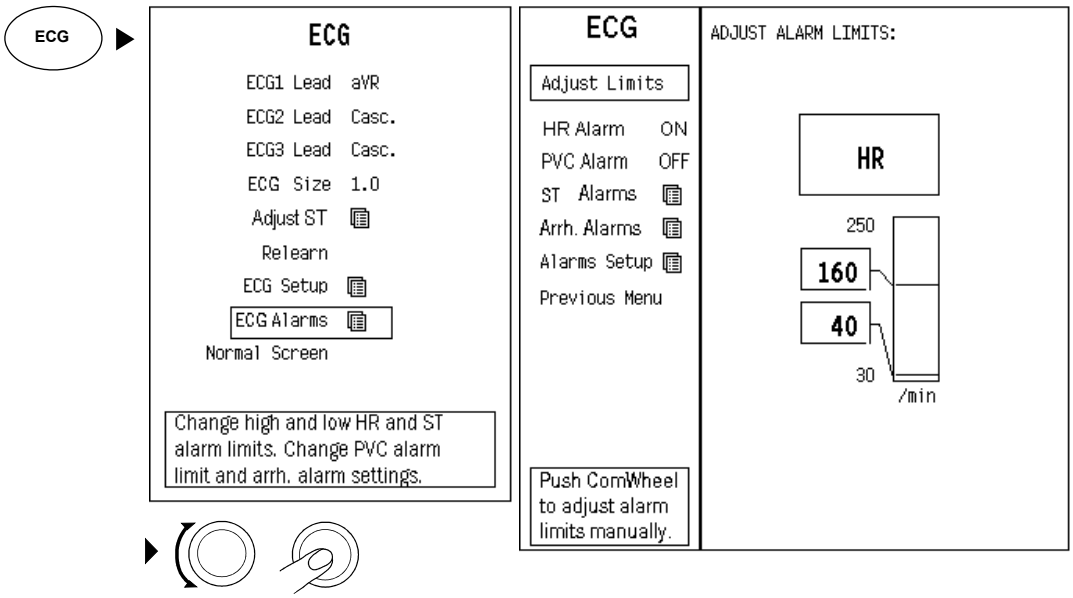


Setting heart rate alarm limits

To set the heart rate alarm limits:

1. Press the **ECG** key.
2. Select ***ECG Alarms***.
3. Select ***Adjust Limits***.

You can also adjust the limits through **Alarms Setup** - ***Adjust Limits***. For detailed instructions, see section "Alarms."

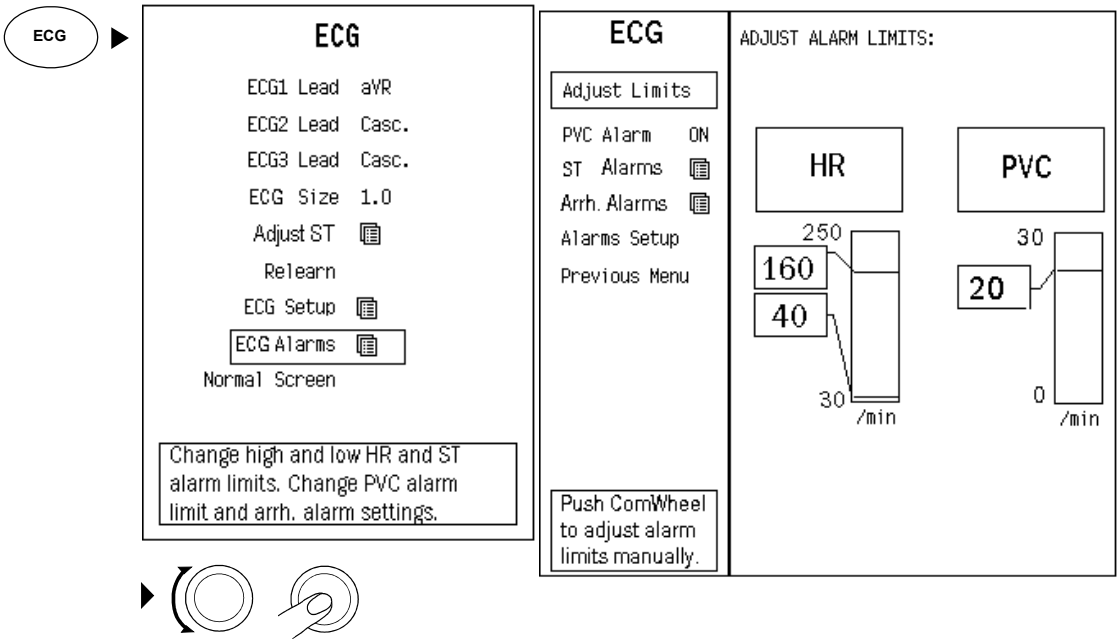


Setting PVC alarm limits

To set the PVC alarm limits:

1. Press the **ECG** key.
2. Select ***ECG Alarms***.
3. Select ***PVC Alarm*** - ***ON***.
4. Select ***Adjust Limits***.

You can also adjust the limits through **Alarms Setup** - ***Adjust Limits***. For detailed instructions, see section "Alarms."



ST segment analysis

Overview

The ST value, analyzed by the monitor, shows the difference of electrical activity between ISO and ST points.

Myocardial ischemia appears in the ECG as an ST segment deviation from the isoelectric line (ISO point). The ST segment generally rises above the PQ isoelectric line in the presence of transmural ischemia and is pressed below the isoelectric line in the subendocardial ischemia.

NOTE: ST segment changes may also be affected by such factors as drugs or metabolic and conduction disturbances.

NOTE: The significance of the ST segment changes needs to be determined by a physician.

Display of ST

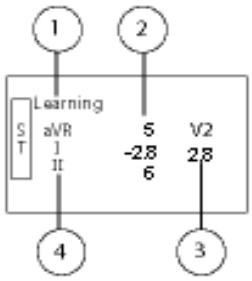


Figure 11-6 ST number field

(1) Message field

(2) ST values of ECG1, ECG2, and ECG3

(3) Fourth ST value showing the largest absolute ST value

(4) Lead label

NOTE: ST segment deviations are not displayed if the patient has a ventricular pacemaker in use.

Monitoring the ST segment

The monitor analyzes ST for all measured leads and gives ST trends separately for each lead. Numerical ST data is shown to the right of the second real-time ECG waveform field.

You can also select numerical ST data to the lower digit field. Press the **Monitor Setup** key and select ***Screen Setup - Digit Fields***. Select ST data to the field you prefer.

The ST analysis starts automatically after the leads have been connected and the QRS detection has started. During a learning period of 32 accepted beats the median ST values are displayed. Also, when the cable or the V lead is changed, or when an electrode is removed, or relearning is started manually, the monitor starts to learn the ST segment.

NOTE: If the patient has an atrial pacemaker, ST calculations can be performed if the pacer spike does not coincide with the ISO point's adjustment range.

Setting the ST measurement points

Automatic setting of the J, ST and ISO points

The ST algorithm automatically searches for the J and ISO points. The distance between the ST and J point is set according to the heart rate:

– If the heart rate is less than 120 bpm, the ST point is set at J+80 ms.

– If the heart rate is more than 120 bpm, the ST point is set at J+60 ms.

Setting the J, ST and ISO points manually

You can also set the J, ST and ISO points manually. If any of these points is manually set, the other two are set at their current values.

Select ***Adjust ST*** and ***Set ISO point***, ***Set J point*** or ***ST point***.

- Setting the J point manually

  The J point is the point on the ECG trace where the S wave transitions to the ST segment.

  Adjust the J point by turning the ComWheel and confirm by pushing the ComWheel. If the J point setting is changed, the original point is shown as a dashed line. When you adjust the J point, also the ST point is set according to the selected ST point setting (J+20, J+40, J+60 or J+80).

  The manually set J point remains until the monitor is turned off or reset. After a turn-off or reset, the J point is set automatically.

- Setting the ST point manually

  ST segment is the component of the ECG trace between the end of the QRS complex and the T wave.

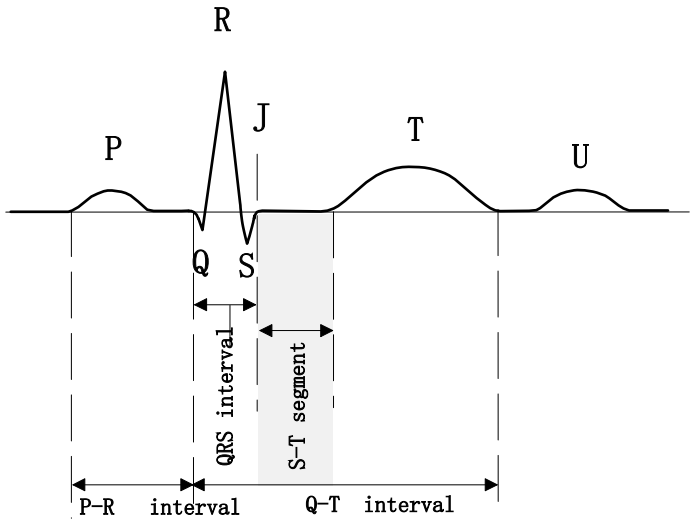
  Manual ST point adjustment sets the distance between ST and J points in ms. Selection values are J+20, J+40, J+60, J+80.

  The manually set ST point remains until the monitor is turned off or reset. After a turn-off or reset, the ST point is set automatically according to the heart rate.

- Setting the ISO point manually

  The ISO point is on the isoelectric line. Adjust the ISO point by turning the ComWheel and confirm by pushing the ComWheel. If the ISO point setting is changed, the original point is shown as a dashed line.

  The manually set ISO point remains until the monitor is turned off or reset. After a turn-off or reset, the ISO point is set automatically.

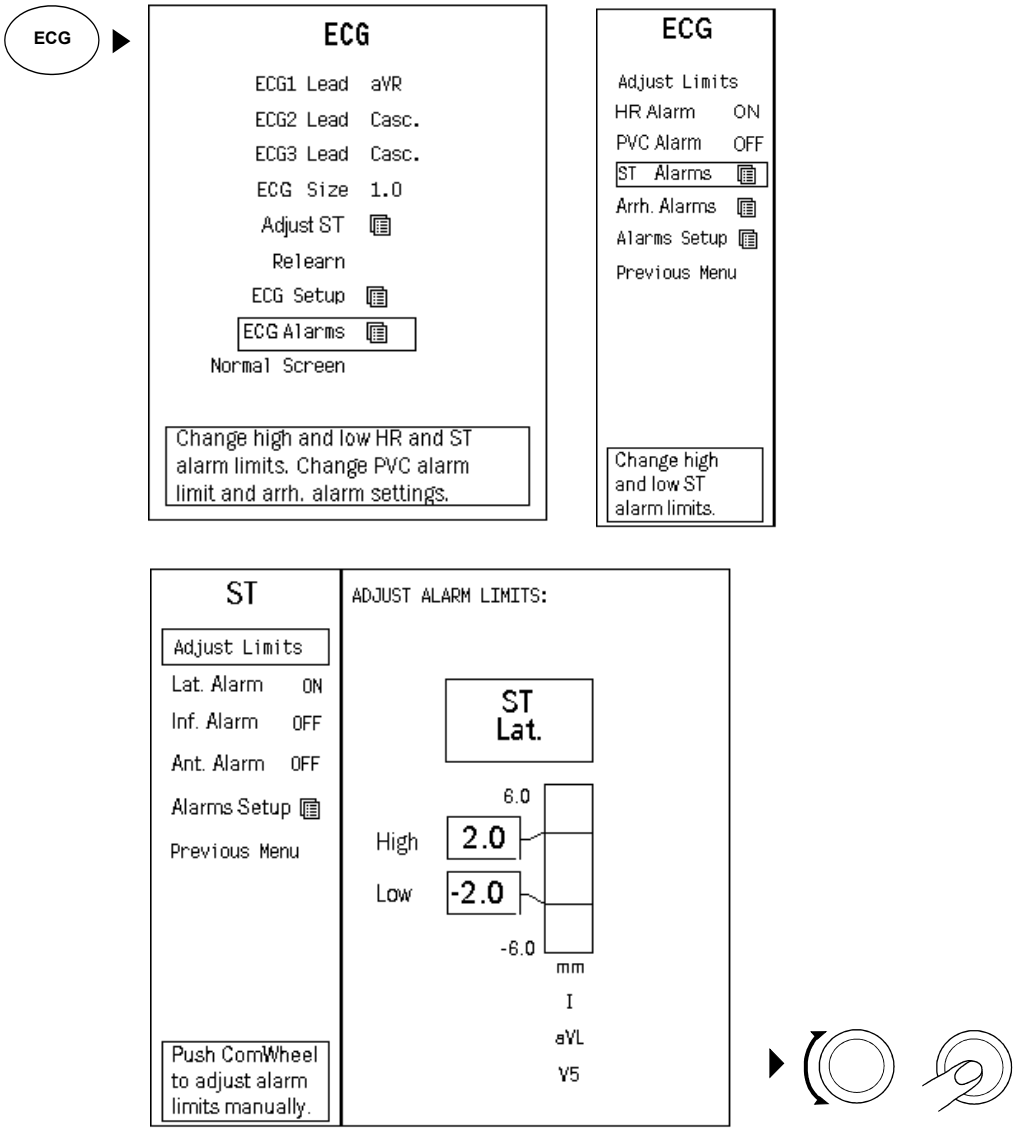


Setting ST alarm limits

To set the ST alarm limits:

1. Press the **ECG** key.
2. Select ***ECG Alarms***.
3. Select ***ST Alarms***.
4. Select ***Adjust Limits***.

You can also adjust the limits through **Alarms Setup** - ***Adjust Limits***.



Description of the ST segment measurement algorithm

The ST segment begins at the point where the QRS ends (J point). Diagnostic criteria of ST segment changes are measured at 60 ms after the J point. For monitoring purposes it is important to keep the measurement point fixed during monitoring to notice the ST changes on the respective trends.

The sophisticated algorithms of B30 monitors search the J and isoelectric (ISO) points. The system learns the ECG and stores the reference QRST complex. The algorithm sets the ISO and J points. Due to the large variation with QRST complexes the user has possibility to adjust the ST measurement points manually. The QRS analysis classifies each beat by using several criteria and rejects distorted complexes from the ST calculation.

NOTE: The ST algorithm has been tested for accuracy of the ST segment data. The significance of the ST segment changes needs to be determined by a physician.

Test results of ST segment measurement algorithm testing

The algorithm testing has been performed by using The European Society of Cardiology ST-T Database (ESC DB).

Average results from ischemic ST detection:

Episode sensitivity	84%
Episode positive predictive accuracy	70%
Duration sensitivity	64%
Duration positive predictive accuracy	74%

Monitoring arrhythmia

The ***Severe*** arrhythmia analysis mode used by the B30 detects asystole, bradycardia, tachycardia, ventricular fibrillation and ventricular tachycardia.

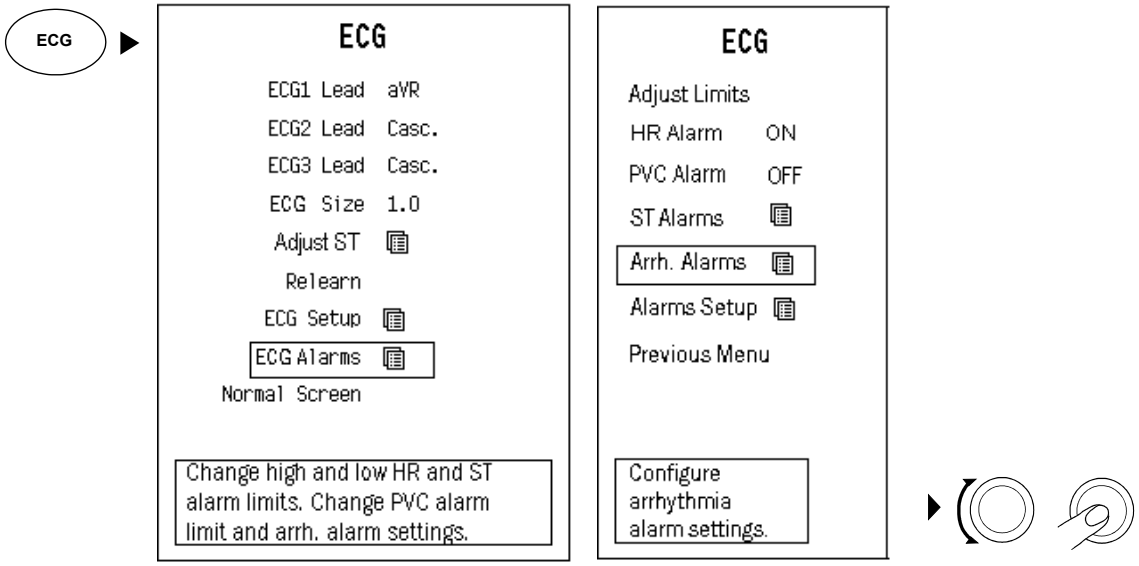
Adjusting arrhythmia alarm settings

To open the adjustment menu:

1. Press **ECG**.
2. Select ***ECG Alarms - Arrh. Alarms***.

In the adjustment menu, turn and push the ComWheel to select the priority for all alarms except asystole and ventricular fibrillation, which are always red (high priority), and ventricular tachycardia, which cannot be selected OFF.

NOTE: Alarm priorities can also be set using the Central, depending on its configuration.



Detecting the ECG arrhythmia alarms

Alarm	Criteria
Asystole	Cardiac arrest, no QRS complexes for five seconds.
Brady	HR below the HR alarm limit.
Tachy	HR over the HR alarm limit.
V Fib	Fibrillatory waveform caused by ventricular fibrillation.
V Tachy	Five or more consecutive PVCs and rate of successive beats over 100 bpm.

Selecting leads for the arrhythmia analysis

When measuring 5-lead ECG, you can affect the selection of the two ECG leads used for detecting beats and ventricular fibrillation. The selection of user leads (ECG1, ECG2, ECG3) on the monitor affects the leads used for detection. The first lead used for detection is lead I or II. The algorithm uses the lead appearing first in user leads. The second lead used for detection is one of the precordial leads (V1-V6). The algorithm uses the precordial lead appearing first in the user leads.

To change the user lead:

1. Press the **ECG** key.
2. Select a lead for ***ECG1 Lead, ECG2 Lead, ECG3 Lead.***

   The monitor starts relearning the new ECG pattern automatically.

NOTE: With the 3 leadwire trunk cable, the algorithm uses the only one available lead ***ECG1 Lead***, which is I, II or III, depending on the selected user lead.

Description of the arrhythmia algorithm

The bedside arrhythmia algorithm is based on template matching. A template is a group of beats matching the same morphology. The algorithm detects QRS complexes, generates QRS templates and performs beat labeling.

Parallel to this process there is an algorithm for detection of ventricular fibrillation. Detection of ventricular fibrillation is based on waveform analysis.

NOTE: A physician must analyze the arrhythmia information in conjunction with other clinical findings.

Test results of arrhythmia algorithm testing

The algorithm testing has been performed by using the following databases:

– AHA (The American Heart Association Database for Evaluation of Ventricular Arrhythmia Detectors)
– MIT-BIH (The Massachusetts Institute of Technology- Beth Israel Hospital Arrhythmia Database)
– NST (The Noise Stress Test Database)
– CU (The Creighton University Sustained Ventricular Arrhythmia Database)

Gross results for beat-by-beat detection (AHA)

Test	Gross
QRS Sensitivity	99.84%
QRS positive preductive accuracy	99.88%
VEB sensitivity	95.24%
VEB positive predictive accuracy	97.24%
VEB false positive rate	0.274%

Gross results for sample-by-sample detection of ventricular fibrillation (AHA)

Test	Gross
VF Sensitivity (duration)	99%
VF positive preductive accuracy (episode)	100%

The gross results are calculated as overall results of all records.

Abbreviations:

VEB	Ventricular ectopic beat
QRS	The waveform presented in an ECG during ventricular depolarization
VF	Ventricular fibrillation or ventricular flutter
ST	Segment of the ECG between the end of the QRS complex and the start of the T-wave.

Monitoring pacemaker patients

The monitor detects and rejects pacemaker pulses (see selection ***Pacemaker*** in the ***ECG Setup*** menu). Sometimes this may lead to unnecessary asystole alarms.

NOTE: The shape of QRS complex may be changed because of the pacemaker so much that QRS detection may be affected.

NOTE: If the patient has an atrial pacer, ST calculations can be performed if the pacer does not coincide with the ISO point's adjustment range.

NOTE: Pacemaker detector may not operate correctly during the use of high-frequency (HF) surgical equipment. The disturbances of HF surgical equipment typically cause false positive pacer detection.

WARNING **PATIENTS WITH PACEMAKERS: Do not rely entirely upon rate meter alarms when monitoring patients with pacemakers. The monitor may count the pacemaker pulses as heartbeats. In this case, asystole and ventricular fibrillation may go undetected. Always keep these patients under close surveillance and monitor their vital signs carefully.**

WARNING **Impedance respiration measurement may cause rate changes in Minute Ventilation Rate Responsive pacemakers. Set the pacemaker rate responsive mode off or turn off the impedance respiration measurement on the monitor.**

Other adjustable features

NOTE: This section describes the rest of the adjustable features related to ECG measurement. To adjust the following features, you need a password. If you wish to adjust the settings of the features, we recommend that you contact the person responsible for the entire configuration.

ECG printout type

See "Changing printer settings" on page 5-4.

ECG waveform sweep speed

To change the waveform sweep speed, **Monitor Setup - *Sweep Speeds***. Select ***Hemodynamics*** and adjust the value.

Checklist

Check that:

- Electrode gel is moist.
- Electrodes have good skin contact.
- Electrodes are positioned correctly.
- Correct leadwire set is selected.
- The trunk cable is connected properly.
- Leadwire set is properly connected to the trunk cable.
- Correct leadwire type is selected in the ***ECG Setup*** menu.
- Pacemaker selection in the ***ECG Setup*** menu is ***Show*** when a pacemaker is used.
- ECG is selected for screen through **Monitor Setup** - ***Screen Setup***.

Table of contents

12 Pulse oximetry

Overview

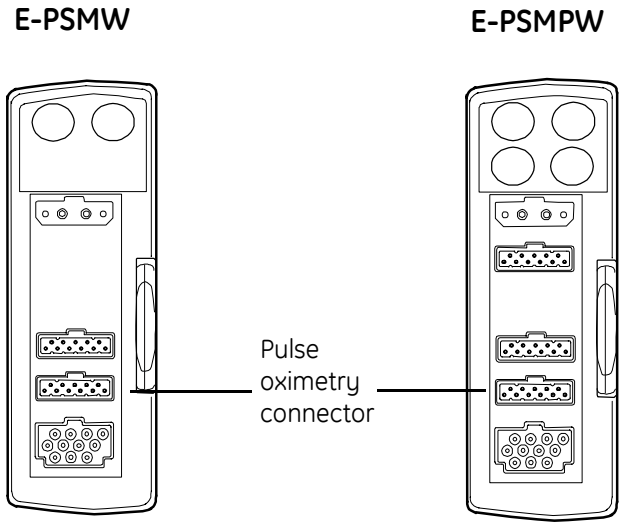
Oxygen saturation SpO_2 is the percentage of saturated hemoglobin compared to total hemoglobin measured by a two wavelength pulse oximeter (also called functional or In Vivo oxygen saturation.

The SpO_2 value is measured by light absorption technique: Red and infrared light is emitted from the emitter side of the sensor. The light is partly absorbed when it passes through the monitored tissue. The amount of transmitted light is detected in the detector side of the sensor. When the pulsative part of the light signal is examined, the amount of light absorbed by arterial hemoglobin is discovered and the saturation level can be calculated.

The plethysmographic pulse wave is derived from variations of the intensity of the transmitted light and reflects the blood pulsation at the measuring site. Thus the amplitude of the waveform reflects the perfusion.

Module description

NOTE: In the monitoring system, use only one module measuring pulse oximetry.



Display of pulse oximetry

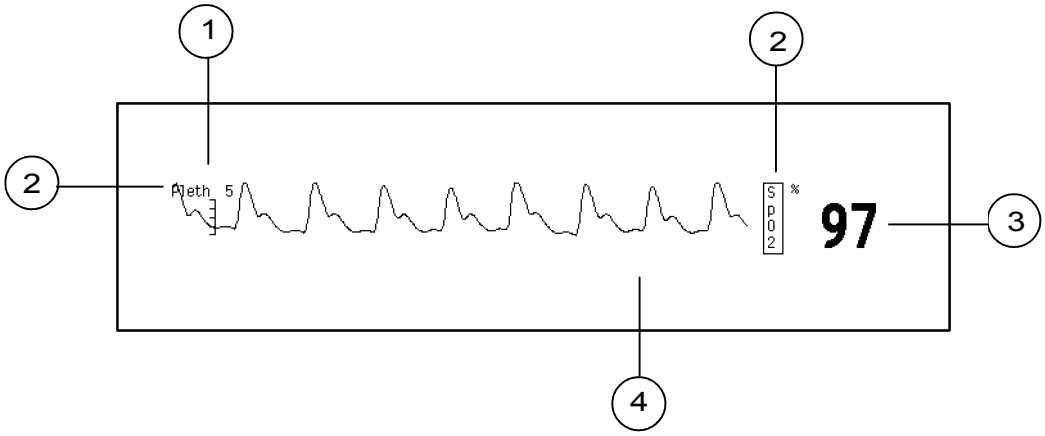


Figure 12-1 Display of SpO_2 value and pleth waveform

(1) Scale of plethysmogram
(2) Label
(3) Oxygen saturation (SpO_2) value
(4) Pulse oximetry message field

Patient connections

Selecting the sensor

GE Healthcare OxyTip+ Finger Sensors are recommended for short term patient monitoring with patients weighing more than 20 kg.

The EarSat sensors are recommended for patients weighing more than 10 kg and patients with compromised peripheral circulation.

For long term monitoring and during high motion conditions, use GE Healthcare OxyTip+ Adhesive Sensors.

For pediatric patients weighing more than 3 kg, use GE Healthcare OxyTip+ Adhesive Sensors or Wrap Sensors.

NOTE: For each SpO_2 accessory, refer to the instructions for use in the accessory package for patient weight limits.

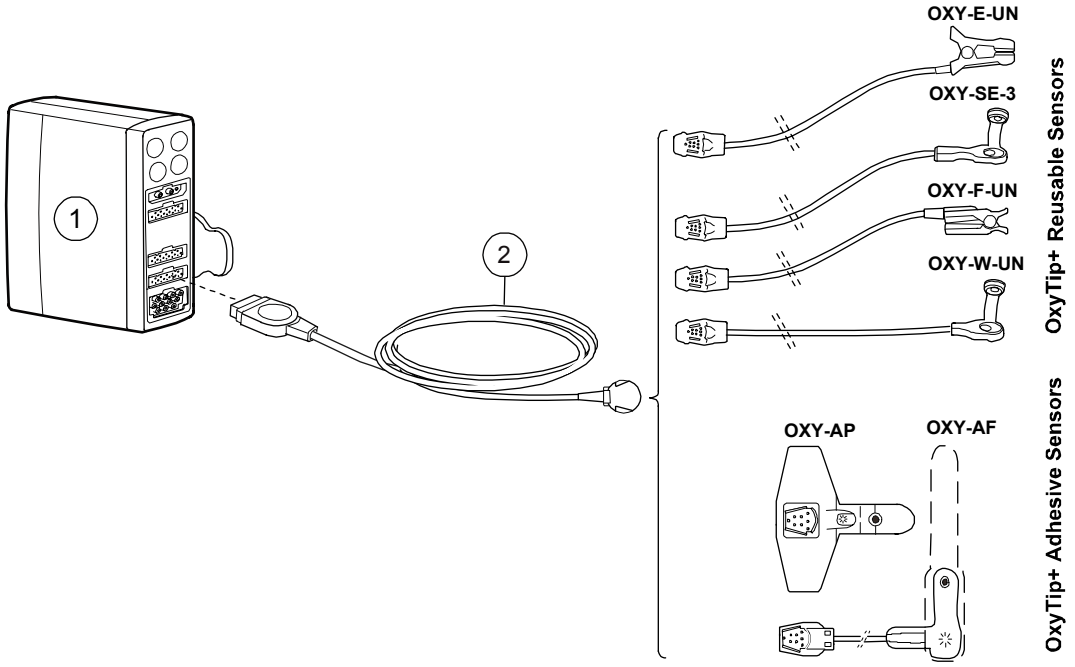


Figure 12-2 Pulse oximetry setup with OxyTip+ sensors

(1) E-PSMW or E-PSMPW module with SpO_2 measurement capability

(2) OxyTip+ interconnect cable

NOTE: The listed sensors are latex-free.

Connecting the patient

NOTE: Use dry and clean sensors only.

1. Connect the sensor to the blue connector in the module.
2. Clean the application site: Remove nail polish, artificial fingernails, earrings etc., clip long fingernails.
3. Position the sensor correctly. For proper sensor positioning, see the “Instructions for use” accompanying each sensor.
4. Attach the sensor to the patient.
5. Attach the sensor cable to the wrist or bed clothes to prevent the cable and sensor from moving.

The message ‘Pulse Search’ is displayed in the message field. After the pulse search is completed, the plethysmographic pulse waveform and the SpO_2 reading are displayed on the screen.

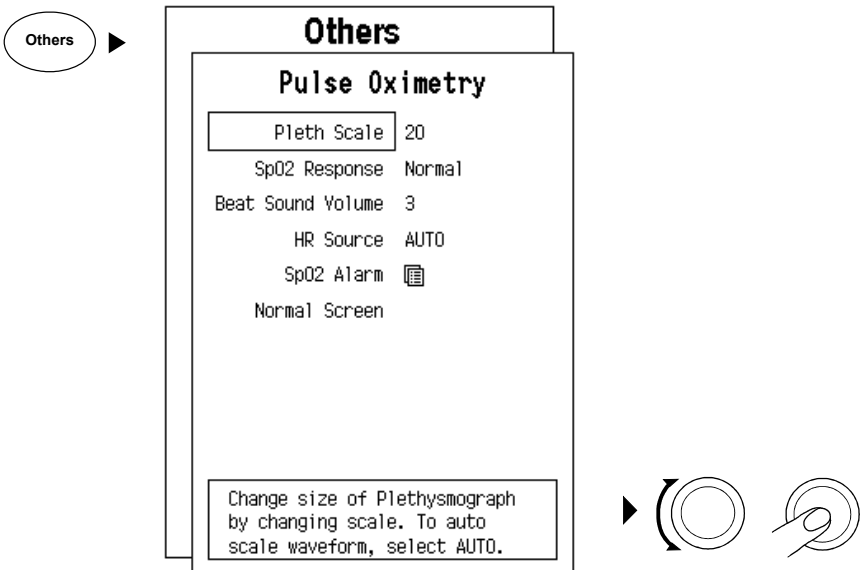
WARNING **Allow sensor and cable to dry completely after cleaning. Moisture and dirt on the connector may affect the measurement accuracy.**

WARNING **To prevent erroneous readings, do not use physically damaged sensors, cables or modules. Discard a damaged sensor or cable immediately. Never repair a damaged sensor or cable; never use a sensor or cable repaired by others. A damaged sensor or a sensor soaked in liquid may cause burns during electrosurgery.**

WARNING **Inaccurate SpO_2 data can result if a sensor is past its useful life. Therefore, re-evaluate the measurement periodically by performing additional assessment of the patient and equipment, including consideration of use of alternate monitoring methods such as direct measurement of arterial oxyhemoglobin (SaO_2).**

WARNING **Conditions that may cause inaccurate readings and impact alarms include interfering substances, excessive ambient light, electrical interference, ventricular septal defects (VSD), excessive motion, low perfusion, low signal strength, incorrect sensor placement, poor sensor fit, and/or movement of the sensor on the patient.**

Pulse oximetry menu



Pleth Scale If the pleth scale selection is AUTO, the scale of the plethysmographic waveform display is automatically set during 'Pulse Search'. The scale is then kept constant throughout the case to enable easy detection of changes in the patient's perfusion. To adjust the pleth scale further, select one of the following: ***2***, ***5***, ***10***, ***20***, ***50***, ***Auto***.

With automatic ***AUTO*** scaling mode, the scale changes automatically if the amplitude of the pleth waveform either exceeds the current scale or falls below the maximum value of the next lower scale by 10% for 30 seconds or more. When the scale changes, the message 'Scale changed' is displayed.

The scale indicator number is displayed on the left side of the waveform.

SpO_2 Response Selects the SpO_2 averaging time. The selections are ***Normal***: 12 seconds (default setting), ***Fast***: 3 seconds.

Beat Sound Volume

Adjusting the SpO_2 beat volume also affects the beat volume of ECG.

When SpO_2 is monitored, the monitor provides a variable pulse beep so that the tone of the pulse beep rises with increasing oxygen saturation and falls as saturation decreases. You can select the volume from 1 (soft) to 10 (loud). With selection 0 there is no audible sound.

HR Source Selects the heart rate source. If the ECG signal is affected by too much noise for a reliable heart rate calculation, heart rate can also be calculated from invasive pressure (Art) or plethysmographic pulse waveform ***Pleth***. The selected heart rate source is displayed above the numerical display of the heart rate. The color of the heart rate is the same as that of the source parameter.

The ***AUTO*** selection priorities for heart rate calculation are: ECG (the lead with highest R-wave), pressure (Art) and plethysmographic pulse waveform.

During monitoring

WARNING **Check the sensor site every four hours (more frequently if the perfusion is poor). Routinely check to ensure adequate circulation distal to the sensor site.**

Patient condition or prolonged use may require changing the sensor site periodically. Check skin integrity, circulatory status and correct alignment and change sensor site at least every four hours.

For patients with poor peripheral blood circulation or sensitive skin, change the site at intervals of 30 minutes to one hour. To confirm the circulatory status, observe the size of the plethysmographic waveform with a fixed pleth scale. Take special care of this when monitoring small children.

If possible, do not attach the SpO2 sensor on a limb that is used for NMT measurement or for administrating cold infusions.

NIBP measurement and arterial blood pressure measurement

To avoid erroneous readings, do not use a blood pressure cuff or arterial blood pressure measurement device on the same limb as the sensor.

Plethysmographic pulse wave

To get an optimal pulse wave use smaller scale indicators when using measuring sites with poor perfusion. A small pulse wave may be a sign of impaired circulation that may require increased attention.

Higher scale indicators together with a well defined pulse wave indicate strong circulation and a relaxed patient.

Removing the sensor

- Open the sensor. Do not pull the sensor from its cable.

Measurement limitations

- The B30 monitors are designed to minimize the interference of electrosurgery. Under some circumstances electrosurgery may cause noise on the screen. Therefore, be careful in interpreting the results, especially the plethysmographic pulse waveform, during electrosurgery.
- The saturation values may be somewhat higher for smokers. Special care should be taken with patients who have burns or carbon monoxide (CO) intoxication. When carbon monoxide intoxication is suspected, always confirm the pulse oximetry reading with a blood sample measurement.
- Intravascular dyes may cause erroneous readings. For example, methylene blue, indigo carmine, indocyanine green or any substances that contain dyes, interfere with the SpO_2 measurement.
- Vasoconstrictive drugs, such as phenylephrine hydrochloride and dopamine, may affect the accuracy of the measurement.
- The pulse oximeter cannot distinguish between oxyhemoglobin and dyshemoglobins, for example, met- or carboxyhemoglobins.
- Poor perfusion may affect the accuracy of measurement when using the ear probe.
- To avoid erroneous readings, do not use a blood pressure cuff or arterial blood pressure measurement device, or NMT sensor in the same limb as the SpO_2 sensor.

Checklist

Check that

- Only one module with pulse oximetry measurement is inserted.
- Correct SpO_2 sensor is selected for each patient size.
- The sensor is completely dry after cleaning.
- Sensor or interconnect cable is plugged to the blue connector in the module.
- Sensor is properly connected to the interconnection cable if used.
- Sensor is positioned correctly to the patient.
- SpO_2 is selected for screen through **Monitor Setup** - ***Screen Setup***.

Table of contents

13 Temperature

Overview

You can simultaneously measure and monitor temperature of two sites by using one of the hemodynamic multiparameter modules E-PSMW or E-PSMPW.

As a measuring probe use only GE Healthcare temperature probes or defibrillator-proof YSI 400 series probes. You can measure, for example, esophageal, nasopharyngeal, rectal, and skin temperature.

NOTE: Monitoring of perioperative body temperature is recommended when inducing hypothermia or if unexpected temperature changes occur.

Module description

Temperature measurement is included in the hemodynamic multiparameter modules E-PSMW and E-PSMPW. With a dual temperature adapter cable you get a two-channel measurement.

NOTE: Do not use identical modules in the same monitoring system simultaneously. To monitor temperature, select E-PSMW or E-PSMPW module.

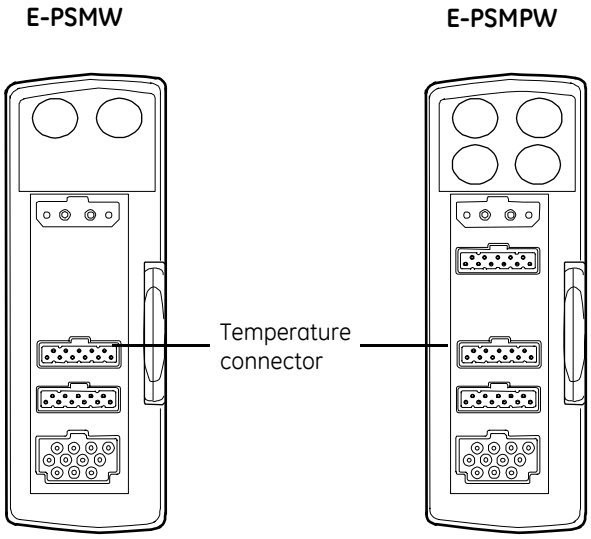


Figure 13-1 Modules for temperature measurement

Displaying temperature

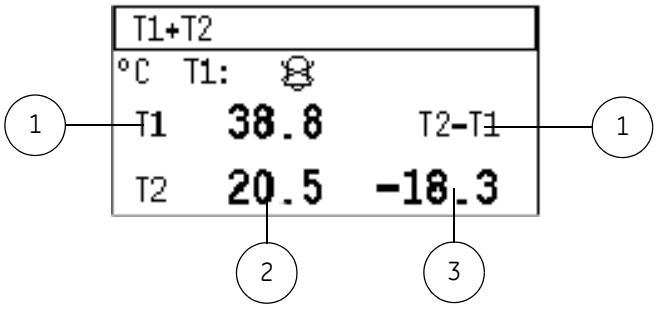


Figure 13-2 T1+T2 digit display

(1) Labels
(2) Temperature measurement value
(3) Calculated T2-T1 difference

The other options are individual ***T1*** and ***T2*** readings in a digit field.

Patient connections

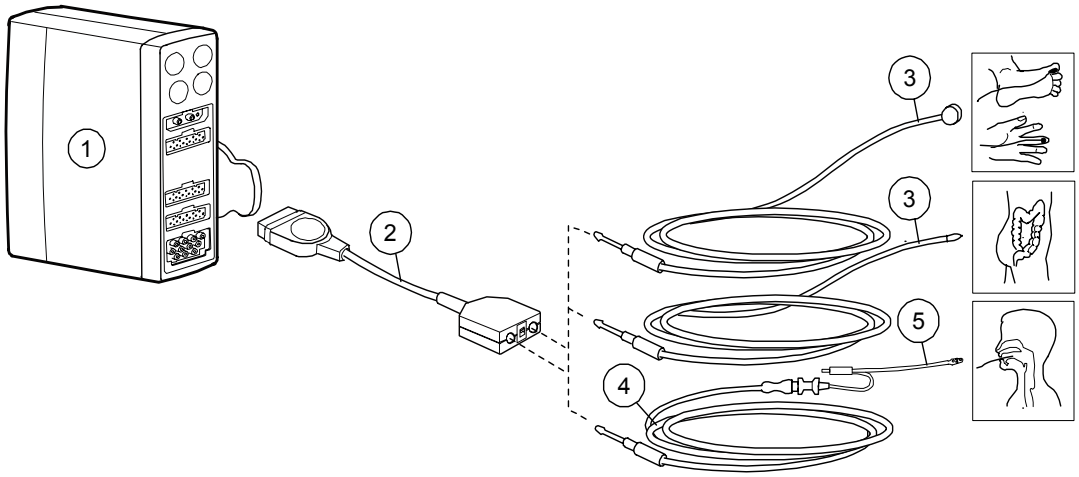


Figure 13-3 Temperature measurement setup

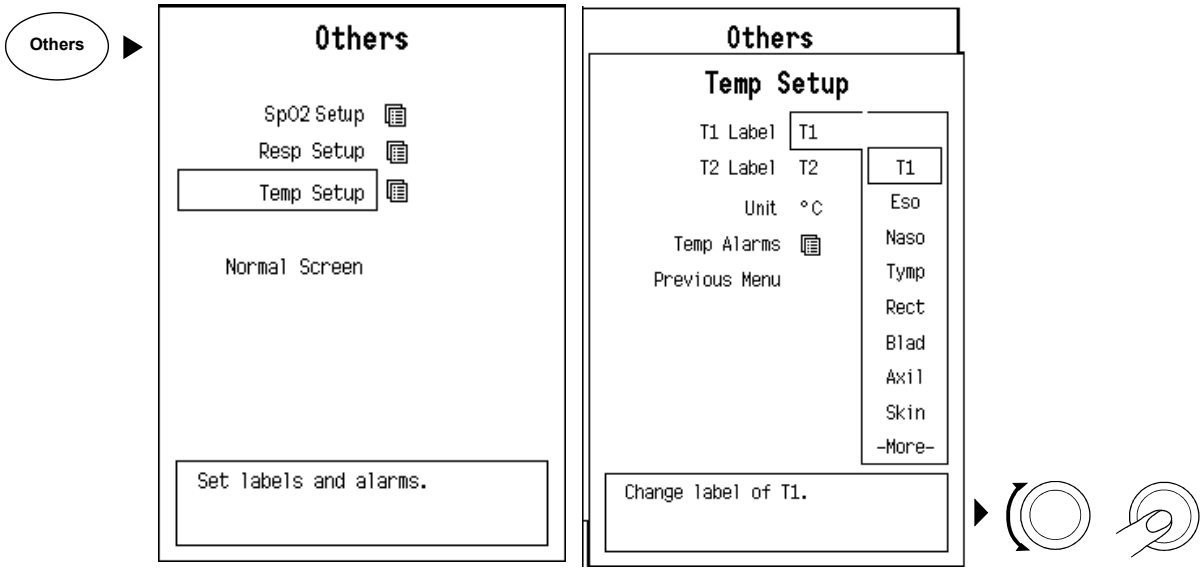
(1) E-PSMW or E-PSMPW module
(2) Adapter cable for temperature probes
(3) Reusable temperature probe
(4) Adapter cable for disposable temperature probe
(5) Disposable temperature probe

To connect the patient:

1. Attach the temperature probe to the patient.
2. Connect the adapter cable to the module connector.

NOTE: For a comprehensive list of accessories, see the "Supplies and Accessories" catalog.

Temp Setup menu



T1, 2 Label Allows you to label each temperature measurement site.

Unit Allows you to select the units to be either degrees Celsius or degrees Fahrenheit.

Allows you to adjust temperature alarm limits for two measurement sites, measured by T1 or T2. You can choose one or both sources to be active at a time.

Previous Menu Returns to the previous menu level.

Changing temperature label

1. Press the **Others** key.
2. ***Temp Setup - T1 Label*** or ***T2 Label***.
3. Select the label with the ComWheel. Labels are ***T1*** and ***T2***, or:
   Eso (Esophageal temperature)
   Naso (Nasopharyngeal temperature)
   Tymp (Tympanic temperature)
   Rect (Rectal temperature)
   Blad (Bladder temperature)
   Axil (Axillary temperature)
   Skin (Skin temperature)
   AirW (Airway temperature)
   Room (Room temperature)
   Myo (Myocardial temperature)
   Core (Core temperature)
   Surf (Surface temperature)

Combining different temperatures

The monitor displays the difference between different temperatures if they are displayed in the same digit field. differences (T2-T1,) are displayed in the temperature digit field if you choose them in the same digit field. For example, to display T1+T2:

1. Press the **Monitor Setup** key and select ***Screen Setup***.
2. Select ***Digit Fields***.
3. Select ***T1+T2*** to one of the lower fields.

Testing temperature

The temperature measurement functioning is automatically tested periodically. During the test, the message 'Performing temp test' is displayed. If the test fails, the monitor displays the message 'Temperature error'.

Changing temperature units

You can select the temperature unit to be either degrees Centigrade or degrees Fahrenheit:

1. Press the **Others** key.
2. ***Temp Setup - Unit***.
3. Select the unit (°C or °F) with the ComWheel.

Checklist

Check that:

- Temperature adapter cable is properly inserted into the connector in the module, and the probe is inserted into the adapter cable.
- Temperature probe is positioned correctly.
- Temperature is selected for screen through **Monitor Setup** - ***Screen Setup***.

Table of contents

14 Invasive blood pressure

Overview

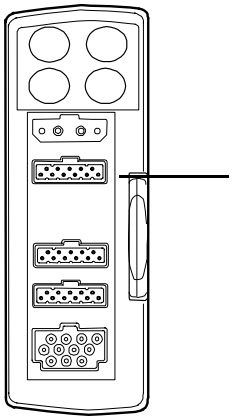
You can measure and monitor two invasive blood pressures at the same time using a dual invasive blood pressure cable. To measure invasive blood pressure you need the E-PSMPW module.

During the invasive blood pressure measurement, the transducer converts pressure variations into electrical signals. The electrical signals are amplified and displayed as numeric pressure values and waveforms.

WARNING **All invasive procedures involve risks to the patient. Use aseptic technique. Follow catheter manufacturer's instructions.**

Module description

E-PSMPW



Module keys

E-PSMPW module has direct function keys to zero both pressure transducers separately.

- Press the **Zero P1** or **Zero P2** module key. The message 'Zeroing' is displayed. After the transducer is zeroed, the message 'Zeroed' is displayed.

Side panel key

The monitor has one side panel key for invasive pressures, the **Zero ALL** key. You can use this to zero all pressure transducers.

NOTE: Selecting ***Zero ALL*** does not zero ICP. Zero it separately.

Display of invasive blood pressure

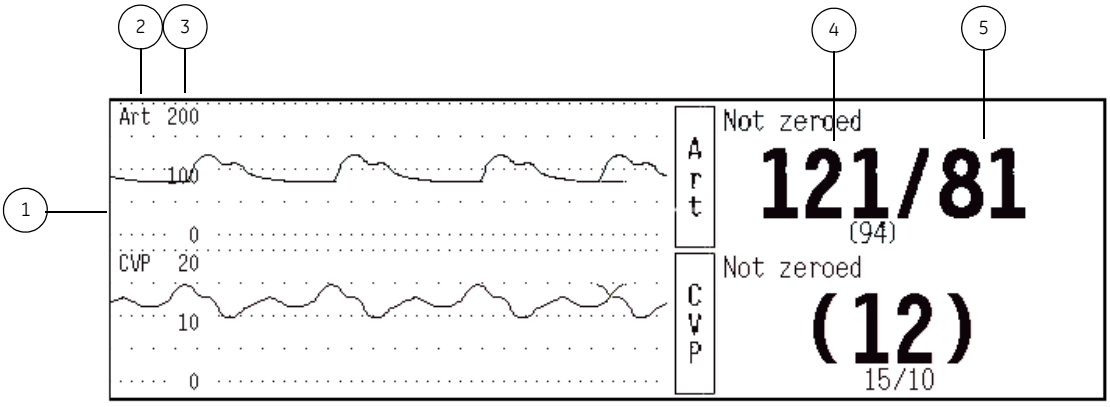


Figure 14-1 InvBP display

(1) Invasive blood pressure waveforms with zero and reference lines

(2) Selected pressure label

(3) Selected pressure scale

(4) Field for messages and alarm limit settings

(5) Systolic, diastolic and mean pressure values of invasive blood pressures

You can have a combined display of all those waveforms that are selected on the screen. This combined display uses the whole waveform field area and the same zero line for all waveforms.

To select:

1. Press the **Monitor Setup** key and select ***Screen Setup***.
2. Select ***Waveform Fields***.
3. To combine all waveforms in one field, select ***Combine Pressures*** and ***Yes***.

Patient connections

1. Connect the pressure transducer to the transducer adapter cable. Connect the cable to the red connector in the module, or to the dual invasive blood pressure adapter cable.

NOTE: Invasive pressures need to be zeroed after reconnecting the pressure transducer or cable, and whenever the patient's position is changed. The transducer is always leveled to the mid right atrium.

2. Prepare the transducer kit according to the manufacturer's instructions. Mount the kit with the transducer zeroing port at mid-heart level.
3. Ensure that there is no air in the line. Refer to transducer manufacturer's instructions on how to remove trapped air from the transducer.
4. Connect the patient catheter to the pressure line.
5. Open the dome stopcock to room air.
6. Zero the transducer. See "Starting with accurate values" on page 14-4.
7. Open the dome stopcock to pressure catheter and check the quality of the waveform.

WARNING **Mechanical shock to invasive blood pressure transducer may cause severe shifts in zero balance and calibration, and cause erroneous readings.**

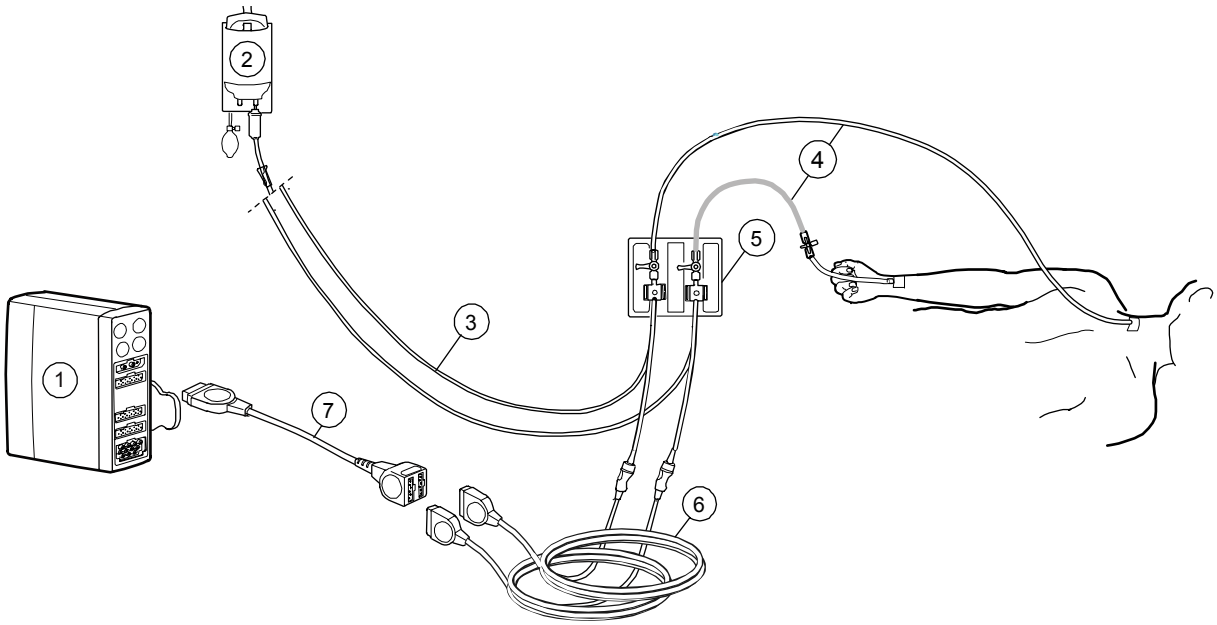


Figure 14-2 Invasive blood pressure setup

(1) E-PSMPW module
(2) Heparinized fluid bag with pressure infusor
(3) Flushing set
(4) Disposable catheter
(5) Transducer
(6) Adapter cable for the InvBP transducer
(7) Adapter cable for dual InvBP measurement

NOTE: Patient connections made according to the picture above using approved accessories are defibrillator-proof.

WARNING **Make sure that no part of the patient connections touches any electrically conductive material including earth.**

WARNING **Use only defibrillator-proof transducers and cables.**

Starting with accurate values

Pressure transducers generally produce a small signal even when no pressure is applied to them. It is necessary to zero the monitor with the transducer to establish an accurate electrical zero point.

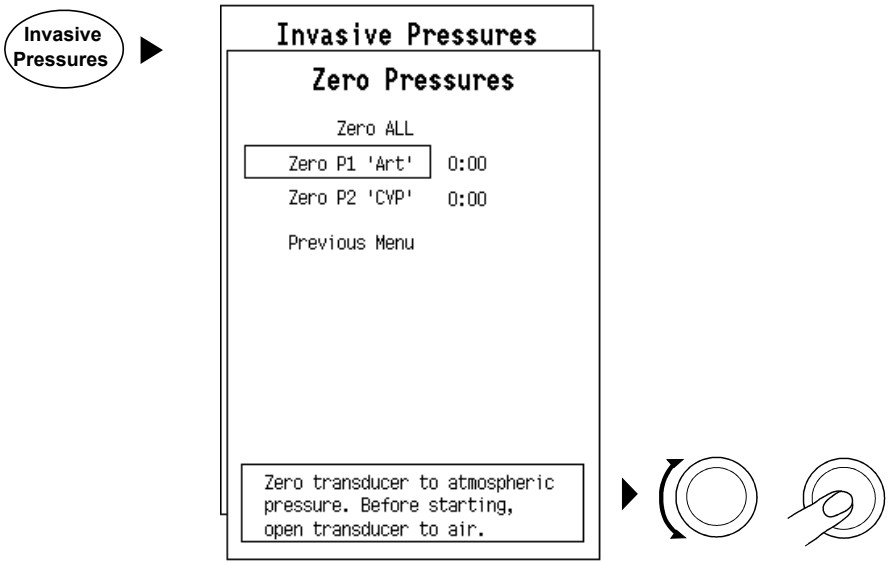
Also, the position of the transducer effects the accuracy of the measurement. An error of 10 mmHg of static pressure is introduced for every 13.6 cm (5.4 inches) difference in height between the mid-heart and the transducer.

To zero the transducer, open the transducer to air and do one of the following:

- Press the **Zero Px** module key or the **Zero ALL** side panel key. This starts zeroing immediately.

NOTE: Selecting ***Zero ALL*** does not zero ICP. Zero it separately.

- Press the **Invasive Pressures** key on the Command Board and select ***Zero Pressures***.

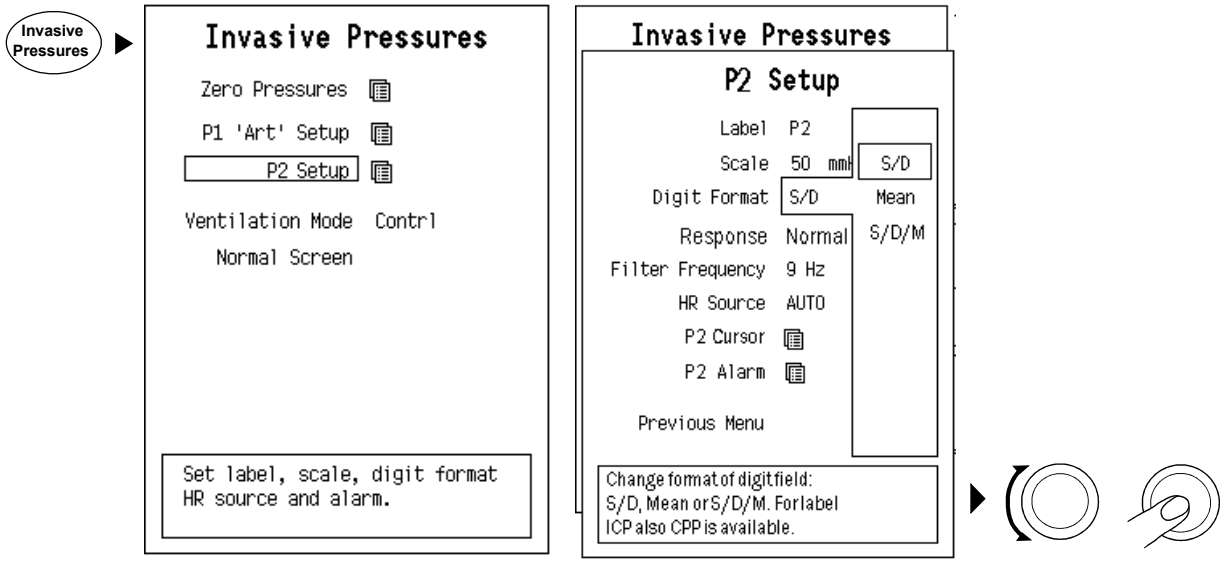


During the zeroing process, the message 'Zeroing' is displayed. After the transducer is zeroed, the message 'Zeroed' is displayed in the digit field. After each channel is zeroed, the time of zeroing is displayed in the menu.

NOTE: Check zero level after power interruptions.

NOTE: Invasive pressures need to be zeroed after reconnecting the pressure transducer or cable, and whenever the patient's position is changed. If all channels have not been zeroed, the message 'InvBP not zeroed' appears. However, the alarms advance to yellow and red levels regardless of zeroing.

Invasive Pressures menu



Zero Pressures Opens a menu to zero both pressures or one of them.

Ventilation Mode Respiration causes artifacts in invasive pressures. At the end of expiration the artifact is at its smallest. Select ***Spont*** for spontaneous respiration and ***Contr*** for controlled ventilation.

Px Setup menu

Label Start-up labels are Art and CVP. Other labels are P1, P2, PA, RAP, RVP, LAP, ICP and ABP. Assigning the appropriate label automatically changes other pressure settings accordingly.

Scale Scales are assigned by the monitor when the channel is labeled. Scales can also be individually adjusted between 10 and 300 mmHg in steps of 10.

Digit Format With the numeric display format you can choose either the Systolic/Diastolic numbers (***S/D***) or the Mean pressure value (***Mean***) in large size to the screen. You can also choose all values (***S/D/M)*** to the screen. If the label is ICP, also the ***CPP*** selection is available (see also page 14-7).

Response Use the ComWheel to change the invasive blood pressure averaging time. The available values are ***Normal*** and ***B-TO-B*** (beat-to-beat). With selection ***Normal***, normal averaging is used. Depending on the label, the values are updated approximately every five seconds. With selection ***B-TO-B***, no averaging is used and the values of the last detected pulse are displayed. These values can change up to three times per second. This feature is useful when it is necessary to detect fast pressure changes. NOTE: This setting affects only the displayed values, not the averaging of invasive pressure trends.

Filter Frequency Measured signal is filtered to remove noise and artifacts. Use the ComWheel to adjust the filter between 4 and 22 Hz.

HR Source If the ECG signal is affected by too much noise for a reliable heart rate calculation, heart rate can be calculated mechanically from the pressure (Art) or plethysmographic pulse waveform. The selected heart rate source is displayed above the numerical display of the heart rate. The color of the heart rate is the same as that of the source parameter. ***Auto*** selection prioritizes the heart rate calculation in a specified order: ECG (the lead with highest R-wave), pressure (Art), and plethysmographic pulse waveform.

PX Alarm Alarms can be adjusted in this menu or in the ***Alarms Setup*** menu which opens by pressing the **Alarms Setup** key.

Determining pressure values visually

By moving the horizontal cursor across the pressure waveform, you can get accurate pressure values at selected points. This may be useful, for example, if the patient's breathing pattern is irregular. The cursor is not available for pressures shown with a combined scale.

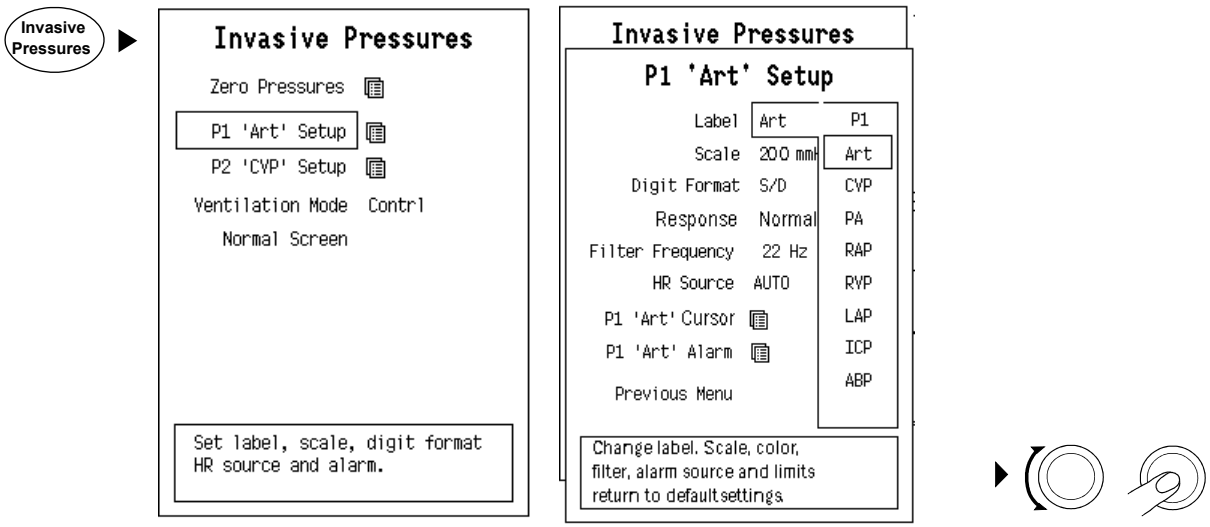
1. Press the **Invasive Pressures** key.
2. Select ***Px Setup - Px Cursor***.
3. Move the cursor up or down by turning the ComWheel. Every time the cursor is moved, the time (hours and minutes) and pressure values are displayed on the screen. This way, you can keep track of the changes made.
4. You can remove the cursor by selecting ***Remove cursor***. Note that if the cursor is not removed, it remains visible in the Normal Screen.

Labeling channels

The label of the pressure channel sets its display scale, color, filter, alarm source and alarm limits. The label descriptions are preconfigured.

To change the label:

1. Press the **Invasive Pressures** key.
2. Select ***P1 Setup***.
3. Select ***Label***.



The labels are the following:

P1, P2	Standard labels
Art	Arterial pressure
CVP	Central venous pressure
PA	Pulmonary arterial pressure
RAP	Right atrial pressure
RVP	Right ventricular pressure
LAP	Left atrial pressure
ICP	First intracranial pressure
ABP	Arterial blood pressure

Both Art and ABP labels are available for situations when two arterial lines are desired but you want to use different settings or alarm labels.

Table 14-1 Invasive blood pressure labels and descriptions

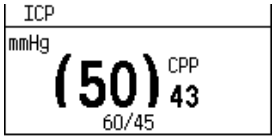
LABEL	P1, Art, ABP	P2, CVP	RAP, LAP	ICP	PA	RVP
Scale mmHg/kPa	200/30	20/3	20/3	20/3	60/8	60/8
Color	Red	Blue	White	White	Yellow	White
Alarm source	Sys	Mean	Off	Off	Off	Off
Digit format	S/D	Mean	Mean	CPP	S/D	S/D
Filter (Hz)	22	9	9	9	9	9
Response	normal	normal	normal	normal	normal	normal

Cerebral perfusion pressure

Cerebral Perfusion pressure CPP is calculated by subtracting ICP mean pressure from Art mean pressure.

CPP mean is displayed next to the ICP value.

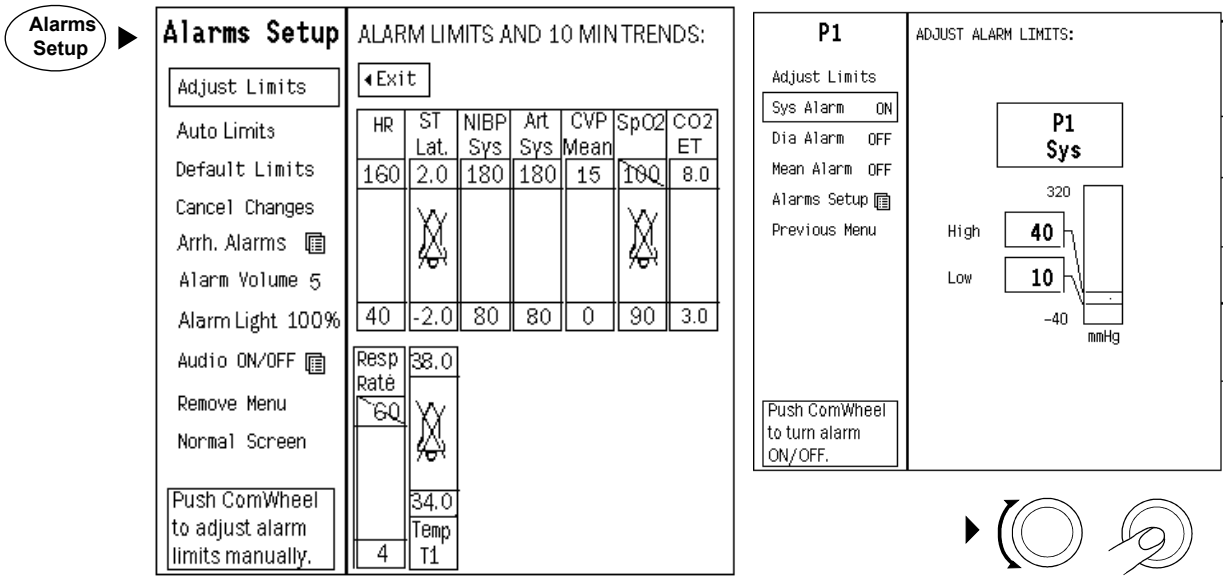
NOTE: Set the ***Label*** of the channel to ***ICP***, and the ***Digit Format*** to ***CPP***.



Adjusting alarm sources and limits

You can adjust or turn off pressure alarm limits in the ***Alarms Setup/Adjust Limits*** menu. Enter the menu by pressing the **Alarms Setup** key.

For each pressure channel you can choose as a source ***Sys*** (Systolic), ***Dia*** (Diastolic), ***Mean*** or ***Off***. Note that you can choose one or both sources to be active at a time.



For more information about alarms and adjusting, see section "Alarms."

Smart InvBP and flushing

Flushing is performed to keep the lines open. It prevents blood from clotting and occluding the lines and measurements. Infusion that is used for flushing goes through the dome into the patient's artery.

Two types of flushing are used simultaneously: flushing with continuous infusion and manual flushing. Flushing with continuous infusion uses a higher pressure than the patient's blood pressure and contains Heparin to prevent blood from clotting. Manual flushing is always used after having taken a blood sample, and every now and then to ensure that the lines remain open.

The monitor detects the pressure used for infusion to flush the invasive blood pressure line. There is a 40 second time-out for performing the flushing. The digits change to dashes, ---/--- , and there are no alarms. After 40 seconds, or when flushing is completed and patient's pulse detected, the pressure digits are displayed and alarms become active. If pressure values are outside the alarm limits, an alarm is given.

The monitor functions the same way when blood samples are taken.

Checklist

Check that:

- Invasive blood pressure transducer cable is plugged to the adapter cable, and this is connected to the red connector in the module.
- Pressure transducer is connected to the cable.
- Patient catheter is connected to the pressure line.
- There is no air in the transducer dome or catheter line and transducer is at mid heart level.
- Pressure transducer is zeroed.
- Invasive blood pressure is selected for screen through **Monitor Setup** - ***Screen Setup***.

Table of contents

15 Impedance respiration

Overview

Impedance respiration is measured across the thorax. When the patient is breathing or is ventilated, the volume of air changes in the lungs, resulting in impedance changes between the electrodes Respiration rate is calculated from these impedance changes, and a respiration waveform is displayed on the monitor screen.

NOTE: Impedance respiration measurement is intended for patients over three years old.

WARNING **This device is not an apnea monitor system intended to alarm primarily upon the cessation of breathing. In central apnea it indicates an alarm after a pre-determined time since the last breath detection. Do not attempt to use it for detecting obstructive or mixed apneas, since respiration movements and impedance variations may continue in these cases.**

WARNING **The impedance respiration measurement may cause rate changes in Minute Ventilation Rate Responsive Pacemakers. Set the pacemaker rate responsive mode off or turn off the impedance respiration measurement on the monitor.**

WARNING **The impedance respiration measurement is inherently very sensitive as it measures very small physiologic signals (changes of impedance of the patient's chest area). Conducted RF current above 1 Vrms may cause erroneous measurements at various frequencies, for example interference with the signal/waveform leading to respiration rate readings inconsistent with the patient's true respiration rate. If you notice this, use another form of respiration monitoring. For further information, see the "Technical Reference Manual.**

Module description

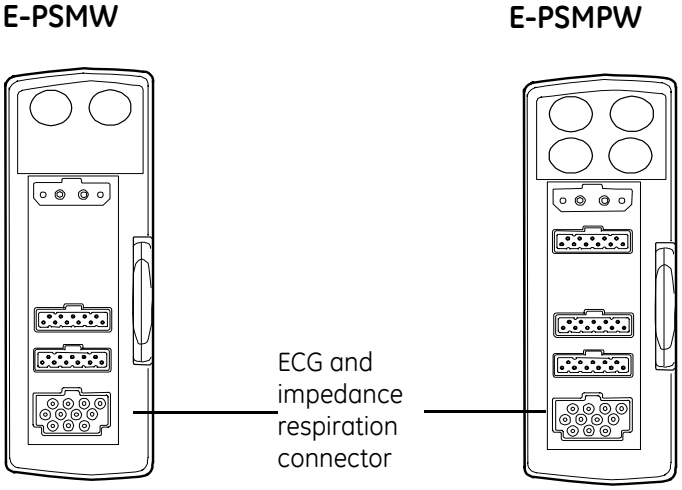
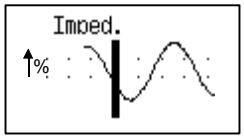


Figure 15-1 Modules E-PSMW and E-PSMPW for impedance respiration measurement

Respiration detection

The respiration rate is the sum of the respirations that have exceeded the detection limit.

The dotted lines present the zero line and the detection limit. The signal strength produced by a respiration should thus exceed this minimum limit to be included in the respiration rate calculation. Peaks within the grids are not calculated.



If the detection mode is ***AUTO***, the grid lines present the minimum limits. The limits in use may be larger. The RR value could include fewer respirations than indicated by the gridline.

Respiration rate calculation

Respiration rate is calculated automatically when ECG or CO_2 is measured unless the respiration measurement is turned off. When CO_2 is measured, the respiration rate is automatically calculated from CO_2.

Respiration rate calculation switches back to impedance respiration if you press the **Silence Alarms** key during an Apnea alarm.

The respiration rate source is displayed above the respiration numeric value.

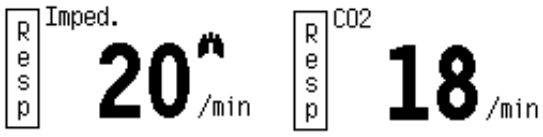
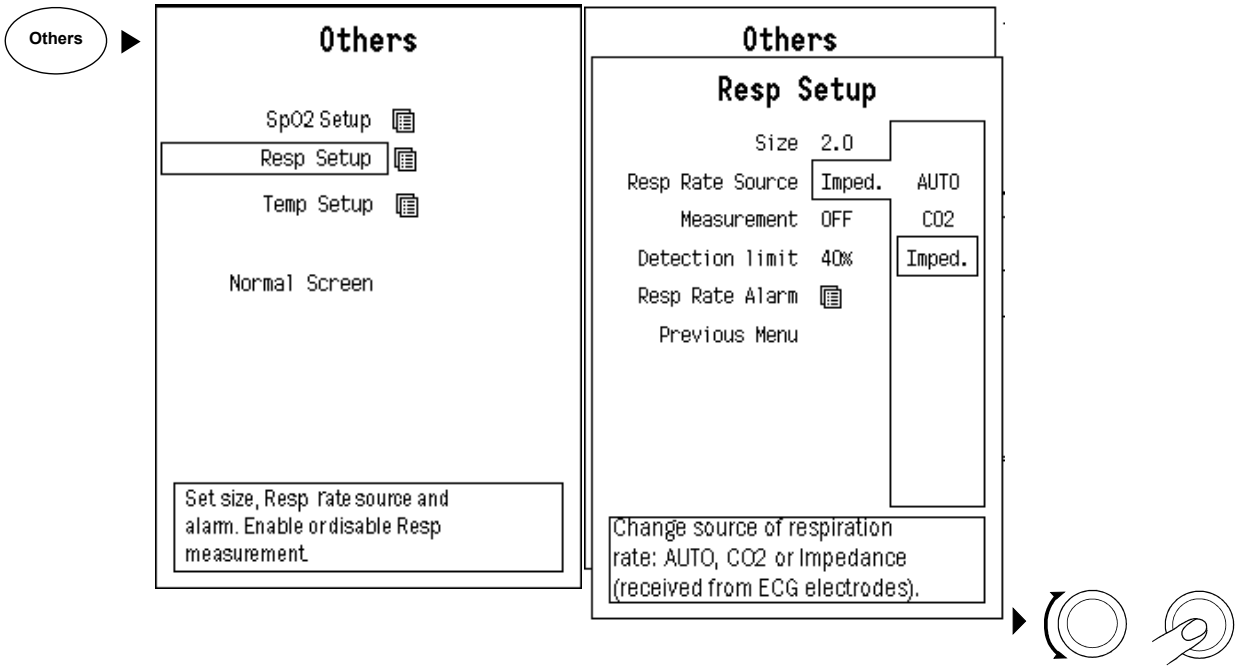


Figure 15-2 Respiration rate source indication for impedance and CO_2

The impedance respiration waveform is displayed next to the RR value also when the RR value is calculated from CO_2.

To manually select impedance respiration as respiration rate source:

1. Press the **Others** key.
2. Select ***Resp Setup***.
3. Select ***Resp Rate Source*** and select ***AUTO, CO2*** or ***Imped***.



Displaying impedance respiration

Figure 15-3 Impedance respiration waveform and numeric respiration rate value.

Patient connections

The setup is the same as for the ECG measurement. For more information, see section "ECG."

NOTE: Impedance respiration measurement is intended for patients over three years old.

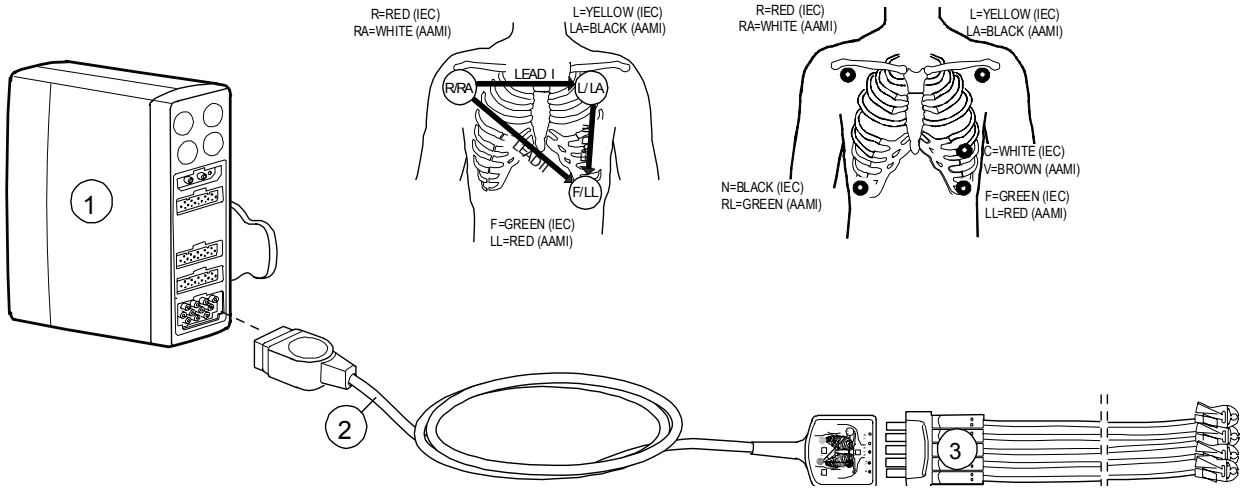


Figure 15-4 Impedance respiration setup

(1) E-PSMW or E-PSMPW module

(2) Multi-link 5 lead standard cable

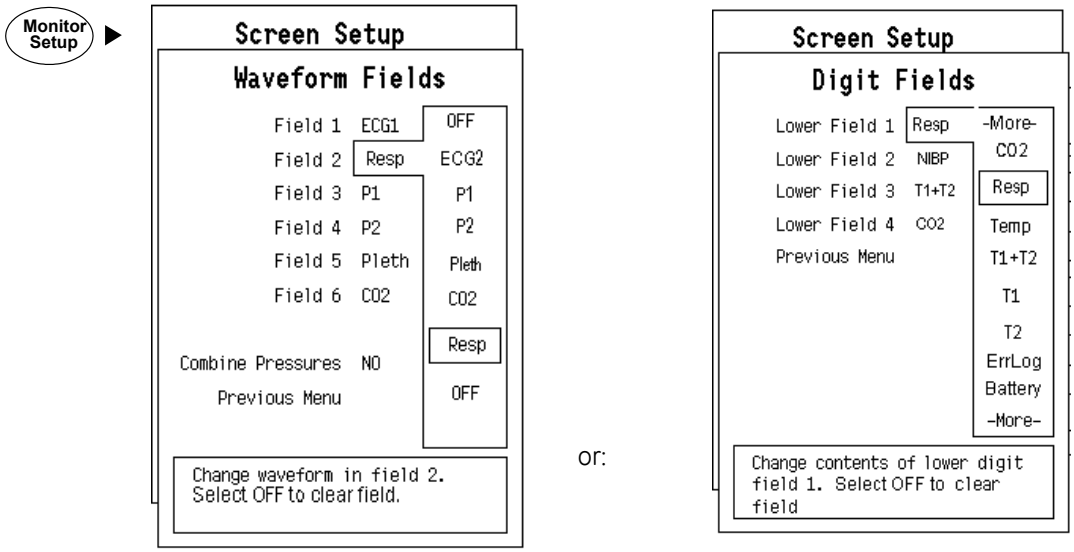
(3) Multi-link leadwire set (3 or 5 leads)

ECG electrodes (pre-gelled electrodes are recommended). Check the expiration date.

NOTE: For a comprehensive list of accessories, see the "Supplies and Accessories" catalog.

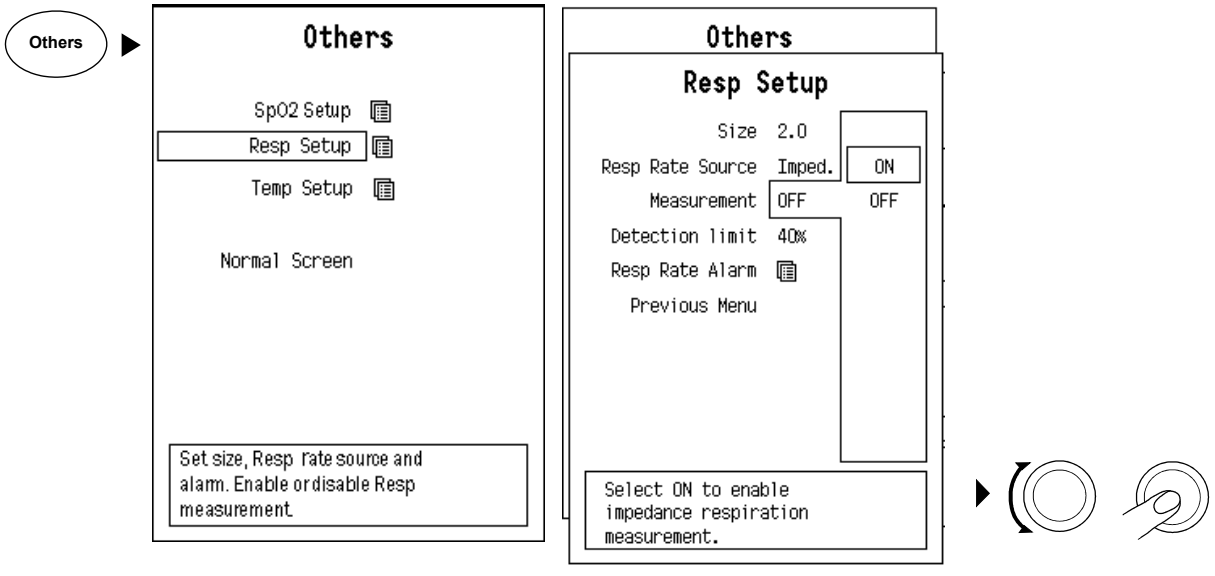
Activating measurement

Select respiration in a waveform or a digit field, otherwise the respiration information is not included in the trends and the alarms are not operative.



Check that the measurement is on:

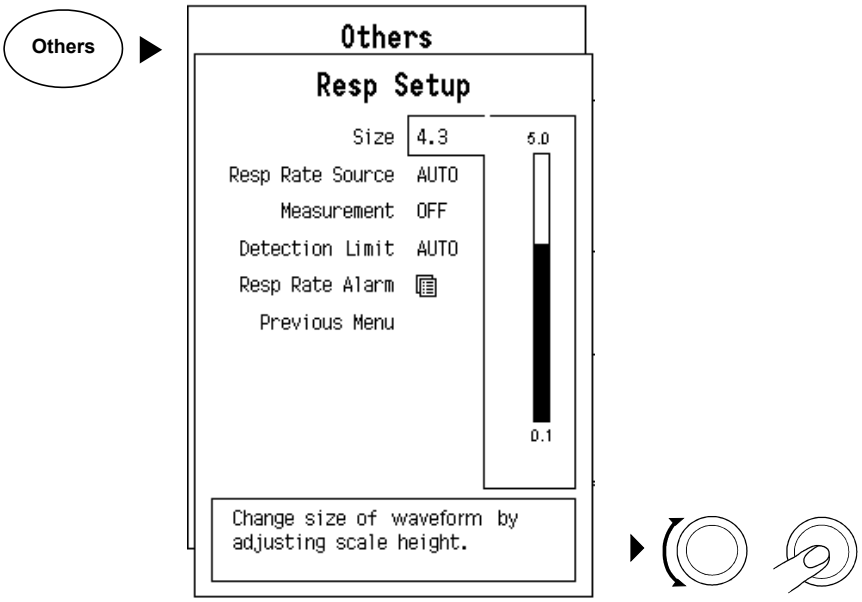
1. Press the **Others** key.
2. Select ***Resp Setup***.
3. Select ***Measurement*** and ***ON***.



Improving waveform readability

To improve readability, increase the waveform size.

1. Press the **Others** key.
2. Select ***Resp Setup***.
3. Select ***Size*** and adjust the waveform size.



The bar on the left side of the waveform always indicates a 1 Ω reference.

Correcting the respiration number

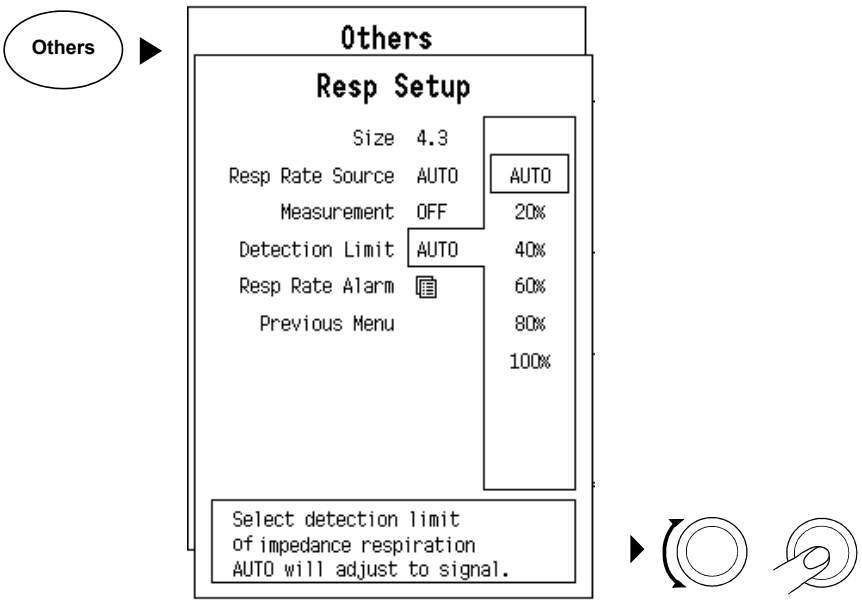
Normally, we recommend the use of the ***AUTO*** detection limit. However, in some specific cases you may wish to adjust the limits manually.

– When the respirations are weak, you can manually adjust the detection limits (measurement sensitivity) closer to each other to ensure that all respirations are included in the RR value. In this case, the dotted line represents the absolute detection limits.

– When there are lots of artifacts, the grids can be adjusted further apart to separate smaller artifacts from larger, true respiration peaks. The small peaks fall within the grids and are not calculated, while the bigger peaks cross the grids and are calculated as true respirations.

To ensure the correct respiration number, adjust the limits closer to each other:

1. Press **Others**.
2. Select ***Resp Setup*** - ***Detection Limit*** and adjust the limit.



The percentage is the ratio to the 1 Ω reference bar which is 100%.

Measurement limitations

Movement artifacts

Changing position, moving the head, moving the arms or shivering may result in movement artifacts. Also the heart may cause noticeable movement and sometimes this may interfere with the respiration measurement.

Electrical interference

Electrical devices, such as electrosurgery units and infrared heaters, that emit electromagnetic disturbance may cause artifacts or disable the respiration measurement completely.

Intermittent mechanical ventilation

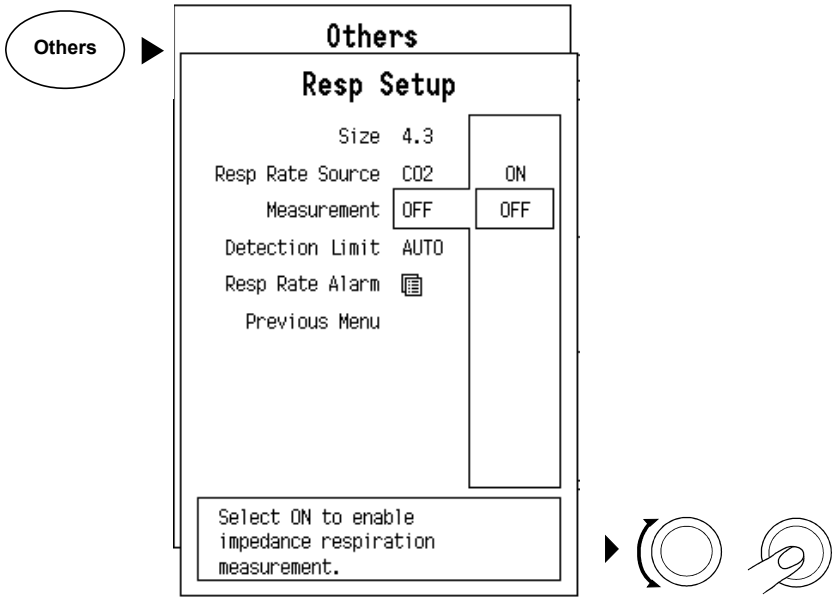
During spontaneous breathing the ventilator may at times support the patient's ventilation with an extra inspiration. If these ventilator inspirations are substantially larger than the spontaneous breaths, the respiration calculation may mistakenly count only the inspirations and expirations produced by the ventilator. You can correct this by adjusting the detection limits manually:

1. Press the **Others** key.
2. Select ***Resp Setup***.
3. Select ***Detection limit*** and adjust the limits.

Turning off the measurement

If the impedance respiration measurement signal interferes with other measurements, such as ECG, you can turn it off.

1. Press the **Others** key.
2. Select ***Resp Setup***.
3. Select ***Measurement OFF***.



Checklist

Check that:

- Electrode gel is moist.
- Electrodes have good skin contact.
- Electrodes are positioned correctly.
- Correct leadwire set is selected.
- The trunk cable is connected properly.
- Leadwire set is properly connected to the trunk cable.
- Correct leadwire type is selected in the ***ECG Setup*** menu.
- ECG + Resp are selected for screen through **Monitor Setup** - ***Screen Setup***.

Table of contents

16 Non-invasive blood pressure

Overview

The non-invasive blood pressure (NIBP) measurement uses the oscillometric measuring principle. The cuff is inflated with a pressure slightly higher than the presumed systolic pressure, then slowly deflated at a speed based on the patient's heart rate, collecting data from the oscillations produced by the pulsating artery. Based on this data, the unit calculates values for systolic, mean and diastolic pressures.

Blood pressure measurements determined with this device are equivalent to those obtained by an intra-arterial blood pressure measurement device. Multiple intra-arterial sites were used.

You can set the NIBP module into an automatic cycling mode to make measurements at desired time intervals. You can also measure NIBP continuously for five minutes in STAT mode or take separate single measurements.

NOTE: Intervals below 10 minutes and STAT measurements are not recommended for extended periods of time.

WARNING **The NIBP measurement is indicated for patients weighing over 5 kg (11 lb).**

Module description

NOTE: In the monitoring system, use only one module at a time for measuring NIBP.

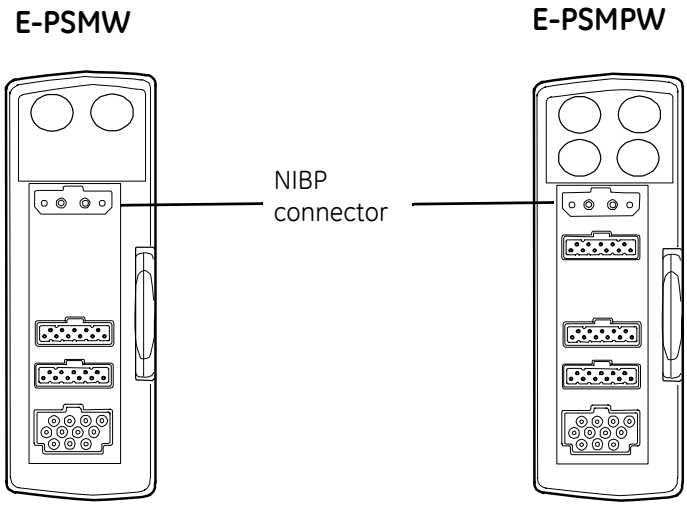


Figure 16-1 Modules measuring non-invasive blood pressure

Direct function keys

There are two module keys for NIBP on the module and on the monitor side panel:

Starts and stops autocycling measurements.

Starts a single measurement, and cancels any measurement.

Displaying non-invasive blood pressure

NIBP can be displayed in the digit field:

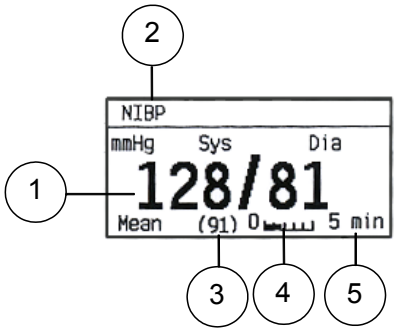


Figure 16-2 NIBP digit field display

(1) Systolic and diastolic pressure value of non-invasive blood pressure
(2) Label
(3) Mean pressure value of NIBP
(4) Time since the last autocycle measurement
(5) NIBP autocycle time indicator

NOTE: When 60 minutes has passed from the latest NIBP measurement, the NIBP numeric value digits turn gray. When 245 minutes has passed from the latest NIBP measurement, the gray numeric value digits are replaced by a dashed line.

Patient connections

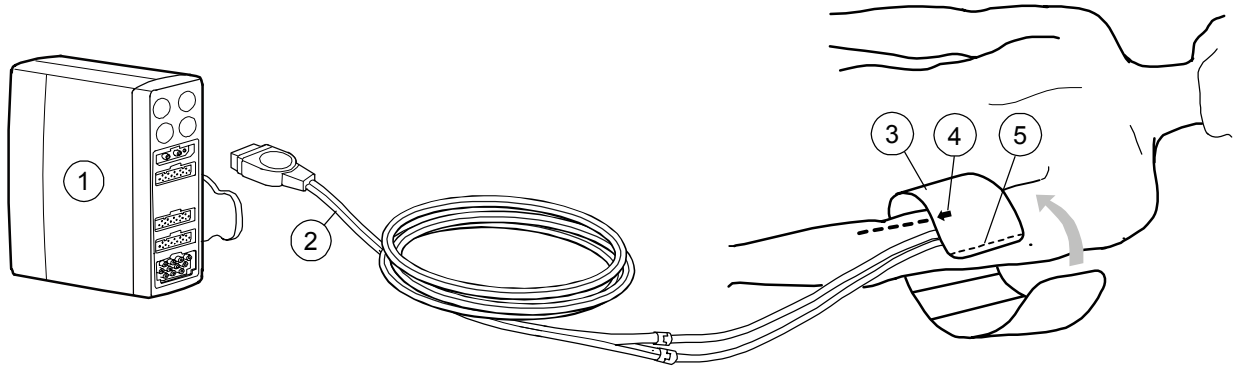


Figure 16-3 Cuff positioning

(1) E-PSMW or E-PSMPW module

(2) Cuff hose

(3) Cuff of correct size

Place the arrow (4) over the brachial artery. Check that the index line (5) falls within the range markings on the cuff, and wrap the cuff around the upper arm.

For a comprehensive list of accessories, see the "Supplies and Accessories" catalog. The listed NIBP cuffs are latex-free.

Selecting a cuff and a cuff hose

Two different cuff hoses with different cuff connections are available:

– BLACK hose for adults and children (corresponding inflation limits ***Adult*** and ***Child.*** including cuff identification.

– LIGHT BLUE hose for infants (corresponding inflation limit ***Infant.*** without cuff identification.

The monitor automatically identifies the black hose and sets the inflation limits automatically for adults to ***Adult***. For children and when using hoses without identification (the light blue infant hose), the inflation limit must be set manually in the ***NIBP Setup*** menu. To do this:

1. Press the **NIBP** key and select ***NIBP Setup - Inflation Limits***.

NOTE: When using hoses without identification, the monitor goes to this selection automatically when you try to start the NIBP measurement. With these hoses, ***AUTO*** option is not available.

2. Select the limit according to the hose with the ComWheel. For children, select ***Child***, and for infants, select ***Infant***.

NOTES:

– You cannot select ***Adult*** inflation limits when using an infant cuff

– The NIBP system incorporates a safety circuit to prevent overpressure or prolonged inflation of the cuff.

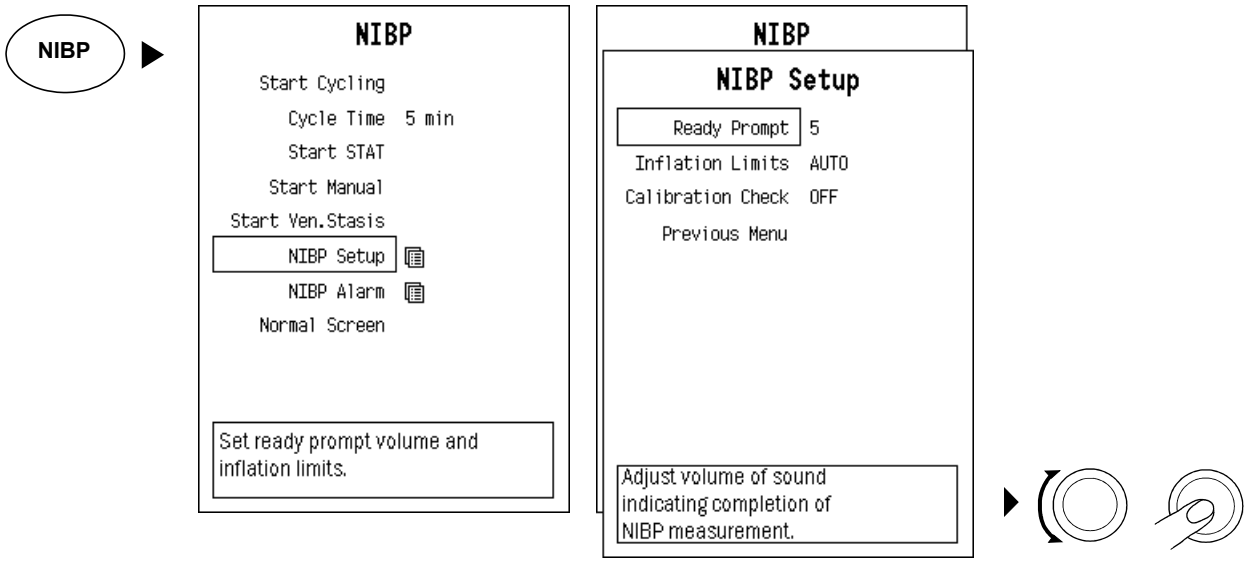
– The alarm limits change automatically according to the cuff hose type used (***Adult***/ ***Infant***.)

To determine the correct cuff size, check that the index line on the outer edge of the cuff falls between the range lines. If not, use a larger or smaller cuff.

Connecting the cuff hose

1. Connect the cuff hose to the NIBP cuff by placing the opposite connectors in contact and locking them together.
2. Plug the NIBP cuff hose to the module.

NIBP Setup menu



Ready Prompt Ready prompt gives an audible tone when the NIBP measurement is ready. Adjust the volume of the beep tone from 1 (soft) to 10 (loud), or to 0 (OFF.)

Inflation Limits When this selection is 'Auto', the monitor automatically identifies the cuff hose and selects the right inflation pressure and alarm limits for adults. For children, and when using infant hoses without identification, set the limit manually to ***Child*** or to ***Infant***.
This selection allows you to override the automatic safety limit feature for the hose/cuff being used.

The selections are: ***Auto, Infant***, ***Child*** and ***Adult***. The selection AUTO is not available when using hoses without identification.

NOTE: You cannot select adult limits with an infant cuff hose.

NOTE: When using very large adult cuffs, use 'Adult' limits to prevent 'Cuff loose' message from displaying.

Calibration Check

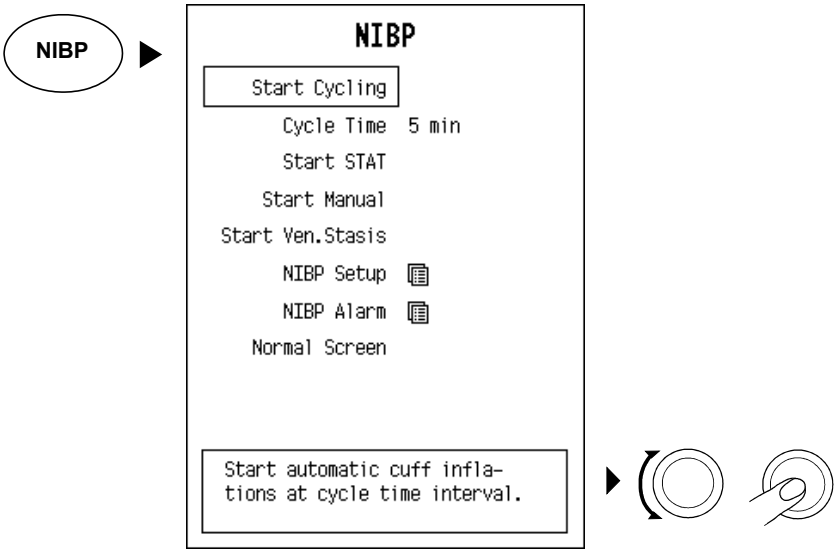
Enables the calibration check with an external manometer:
Remove cuff from the module connector before entering the menu. When the menu is displayed, attach an external manometer with pump to the connector. Pump approximately 200 mmHg and compare the readings of the manometer and screen. If the difference is more than 4 mmHg, calibration by authorized service personnel may be necessary.

Previous Menu Returns to the ***NIBP*** menu level.

Starting

Note that the measurement unit may be mmHg or kPa. The unit is selected during configuration through **Monitor Setup** - ***Install/Service*** - ***Installation*** - ***Units***.

You can start the NIBP measurement using either the direct function keys on the module or on the side panel, or by pressing the **NIBP** key on the Command Board.



In the beginning of the measurement, sys and dia labels are replaced by the inflation limit indication (***Infant, Child, Adult***) for five seconds. The cuff pressure is displayed in the mean pressure value field.

If motion artifacts are detected, the monitor automatically holds deflation until the motion stops (maximum of 30 seconds). If the artifacts prevent proper measurement, a new measurement starts automatically.

When the measurement is ready, you can hear a short beep and see the result numbers flashing.

WARNING **The monitor sets the inflation pressure automatically according to the previous measurement. Discharge the patient from the monitor to reset the inflation limit before measuring a new patient.**

During measurement

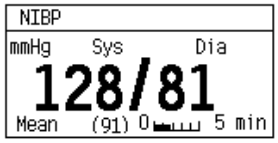
- Observe the cuffed limb frequently. Measurement may impair blood circulation. Intervals below 10 minutes and STAT measurements are not recommended for extended periods of time.
- Make sure that the tubes are not bent, pressed or stretched. Measurement may be impaired.
- Blood pressure values may be affected by a change in the patient's position.
- The presence of some arrhythmias during NIBP measurement may increase the time required for the measurement. For details, see "Functioning of NIBP measurement during arrhythmias" on page 16-9.

Autocycling

The **Auto On/Off** key sets automatic NIBP measurement at selected intervals on and off. Autocycling is synchronized to real time so that if the first measurement was at 12.02, the next measurement is at 12.05 and again at 12.10 (5 min. interval.)

To start the autocycling, do one of the following:

- Press the **Auto On/Off** module or side panel key, or
  press the **NIBP** key on the Command Board and select ***Start Cycling***.



The bar at the bottom of the NIBP field shows the time remaining to the next measurement.

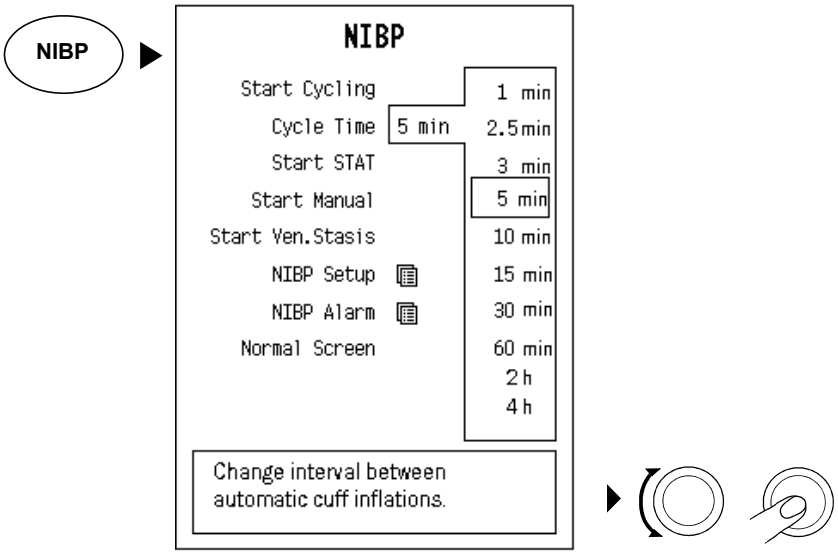
To stop autocycling:

- Press the **Auto On/Off** module or side panel key or
  press the **NIBP** key on the Command Board and select ***Stop Cycling***.

Setting cycle time

The possible intervals for autocycling are 1, 2.5, 3, 5, 10, 15, 30 minutes or 1, 2 or 4 hours. To set the cycle time:

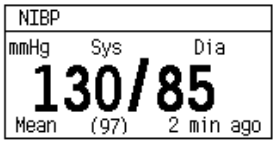
- Press the **NIBP** key on the Command Board and select ***Cycle Time***.
- Select the alternative with the ComWheel.



Starting a manual measurement

To start the measurement, do one of the following:

- Press the **Start/Cancel** module or side panel key, or
  press the **NIBP** key on the Command Board and select ***Start Manual***.



Canceling a measurement

To cancel any NIBP measurement, do one of the following:

Press the **Start/Cancel** module or side panel key, or
press the **NIBP** key on the Command Board and select ***Cancel***.

Starting and stopping a continuous measurement (STAT)

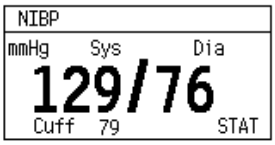
The STAT mode initiates continuous measurement for five minutes. A new NIBP measurement starts immediately after the previous one.

In STAT mode the early systolic value is measured and displayed until the final result is available.

After five minutes the monitor automatically returns to the previously selected cycling interval or to manual mode.

To start the measurement, do one of the following:

- Press the **NIBP** key on the Command Board and select ***Start STAT***

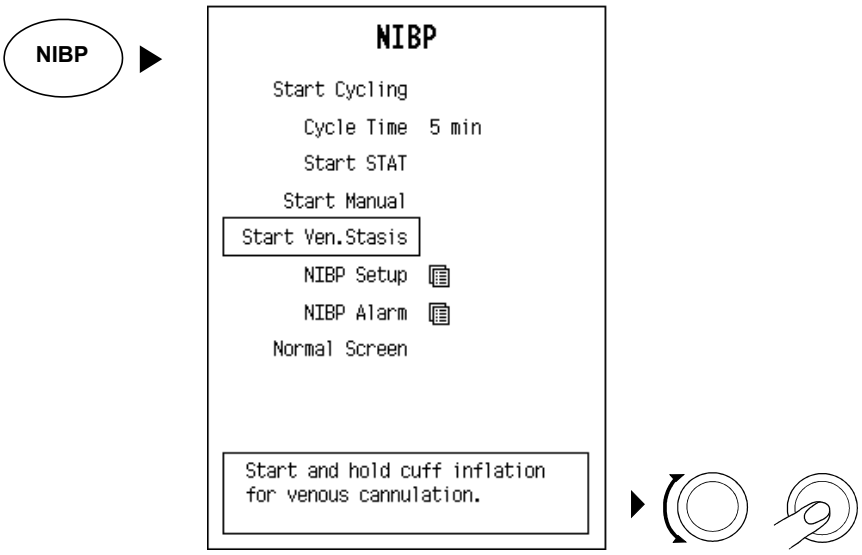


To discontinue the measurement:

- press the **NIBP** key on the Command and select ***Stop STAT***.

Using venous stasis

Venous Stasis initiates and holds the pressure in the cuff to help venous cannulation. A constant pressure is maintained in the cuff. The value is selected automatically after the inflation limits (infant, child or adult) are set.



To release the pressure before two minutes have expired:

- Press the **Start/Cancel** key on the module, or
  press the **NIBP** key on the Command Board and select ***Stop Ven. Stasis***.

The inflation limits, venous stasis pressure and venous stasis times are listed in the table below.

	Inflation limit	**Maximum venous stasis inflation limit**	**Venous stasis time**
Infant	150±5 mmHg (19.3 ± 0.7 kPa)	40±5mmHg (5.3 ± 0.7 kPa)	1 min
Child	200±10mmHg (26.7 ± 1.3 kPa)	60±5mmHg (8.0 ± 0.7 kPa)	2 min
Adult	280±10 mmHg (37.3 ± 1.3 kPa)	80±5 mmHg (10.7 ± 0.7 kPa)	2 min

Venous stasis pressure may be lower than the values above if the patient has low blood pressure. The venous stasis pressure adapts to the measured mean pressure being approximately the same as the mean pressure but always at least the following:

Infant 20 ± 5 mmHg (2.7 ±0.7 kPa)

Child 30 ± 5 mmHg (4.0 ±0.7 kPa)

Adult 40 ± 5 mmHg (5.3 ±0.7 kPa)

Automatic NIBP double check

If the NIBP value exceeds the alarm limits, a new measurement takes place automatically (immediately, when ***Manual*** measurement is selected, and after 30 seconds when ***Auto*** measurement is selected.) If the alarm situation persists, an alarm is given.

Functioning of NIBP measurement during arrhythmias

The functioning of the NIBP measurement has been tested by using Biotek BP Pump W (Non-invasive blood pressure monitor tester with wrist cuff) in the presence of the following arrhythmias (available from the Biotek BP Pump W): Tachycardia, Bradycardia, Premature Atrial Contraction #1, Premature Atrial Contraction #2, Premature Ventricular Contraction and Atrial Fibrillation and PVCs.

The test results indicate that the presence of some arrhythmias during measurement may increase the time required for the measurement.

Checklist

Check that:

- The hose is correct: black NIBP hose for adults and children and light blue for infants.
- The O-ring on the hose connector is intact.
- The connector is firmly pushed inside the cuff tube.
- The NIBP hose is properly connected to the module and will not detach if pulled.
- The NIBP cuff is correct for the patient size.
- There are no holes or cracks in the cuff bladder or cuff tube.
- The symbol indicating the center of the bladder is over the artery.
- All residual air is squeezed out of the cuff before wrapping it around the arm.
- The cuff is not loose.
- The cuff is at heart level.
- The cuff tubes or NIBP tube are not kinked or squeezed together.
- If leak is suspected, start venous stasis and check that the pressure is stable during stasis.
- Non-invasive blood pressure is selected to be displayed through **Monitor Setup** - ***Screen Setup***.

Table of contents

17 Airway gas (CO2)

Overview

With the N-FC and N-FCREC modules, you can measure and monitor the gases being delivered to the patient and exhaled by the patient.

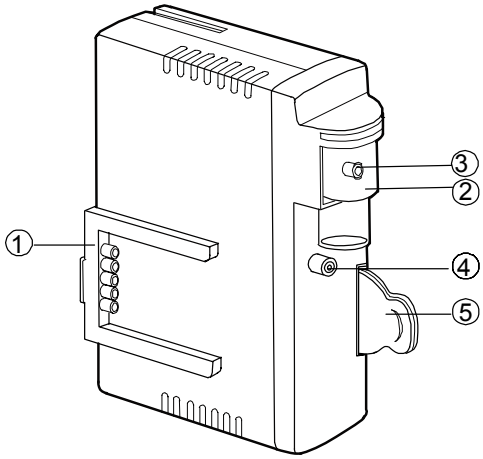
The modules are equipped with a water separation system and they measure only CO_2.

Respiration rate is the frequency of peak (end tidal) CO_2 measurements per minute. A breath is defined as a change in the CO_2 signal which exceeds 1% (8 mmHg). All concentrations are measured and displayed breath by breath.

Module description

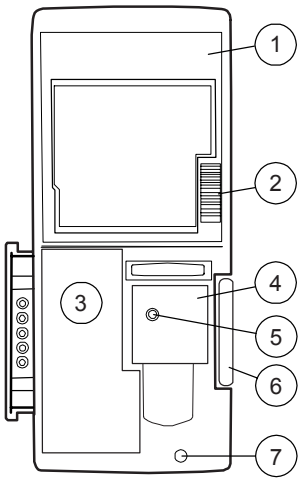
The airway gas measurement is housed in the N-FC and N-FCREC modules.

You can connect and disconnect airway modules like any other modules.



(1) Insertion guide for attaching on E-PSM(P)W module
(2) Water trap
(3) Sampling gas inlet
(4) Gas outlet
(5) Tab for removing the module

Figure 17-1 N-FC module



(1) Recorder
(2) Paper compartment lever
(3) CO2 measurement
(4) Water trap
(5) Sampling gas inlet
(6) Tab for removing the module
(7) Gas outlet

Figure 17-2 N-FCREC module

Display of gases

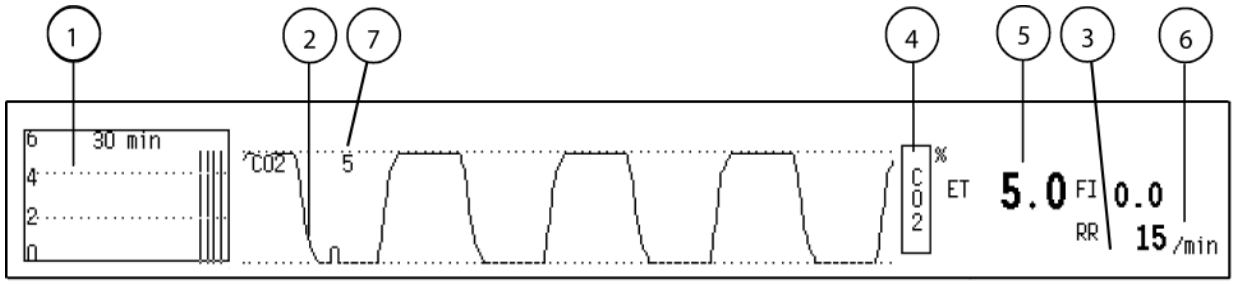


Figure 17-3 Airway gas waveform display

(1) 30 minute trend for CO_2 (selected in the Monitor Setup menu)
(2) Gas waveforms
(3) Message field for gases
(4) Gas label
(5) Digit field for ET and FI gas values
(6) Respiration rate
(7) Scale

NOTE: When the measured CO_2 value is outside the specified measurement range, the numeric value is gray.

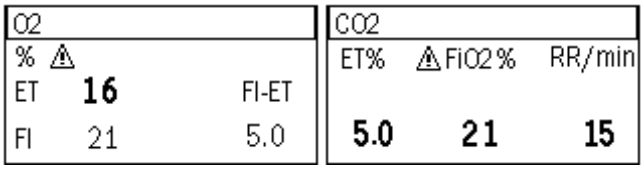


Figure 17-4 Lower digit field for gases

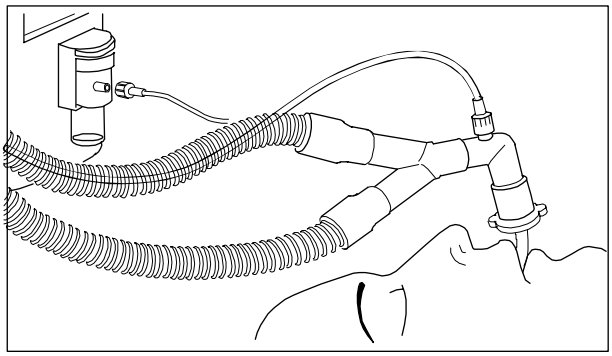
Patient connections

1. Insert the N-FC or N-FCREC in the monitor. Align the module with the insertion guides and push until it clicks.
2. Check visually that the airway adapter connections are tight and that the adapter is operating properly, then attach it to the patient.
3. Make sure that the water trap container is empty and properly attached. The water trap should be changed between patients and emptied whenever it is more than half full.

WARNING **Handle the water trap and its contents as you would any body fluid. Infectious hazard may be present.**

4. Connect the gas sampling line to the sampling line connector on the water trap.
5. Turn on the monitor. The monitor performs a self-check.
6. Before connecting the patient, wait until the message 'Calibrating gas sensor' disappears. Then make the patient connections as described below and connect the sampling line to the airway adapter.
7. Position the adapter with sampling port upwards. This prevents any condensed water from entering the sampling line.

If N-FCREC or N-FC is used with O_2 and/or N_2O contents higher than 40%, make sure that ***FiO2 Level*** and ***N2O Level*** are set accordingly through **Airway Gas** - ***CO2 Setup*** to enable O_2 and/or N_2O compensation.



Take the gas sample as close to the patient's airway as possible, as shown in the illustrations, and connect the sampling line to the patient's airway adapter.

Position the adapter's sampling port upwards to prevent any condensed water from entering the sampling line.

NOTE: The message 'Sampling line blocked' may result if you attach the sampling line to the water trap after turning on the monitor.

Points to note

- You can connect and disconnect airway modules like any other modules.
- For a comprehensive list of accessories, see the "Supplies and Accessories" catalog.
- In the monitoring system, use only one module for measuring airway gases.
- The message 'Sampling line blocked' may result if you attach the sampling line to the water trap after turning the monitor on.
- When the warning symbol is displayed beside the O_2 value FiO_2, low alarm limit is set below 21%.

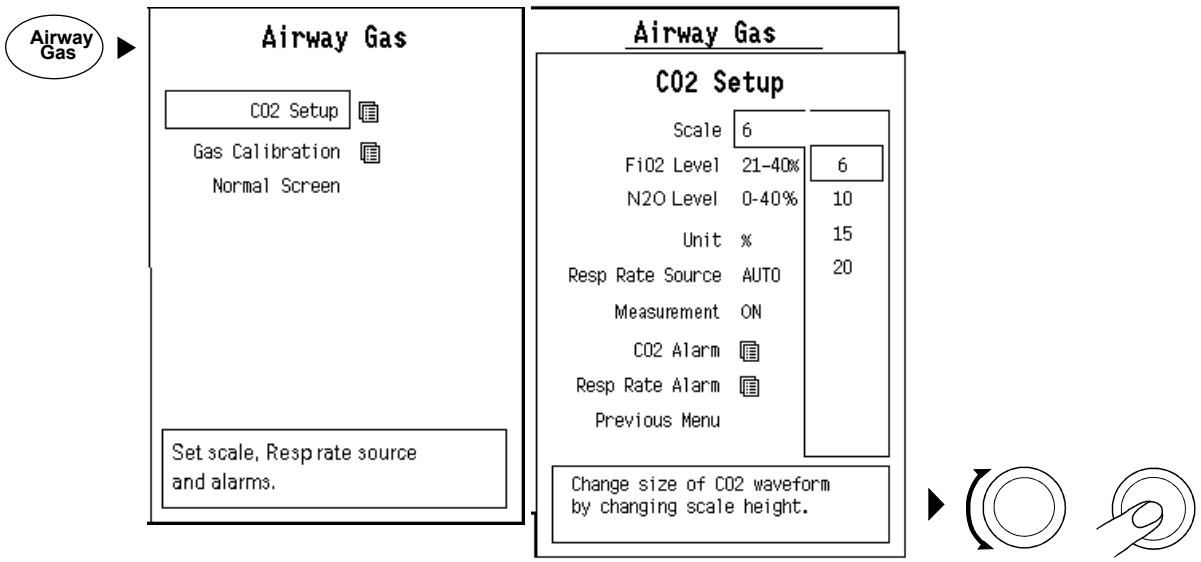
WARNING **Use only approved accessories. For a list of approved supplies and accessories, see the "Supplies and Accessories" catalog delivered with the monitor. Other accessories may cause a safety hazard, damage the equipment or system, result in increased emissions or decreased immunity of the equipment or system or interfere with the measurement.**

CAUTION Remove the airway sampling line from the patient's airway while nebulized medications are being delivered.

CAUTION Do not apply pressurized air to any outlet or tubing connected to the monitor. Pressure may destroy sensitive elements.

WARNING **Always test the airway adapter for a tight connection and proper operation before attaching it to the patient.**

CO_2 setup menu



Scale Allows you to select the following scales:

scale options for %	scale options for kPa	scale options for mmHg
0-6%	0 - 6 kPa	0 - 50 mmHg
0-10%	0 - 10 kPa	0 - 80 mmHg
0-15%	0 - 15 kPa	0 - 100 mmHg
0-20%	0 - 20 kPa	0 - 160 mmHg

FiO2 Level Selects the FiO_2 level. The FiO_2 level is used in gas compensations of the CO_2 measurement to increase the measurement accuracy. Make sure the level is set if the FiO_2 level is higher than 40%.

Unit Selects the CO_2 display unit: **%**, **kPa** or **mmHg**.

Resp Rate Source

You can select the rate to be calculated from the ECG leads (impedance measurement) or the CO_2 measurement. If you select AUTO, the rate is automatically calculated from the measured CO_2. If impedance measurement is present and the source is AUTO, the respiration rate calculation switches back to impedance respiration if you press the **Silence Alarms** key during an Apnea alarm.

CO2 Alarm Opens the CO_2 ***Alarms Adjustment*** menu to change the CO_2 alarm limits.

Resp Rate Alarm

Opens the ***Resp Rate Alarms Adjustment*** menu to change the respiration rate alarm limits.

Previous Menu Returns to the previous menu.

Selecting alarm sources

To select alarm sources, go to the ***CO2 Setup*** menu's submenu ***CO2 Alarm***. The selections are ***FI*** or ***ET*** as the high and low alarm limit.

Calibrating

NOTE: Ensure that the calibration gas and regulator are functioning properly before calibration. Perform annual maintenance of the regulator as required.

NOTE: Do not wash or disinfect calibration gas sampling lines.

The airway module should be calibrated once every six months or whenever there are indications of errors in the gas readings.

Calibrate the gas measurement with the GE Healthcare calibration gas. Do not use any other calibration gases.

– Use the regulator 755534 or equivalent.
– Use the gas 755580 only and set the CO_2 concentration to 20%.

If you do not use the recommended calibration gases, the calibration does not succeed.

During gas calibration, % units are always used for CO_2 regardless of selected measuring units.

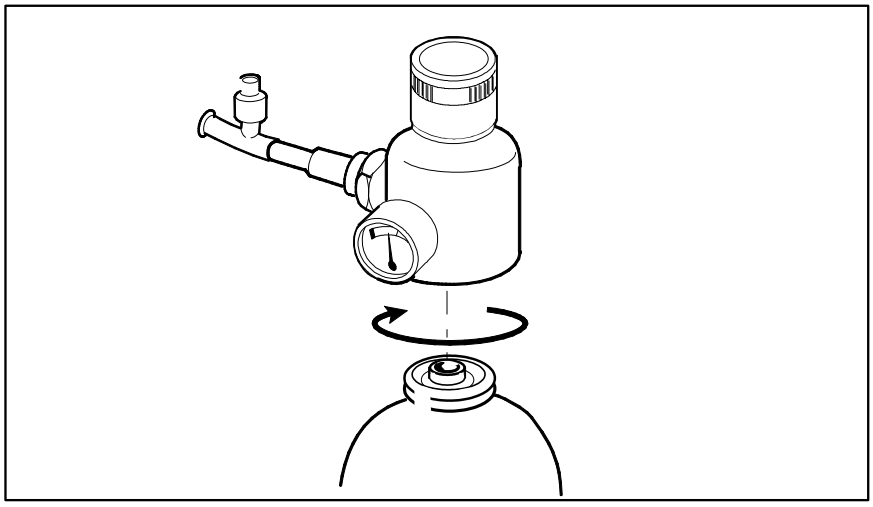


Figure 17-5 Attaching regulator to calibration can

1. Attach the regulator to the gas container.
2. Attach a new sampling line to the water trap. Connect the loose end of the sampling line to the regulator on the gas container.

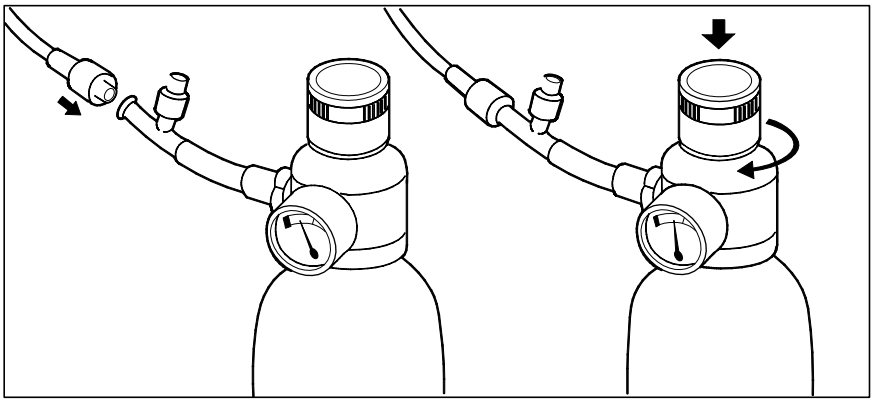


Figure 17-6 Connecting sampling line to the gas valve and feeding gas

3. Turn on the power. For maximum accuracy, let the monitor warm up for 30 minutes. The menu item ***Gas calibration*** remains gray as long as the message 'Calibrating gas sensor' is displayed.
4. Press the **Airway Gas** key and select ***Gas calibration***.
5. Wait until 'Zero ok' and then 'Feed gas' messages are displayed after each gas on the screen.
6. Open the regulator and feed calibration gas until the message 'Adjust' is displayed, then close the valve. If you use an older brass regulator, the feeding pressure should be adjusted between 5 and 7 psi.
7. Check that the displayed gas values match the values on the calibration gas container.

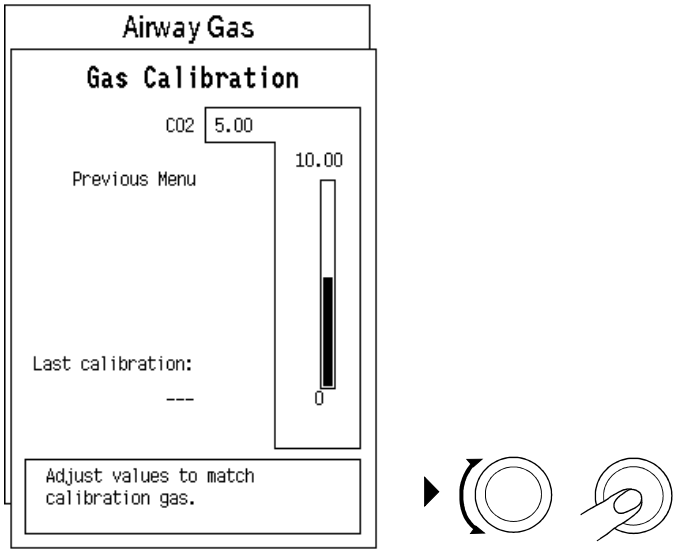
NOTE: Set the CO_2 level according to the gas, for example with 755580, set the CO_2 level to 20%.

NOTE: If an error occurs during calibration or if no gas is fed, the highlight goes automatically over the item ***Recalibrate*** and the text 'Calibr. error' is displayed after each gas. Push the ComWheel to perform a new calibration.

If adjustments are required:

- Turn the ComWheel to highlight the first gas to be adjusted and then push the ComWheel.
- Turn the ComWheel until the displayed value matches the desired value in the gas bottle and push it again.

Repeat these two steps for each gas.



The use of an old regulator with the new aerosol cylinders requires an adapter available from GE Healthcare. For ordering details, see the "Supplies and Accessories" catalog.

If the message 'Zero error' is displayed, press the **Normal Screen** key and repeat the calibration procedure. If the problem persists, contact authorized service personnel.

The monitor performs autozeroing after start up. The autozeroing intervals are: 4 min, 15 min, 30 min and 60 minutes after start-up, thereafter every 60 minutes.

NOTE: If you are using separate gas cylinders, calibrate each gas separately.

The time of the last calibration is shown at the bottom of the menu page.

Interfering gases

Non-disturbing gases are those with a maximum effect on the CO_2 reading < 0.2 vol%. The effect is valid for specific concentrations shown in parentheses of the non-disturbing gas:

Ethanol C_2H_5OH (<0.3%)

Acetone (<0.1%)

Methane CH_4 (<0.2%)

Nitrogen N_2

water vapor

Dichlorofluoromethane (<1%)

Tetrafluoroethane (<1%)

Disturbing gases and their effect on the CO_2 reading at 5.0 vol-% CO_2 are shown below. Errors listed reflect the effect of specific concentrations (shown in parentheses) of an individual disturbing gas and should be combined when estimating the effect of gas mixtures:

Halothane (4%) increases < 0.3 vol%

Isoflurane (5%) increases < 0.4 vol%

Enflurane (5%) increases < 0.4 vol%

Desflurane (24%) increases < 1.2 vol%

Sevoflurane (6%) increases < 0.4 vol%

Helium (50%) decreases < 0.3 vol%

If O_2 compensation is not activated: O_2 (40 to 95%) decreases < 0.3 vol%

If O_2 compensation is activated: O_2 (40 to 95%) error < 0.15 vol%

If N_2O compensation is not activated: N_2O (40%) increases < 0.4 vol%, N_2O (40 to 80%) increases < 0.8 vol%

If N_2O compensation is activated: N_2O (40 to 80%) error < 0.3 vol%

Unit conversions

Relationship between gas concentration and its partial pressure:

Reading in mmHg (dry gas) =

$$\frac{\text{(ambient pressure in mmHg) x (gas concentration in\%)}}{100}$$

Reading in mmHg (water vapor saturated gas) =

$$\frac{\text{(ambient pressure in mmHg - 47 mmHg) x gas concentration in\%}}{100}$$

Reading in kPa (dry gas) =

$$\frac{\text{(ambient pressure in mmHg) x (gas concentration in\%)}}{750}$$

Reading in kPa (water vapor saturated gas) =

$$\frac{\text{((ambient pressure in mmHg - 47mmHg) x (gas concentration in\%)}}{750}$$

NOTE: 47 mmHg is the partial pressure of the saturated water vapor at 37°C.

Checklist

Check that:

- Water trap is locked into the module.
- Water trap container is empty.
- A new sampling line is used after each patient.
- Sampling line is connected to the water trap.
- Monitor is turned on and self-check is performed with the sampling line attached.
- Sampling line is connected to the airway adapter.
- The humidification and/or bacteria filter are in correct place.
- Breathing circuit or accessories have no residuals of alcohol based disinfectants.
- Desired gas parameter is selected for screen through **Monitor Setup** - ***Screen Setup***.

Index

A

B

C

D

E

F

G

H

I

L

M

N

O

P

R

S

T

U

V

W

Z

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