BeneVision N Series

Patient Monitor

Operator's Manual

**(For BeneVision N22/BeneVision N19/
BeneVision N17/BeneVision N15/BeneVision N12/BeneVision N12C)**

CE 0123

Release time: June 2019

Revision: 12.0

Intellectual Property Statement

SHENZHEN MINDRAY BIO-MEDICAL ELECTRONICS CO., LTD. (hereinafter called Mindray) owns the intellectual property rights to this Mindray product and this manual. This manual may refer to information protected by copyrights or patents and does not convey any license under the patent rights of Mindray, nor the rights of others.

Mindray intends to maintain the contents of this manual as confidential information. Disclosure of the information in this manual in any manner whatsoever without the written permission of Mindray is strictly forbidden.

Release, amendment, reproduction, distribution, rental, adaption and translation of this manual in any manner whatsoever without the written permission of Mindray is strictly forbidden.

mindray is the registered trademarks or trademarks owned by Mindray in China and other countries. All other trademarks that appear in this manual are used only for editorial purposes without the intention of improperly using them. They are the property of their respective owners.

Responsibility on the Manufacturer Party

Contents of this manual are subject to changes without prior notice.

All information contained in this manual is believed to be correct. Mindray shall not be liable for errors contained herein nor for incidental or consequential damages in connection with the furnishing, performance, or use of this manual.

Mindray is responsible for the effects on safety, reliability and performance of this product, only if:

- all installation operations, expansions, changes, modifications and repairs of this product are conducted by Mindray authorized personnel;
- the electrical installation of the relevant room complies with the applicable national and local requirements;
- the product is used in accordance with the instructions for use.

WARNING

- **This equipment must be operated by skilled/trained clinical professionals.**
- **It is important for the hospital or organization that employs this equipment to carry out a reasonable service/maintenance plan. Neglect of this may result in machine breakdown or personal injury.**

Warranty

THIS WARRANTY IS EXCLUSIVE AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING WARRANTIES OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE.

Exemptions

Mindray's obligation or liability under this warranty does not include any transportation or other charges or liability for direct, indirect or consequential damages or delay resulting from the improper use or application of the product or the use of parts or accessories not approved by Mindray or repairs by people other than Mindray authorized personnel.

This warranty shall not extend to

- Malfunction or damage caused by improper use or man-made failure.
- Malfunction or damage caused by unstable or out-of-range power input.
- Malfunction or damage caused by force majeure such as fire and earthquake.
- Malfunction or damage caused by improper operation or repair by unqualified or unauthorized service people.
- Malfunction of the instrument or part whose serial number is not legible enough.
- Others not caused by instrument or part itself.

Company Contact

Manufacturer:	Shenzhen Mindray Bio-Medical Electronics Co., Ltd.
Address	Mindray Building, Keji 12th Road South, High-tech Industrial Park, Nanshan, Shenzhen 518057, P.R.China
Website	www.mindray.com
E-mail Address:	service@mindray.com.cn
Tel:	+86 755 81888998
Fax:	+86 755 26582680

EC-Representative:	Shanghai International Holding Corp. GmbH (Europe)
Address:	Eiffestraβe 80, 20537 Hamburg, Germany
Tel:	0049-40-2513175
Fax:	0049-40-255726

Preface

Manual Purpose

This manual contains the instructions necessary to operate the product safely and in accordance with its function and intended use. Observance of this manual is a prerequisite for proper product performance and correct operation and ensures patient and operator safety.

This manual is based on the maximum configuration and therefore some contents may not apply to your product. If you have any question, please contact us.

This manual is an integral part of the product. It should always be kept close to the equipment so that it can be obtained conveniently when needed.

Intended Audience

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

Illustrations

All illustrations in this manual serve as examples only. They may not necessarily reflect the setup or data displayed on your patient monitor.

Conventions

- ***Italic text*** is used in this manual to quote the referenced manuals, chapters, sections and formulas.
- **Bold text** is used to indicate the screen texts and names of hard keys.
- → is used to indicate operational procedures.

Table of Contents

This page intentionally left blank.

1 Safety

1.1 Safety Information

WARNING

- **Indicates a potential hazard or unsafe practice that, if not avoided, could result in death or serious injury.**

CAUTION

- **Indicates a potential hazard or unsafe practice that, if not avoided, could result in minor personal injury or product/property damage.**

NOTE

- **Provides application tips or other useful information to ensure that you get the most from your product.**

1.1.1 Warnings

WARNING

- **This equipment is used for single patient at a time.**
- **To avoid explosion hazard, do not use the equipment in the presence of oxygen-rich atmospheres, flammable anesthetics, or other flammable agents.**
- **Use and store the equipment in specified environmental condition. The monitor and accessories may not meet the performance specification due to aging, stored or used outside the specified temperature and humidity range.**
- **The equipment is not intended to be used within the Magnetic Resonance (MR) environment.**
- **Before connecting the equipment to the power line, check that the voltage and frequency ratings of the power line are the same as those indicated on the equipment's label or in this manual.**
- **Before putting the system into operation, the operator must verify that the equipment, connecting cables and accessories are in correct working order and operating condition.**
- **To avoid risk of electric shock, the equipment must only be connected to mains power with protective earth. If a protective earth conductor is not provided, operate it on battery power, if possible.**
- **Do not use the multiple portable socket outlets (MPSO) or AC mains extension cords. Insure that the sum of the individual ground leakage currents does not exceed the allowable limits.**
- **Do not touch the patient and live parts simultaneously. Otherwise patient injury may result.**
- **Do not come into contact with the patient during defibrillation. Otherwise serious injury or death could result.**
- **Do not open the equipment housings. All servicing and future upgrades must be carried out by trained and authorized personnel.**
- **Do not rely exclusively on the audible alarm system for patient monitoring. Turning the alarm volume to a low level or off may result in a hazard to the patient. Remember that alarm settings should be customized according to patient situations. Always keep the patient under close surveillance.**
- **Alarm settings should be customized according to patient situations.**
- **Do not place the equipment or accessories in any position that might cause it to fall on the patient.**
- **Do not start or operate the equipment unless the setup was verified to be correct.**

- **To avoid inadvertent disconnection, route all cables in a way to prevent a stumbling hazard. Wrap and secure excess cabling to reduce risk of entanglement by patients or personnel.**
- **The equipment should not be used as the sole basis for medical decisions. It must be used in conjunction with clinical signs and symptom.**
- **If any measurement seems questionable, first check the patient's vital signs by alternate means and then check the equipment for proper functioning.**
- **The physiological data and alarm messages displayed on the equipment are for reference only and cannot be directly used for diagnostic interpretation.**
- **Route, wrap and secure the cables to avoid inadvertent disconnection, stumbling and entanglement.**
- **The software equipment copyright is solely owned by Mindray. No organization or individual shall resort to modifying, copying, or exchanging it or to any other infringement on it in any form or by any means without due permission.**

1.1.2 Cautions

CAUTION

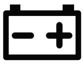
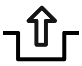
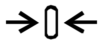
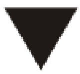
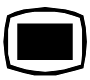
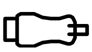
- **Use only parts and accessories specified in this manual.**
- **Ensure that the equipment is supplied with continuous electric power during work. Sudden power failure may cause data loss.**
- **Magnetic and electrical fields are capable of interfering with the proper performance of the equipment. For this reason make sure that all external devices operated in the vicinity of the equipment comply with the relevant EMC requirements. Mobile phone, X-ray equipment or MRI devices are a possible source of interference as they may emit higher levels of electromagnetic radiation.**
- **Always install or carry the equipment properly to avoid damage caused by drop, impact, strong vibration or other mechanical force.**
- **Dry the equipment immediately in case of rain or water spray.**
- **Some settings are password protected and can only be changed by authorized personnel. Contact your department manager or biomedical engineering department for the passwords used at your facility.**
- **Do not loop the patient cabling into a tight coil or wrap around the device, as this can damage the patient cabling.**
- **Dispose of the package material as per the applicable waste control regulations. Keep it out of children's reach.**
- **At the end of its service life, the equipment, as well as its accessories, must be disposed of in compliance with the guidelines regulating the disposal of such products. If you have any questions concerning disposal of the equipment, please contact us.**

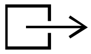
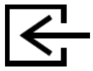
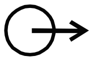
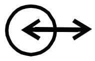
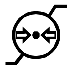
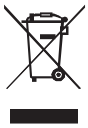
1.1.3 Notes

NOTE

- **Put the equipment in a location where you can easily view and operate the equipment.**
- **The equipment use a mains plug as isolation means to the mains power. Do not locate the equipment in a place difficult to operate the mains plug.**
- **The typical operator's position is in front of the monitor.**
- **The software was developed in compliance with IEC62304. The possibility of hazards arising from software errors is minimized.**
- **This manual describes all features and options. Your equipment may not have all of them.**
- **Keep this manual in the vicinity of the equipment so that it can be obtained conveniently when needed.**

1.2 Equipment Symbols

Symbol	Description	Symbol	Description
	General warning sign		Refer to instruction manual/booklet
SN	Serial number	REF	Catalogue number
	Date of manufacture		Manufacturer
	USB connector	IPX1	Protected against vertically falling water drops per IEC 60529
	Battery indicator		Computer network
	Equipotentiality		Alternating current
	DEFIBRILLATION-PROOF TYPE CF APPLIED PART		DEFIBRILLATION-PROOF TYPE BF APPLIED PART
	Stop USB		Zero key
	NIBP start/stop		Calibration
	Start		Stop
	Stand-by		Menu
	Set baseline		Unlocking
	Unlocking		Locking
	Check sensor		Graphical record

Symbol	Description	Symbol	Description
	Gas outlet		Gas inlet
	Output		Input/output
	Humidity limitations		Atmospheric pressure limitations
	Temperature limitations		Non-ionizing electromagnetic radiation
	Dispose of in accordance to your country's requirements		Pushing prohibited (wheels locked no pushing)
EC REP	Authorised representative in the European Community		Plastic identification symbol
CE 0123	The product bears CE mark indicating its conformity with the provisions of the Council Directive 93/42/EEC concerning medical devices and fulfills the essential requirements of Annex I of this directive. Note: The product complies with the Council Directive 2011/65/EU.		

2 Equipment Introduction

2.1 Intended Use

The BeneVision N series patient monitors (N22, N19, N17, N15, N12, N12C), hereafter called the monitor, are intended to be used for monitoring, displaying, reviewing, storing, alarming and transferring of multiple physiological parameters including ECG (3-lead, 5-lead, 6-lead, and 12-lead selectable, arrhythmia detection, ST segment analysis, QT/QTc monitoring, and heart rate (HR)), respiration (Resp), temperature (Temp), pulse oxygen saturation (SpO2), pulse rate (PR), non-invasive blood pressure (NIBP), invasive blood pressure (IBP), cardiac output (C.O.), carbon dioxide (CO_2), oxygen (O_2), anesthetic gas (AG), impedance cardiograph (ICG), bispectral index (BIS), respiration mechanics (RM), continuous cardiac output (CCO), central venous oxygen saturation ($ScvO_2$), electroencephalograph (EEG), neuromuscular transmission (NMT), and regional oxygen saturation (rSO_2). The monitor also provides an interpretation of resting 12-lead ECG.

All the parameters can be monitored on single adult, pediatric, and neonatal patients with the exception of the following:

- The BIS, CCO, ScvO2 and NMT monitoring are intended for adult and pediatric patients only.
- C.O. monitoring is only intended for adult patients.
- ICG monitoring is only intended for use on patients above the age of 13 years, with weight greater than 34 kg, and taller than 130 cm..

This monitor is to be used in healthcare facilities by clinical professionals or under their guidance. It is not intended for helicopter transport, hospital ambulance, or home use.

WARNING

- **This monitor is intended for use only by clinical professionals or under their guidance. It must only be used by persons who have received adequate training in its use. Anyone unauthorized or untrained must not perform any operation on it.**

2.2 Applied Parts

The applied parts of the monitor are:

- ECG electrode and leadwire
- SpO_2 sensor
- Temp probe
- NIBP cuff
- IBP transducer
- C.O. sensor
- CCO sensor
- $ScvO_2$ sensor
- PiCCO sensor
- ICG sensor
- CO_2 sampling line/nasal sampling cannula, water trap, and mask
- AG sampling line, water trap, airway adapter, and mask
- RM sensor
- EEG electrode
- BIS sensor
- NMT sensor and electrode
- rSO_2 sensor

2.3 System Components

The N22 and N19 monitors consist of the main unit, primary display, secondary displays, external modules, satellite module rack (SMR), input devices, and output devices.

The N17, N15, N12, and N12C monitors consist of the main unit, external modules, satellite module rack (SMR), input devices, and output devices.

NOTE

- **Your monitor may not include all these components. Contact your local service personnel for the available components.**

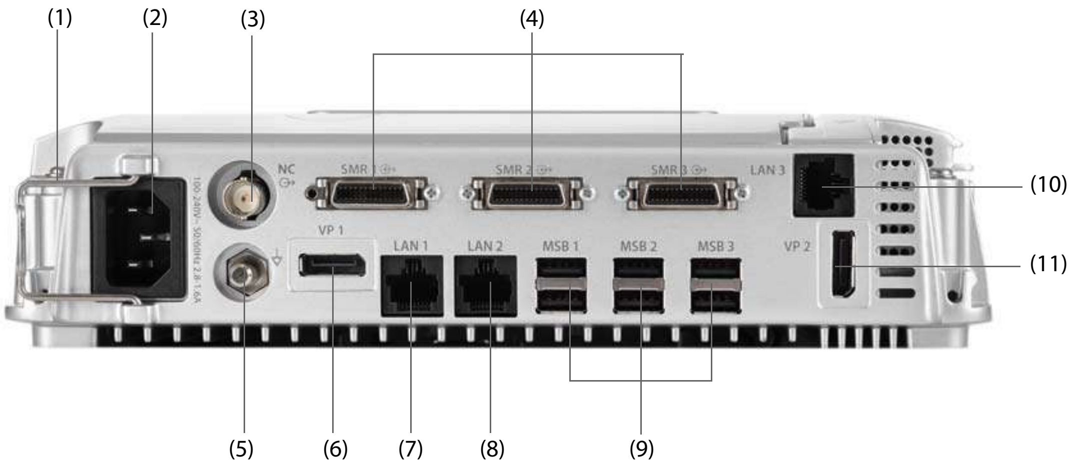
2.3.1 N22, N19 Main Unit

The main unit processes data from modules.

2.3.1.1 N22, N19 Main Unit for Integrated Installation

If the main unit and the primary display are installed together. It provides the following connectors:

N22, N19 Bottom View



CAUTION

- **Main unit installation and debugging should be executed by Mindray service personnel or authorized technicians.**

N22, N19 Left View

(1) Cable retainer

(2) AC Power input

(3) Nurse call connector (NC)
It is a BNC connector. It connects the monitor to the hospital's nurse call system through the nurse call cable (PN: 8000-21-10361). Alarms from the monitor are sent to the nurse station through the nurse call system, if configured to do so.

(4) Satellite module rack connector (SMR1, 2, 3): connects the SMR and N1 or T1 Dock.

(5) Equipotential Grounding Terminal
When using the monitor together with other devices, connect their equipotential grounding terminals together to eliminate the potential difference between them.

(6) Video output connector (VP1): connects the secondary display.

(7) Network Connector (LAN1)
It is a standard RJ45 connector which connects the monitor to the central monitoring system (CMS) or other network devices.

(8) Network Connector (LAN 2)
Reserved for future use.

(9) Serial bus connectors (MSB1, 2, 3): connect USB devices, for example the keyboard, mouse, and barcode reader. If independent secondary display is connected, the MSB1 connector is connected to the SBH connector at the rear of the secondary display to activate the MSB connector connecting the keyboard and mouse for the independent secondary display.

(10) Network Connector (LAN3)
It is a standard RJ45 connector which connects the iView system to the external network.

(11) Video output connector (VP2): connects the iView display.

(12) USB connectors: available only when iView module is configured. They connect USB devices for the iView, for example keyboard and mouse.

2.3.1.2 N22, N19 Main Unit for Separate Installation

If the main unit and the primary display are separately installed, besides the connectors described in *2.3.1.1 N22, N19 Main Unit for Integrated Installation*, the main unit also provides connectors at the rear.

(1) Video output connector (VP3): connects the VP connector on the separated primary display.

(2) Serial bus connector (MSB4): connects the serial bus hub connector (SBH) on the separated primary display.

(3) Signal input connector (SIG): connects the SIG1 connector on the separated primary display.

(4) DC-in connector: connects the DC-in connector on the separated primary display.

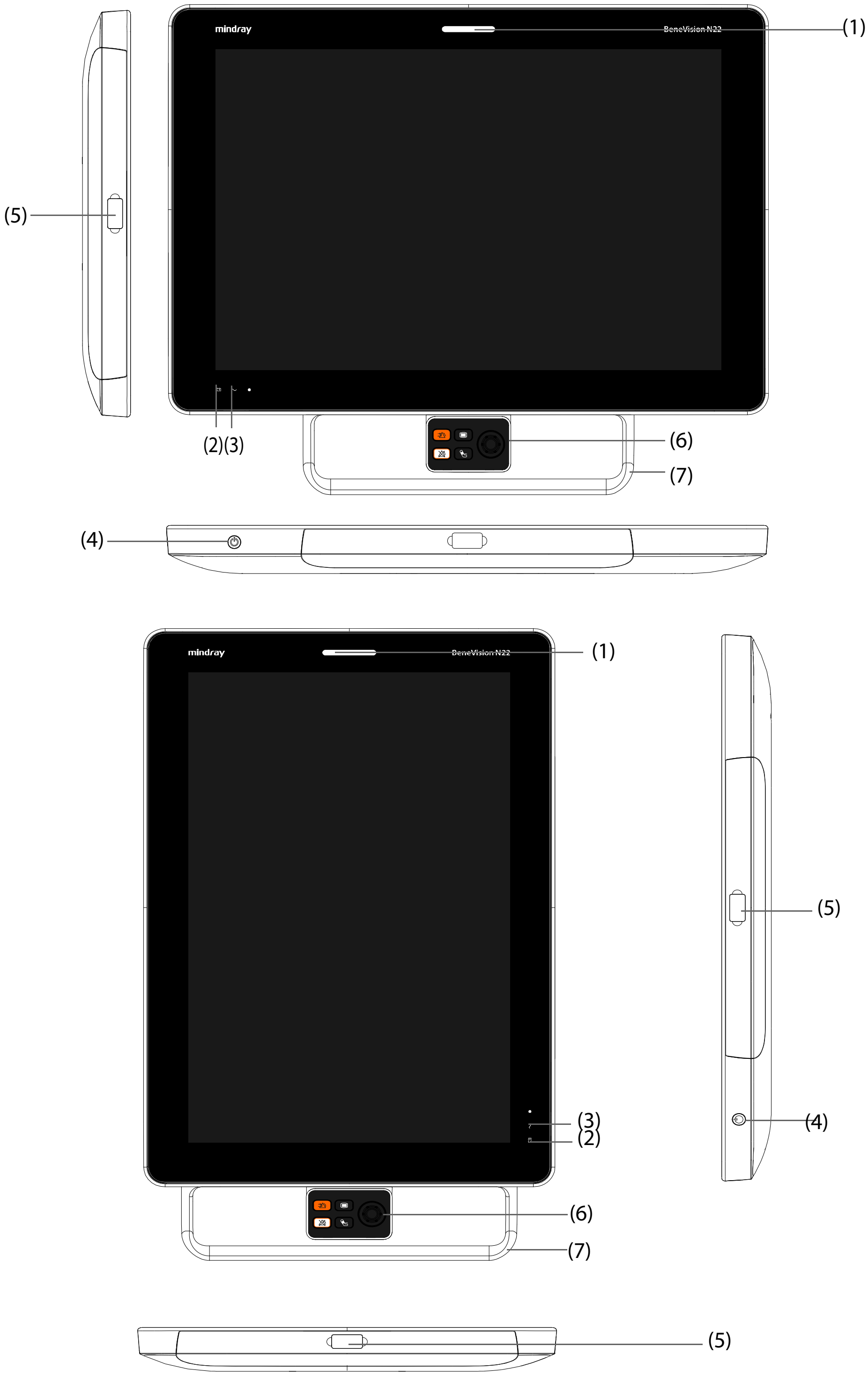
2.3.2 N22, N19 Displays

The displays are used to display system information, alarm messages, parameter numerics, waveforms, and so on. The displays integrate audible and visual alarms and provide USB connectivity. There are two display sizes available: the 22-inch display and the 19-inch display. The monitor supports a primary display, a secondary display, and a iView display.

2.3.2.1 N22, N19 Integrated Primary Display

The primary display can be installed with or separately from the main unit, either horizontally or vertically.

The following picture shows the indicators and connectors on the primary display when it is installed with the main unit.



(1) Alarm lamp:
When a physiological alarm or technical alarm occurs, this lamp lights and flashes corresponding with the alarm priority:

- High priority alarms: the lamp quickly flashes red.
- Medium priority alarms: the lamp slowly flashes yellow.
- Low priority alarms: the lamp lights in cyan without flashing.

(2) Battery indicator:

- Yellow: the battery is being charged.
- Green: the battery is fully charged.
- Flashing green: the monitor operates on battery power.
- Off: no battery is installed, or the battery is malfunctioning, or the monitor is powered off and no AC power is connected.

(3) AC power indicator

- On: when AC power is connected.
- Off: when AC power is not connected.

(4) Power switch

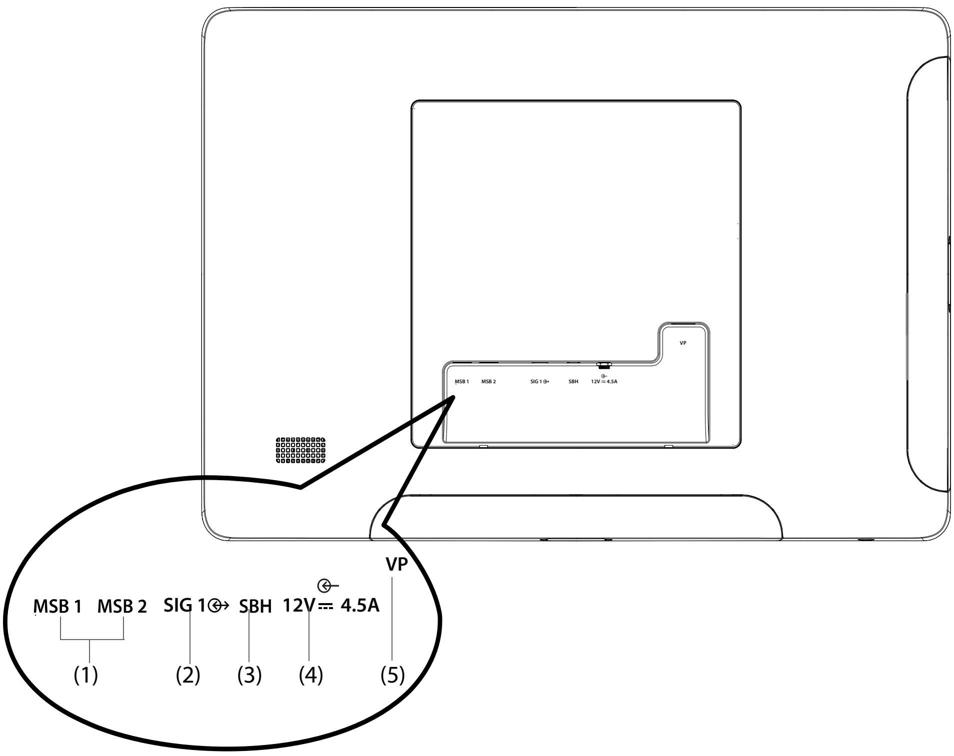
- Pressing this switch turns on the monitor.
- When the monitor is on, pressing and holding this switch turns off the monitor.

(5) Serial bus connectors (MSB): connect USB devices, for example keyboard, mouse, and barcode reader.

(6) Navigation knob

(7) Handle: you can drag the handle to rotate the display.

Besides the indicators and connectors, which are the same as those of the integrated primary display, the separated primary display and the secondary display have connectors at the rear.



(1) Serial bus connector (MSB1, MSB2): connect USB devices, for example keyboard, mouse, and barcode reader.

(2) Signal input connector (SIG1): for the separate primary display, it connects the SIG connector at the rear of the main unit; for the secondary display, it is reserved for future use.

(3) Serial bus hub connector (SBH): connects the MSB1 connector at the bottom of the main unit to activate MSB connectors for the independent secondary display.

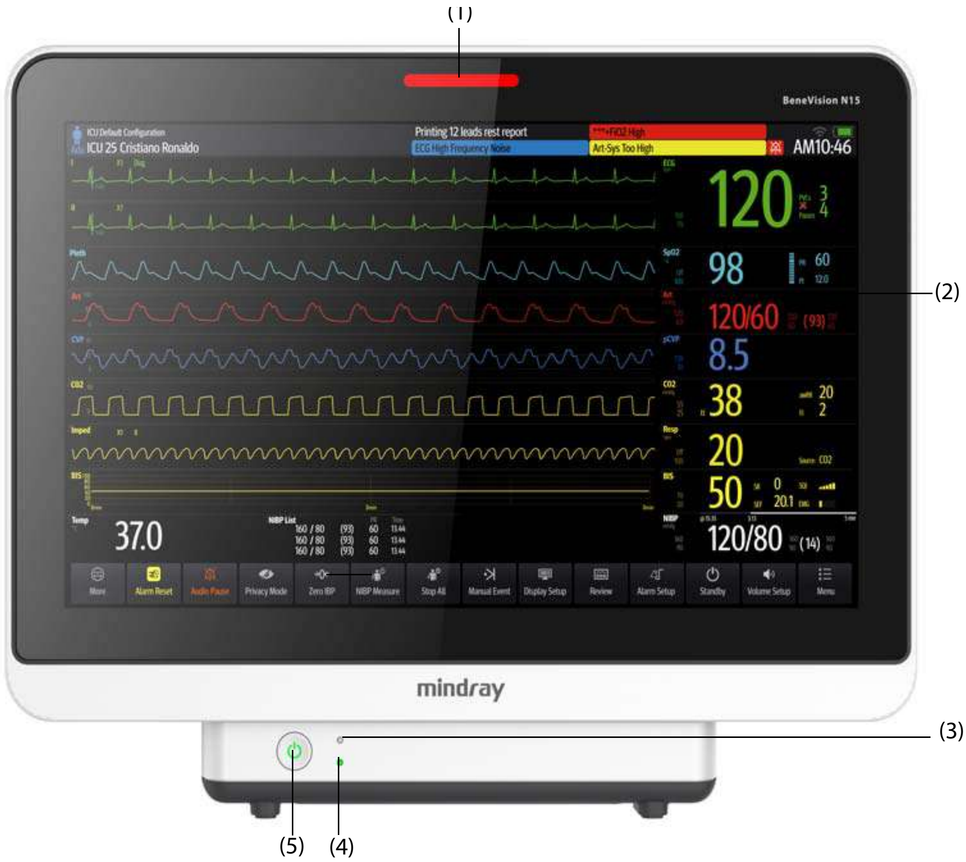
(4) DC-in connector: connects the DC adapter to run the secondary display.

(5) Video output connector (VP): connects the VP1 connector at the bottom of the main unit.

2.3.3 N17, N15, N12, N12C Main Unit

The main unit displays and saves data from modules.

2.3.3.1 N17, N15, N12, N12C Front View



(1) Alarm lamp:
When a physiological alarm or technical alarm occurs, this lamp lights and flashes corresponding with the alarm priority:

- High priority alarms: the lamp quickly flashes red.
- Medium priority alarms: the lamp slowly flashes yellow.
- Low priority alarms: the lamp lights in cyan without flashing.

(2) Display

(3) Battery indicator:

- Yellow: the battery is being charged.
- Green: the battery is fully charged.
- Flashing green: the monitor operates on battery power.
- Off: no battery is installed, or the monitor is powered off and no AC power is connected.

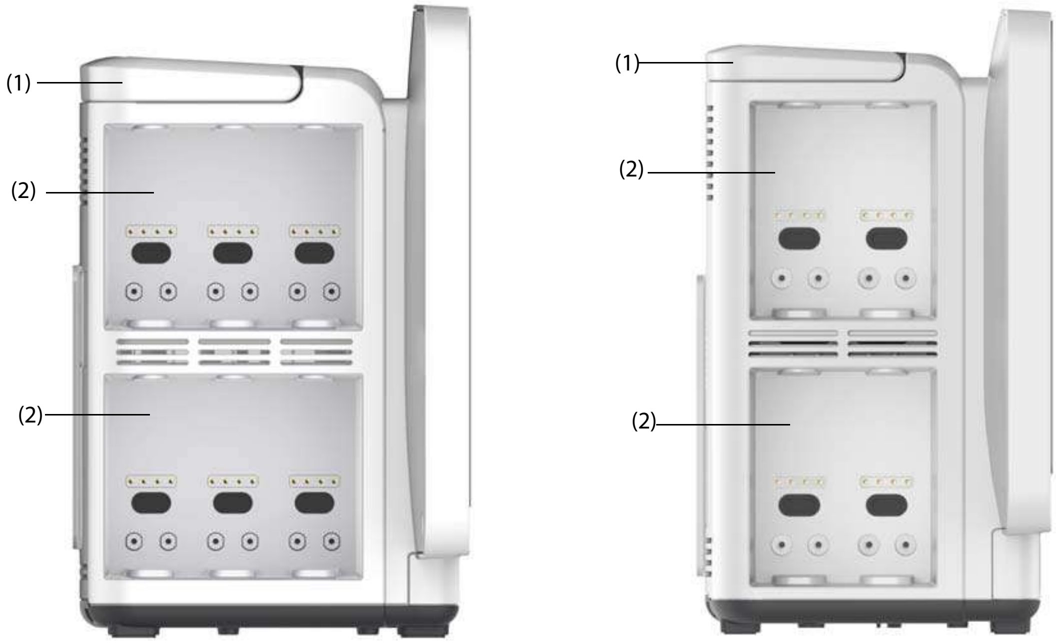
(4) AC power indicator

- On: when AC power is connected.
- Off: when AC power is not connected.

(5) Power switch

- Pressing this switch turns on the monitor.
- When the monitor is on, pressing and holding this switch turns off the monitor.

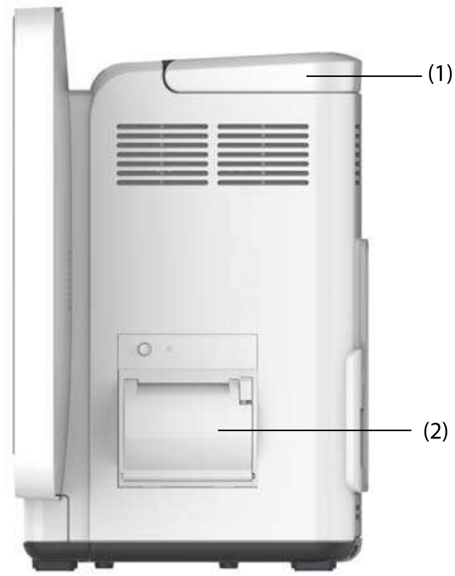
2.3.3.2 N17, N15, N12, N12C Left View



N17/N15 **N12/N12C**

(1) Handle (2) Module racks

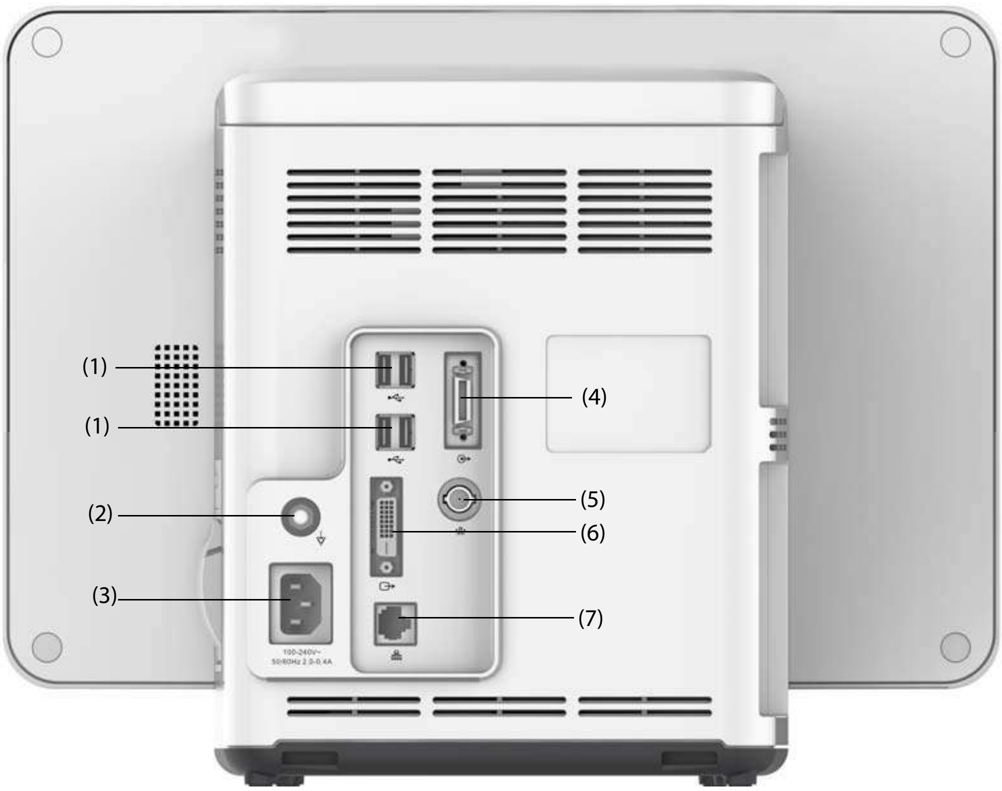
2.3.3.3 N17, N15, N12, N12C Right View



(1) Handle

(2) Recorder

2.3.3.4 N15, N12, N12C Rear View



(1) USB connectors

Connect USB devices, for example the keyboard, mouse, and barcode reader.

(2) Equipotential Grounding Terminal

When using the monitor together with other devices, connect their equipotential grounding terminals together to eliminate the potential difference between them.

(3) AC Power input

(4) Satellite module rack connector

For N15, connects the SMR and N1 or T1 Dock.

For N12/N12C, connect N1 or T1 Dock.

(5) Nurse call connector

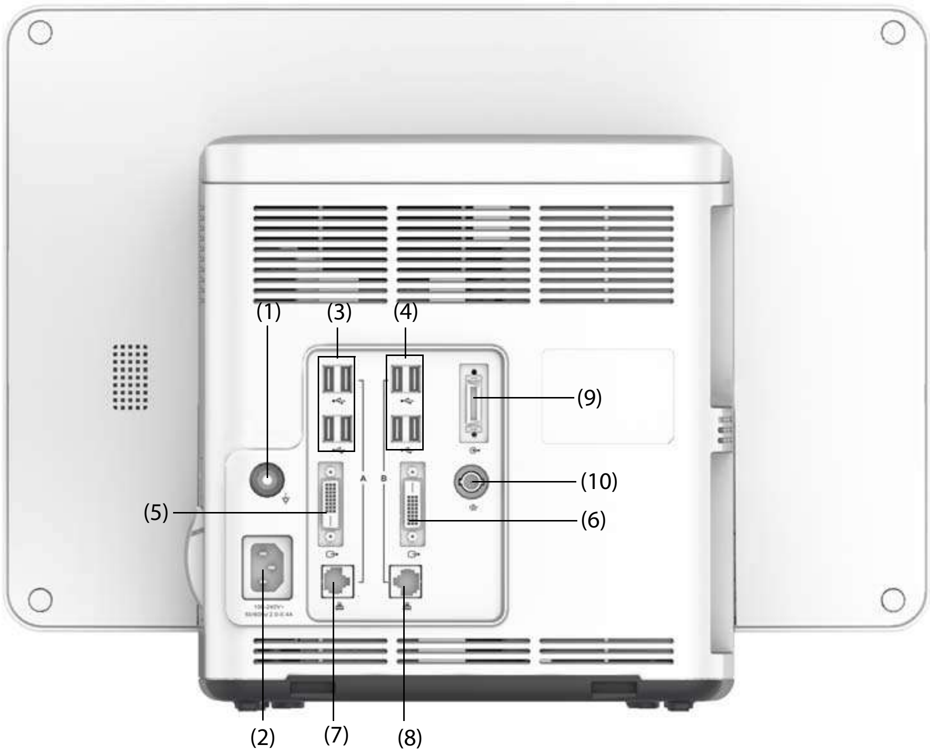
It is a BNC connector. It connects the monitor to the hospital's nurse call system through the nurse call cable (PN: 8000-21-10361). Alarms from the monitor are sent to the nurse station through the nurse call system, if configured to do so.

(6) Digital video connector: connects external display.

(7) Network Connector

It is a standard RJ45 connector which connects the monitor to the central monitoring system (CMS) or other network devices.

2.3.3.5 N17 Rear View



(1) Equipotential Grounding Terminal

When using the monitor together with other devices, connect their equipotential grounding terminals together to eliminate the potential difference between them.

(2) AC Power input

(3) USB connectors

Connect USB devices, for example the keyboard, mouse, and barcode reader.

(4) USB connectors: available only when iView module is configured. They connect USB devices for the iView system, for example keyboard and mouse.

(5) Digital video connector: connects the external display which mirrors the monitor display.

(6) Digital video connector:

Connects the iView display if the iView module is configured.

Connects the external display.

(7) Network Connector

It is a standard RJ45 connector which connects the monitor to the central monitoring system (CMS) or other network devices.

(8) Network Connector: available only when iView module is configured. It is a standard RJ45 connector which connects the iView system to the external network.

(9) Satellite module rack (SMR) connector: connects SMR or N1 or T1 Dock.

(10) Nurse call connector

It is a BNC connector. It connects the monitor to the hospital's nurse call system through the nurse call cable (PN: 8000-21-10361). Alarms from the monitor are sent to the nurse station through the nurse call system, if configured to do so.

2.3.4 Satellite Module Rack (SMR)

The SMR provides interface between the monitor and external modules. The SMR has eight module slots. It is connected to the main unit through the SMR connector.

The following pictures show the indicator and connectors on the SMR.

(1)

(2) (3)

(1) SMR status indicator: illuminates when the SMR is powered on.

(2) Monitor connector: connects the BeneView monitor.

(3) Monitor connector: connects the BeneVision monitor.

2.3.5 External Modules

The external modules are used to monitor the patient's physiological parameters, record patient information and data, and connect external devices. The monitor provides the following modules:

- Parameter modules: acquires and processes the patient's data and sends the data to the main unit.
- Recorder module: prints patient information, parameter measurements and waveforms.
- BeneLink module: connects external devices. The monitor outputs data from external devices through the BeneLink module.

2.3.5.1 Available Modules

The following table lists available modules

Module label	Comments
MPM	Integrates 3/5-lead ECG, Resp, SpO_2, Temp, NIBP, IBP monitoring, or 3/5/6/12-lead ECG, Resp, SpO_2, Temp, NIBP, IBP monitoring, and analog output
SpO_2	Supports SpO_2 monitoring
Temp module	Supports temperature monitoring
C.O.	Supports C.O. monitoring

Module label	Comments
IBP	Supports IBP monitoring
BIS	Supports BIS monitoring
ICG	Supports ICG monitoring, Medis ICG
CCO/SvO_2	Connects Edwards Vigilance II® or Vigileo™ monitor, supports CCO and SvO_2 monitoring
PiCCO	Supports CCO monitoring and other hemodynamic parameters
$ScvO_2$	Supports $ScvO_2$ monitoring
EEG	Supports EEG monitoring
NMT	Supports NMT monitoring
rSO_2	Supports rSO_2 monitoring
CO_2	Supports CO_2 monitoring. The sidestream CO_2, module can integrate O_2 (paramagnetic) monitoring.
RM	Supports RM monitoring
AG	Supports AG monitoring. The AG module can integrate O_2 and BIS monitoring.
Tympanic Temp adapting module	Connects the Genius tympanic thermometer to the monitor
BeneLink	Connects external devices
/	Recorder

You can simultaneously use maximum three IBP modules and three Temp modules (besides the Temp and IBP of the MPM module), and two rSO_2 modules. The other modules can only be used one at a time. Otherwise, the monitor will issue a module conflict prompt.

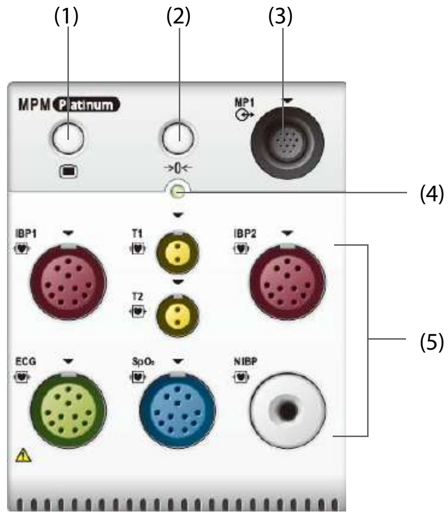
For example, if a CO_2 module is already loaded and then another CO_2 module is inserted, the monitor will then prompt module conflict. To solve the problem of module conflict, just remove a module.

2.3.5.2 Example Module

The parameter modules have similar structure:

- The parameter label is marked at the upper left corner.
- Hard keys are located on the upper part.
- Patient cable connectors are located at the lower part.

We take the MPM module as an example.



(1) Setup hard key: enters or exits the **MPM setup** menu.

(2) Zero hard key: enters the **Zero IBP** menu.

(3) Analog out connector: outputs defibrillation synchronization pulse, ECG, and IBP analog signal.

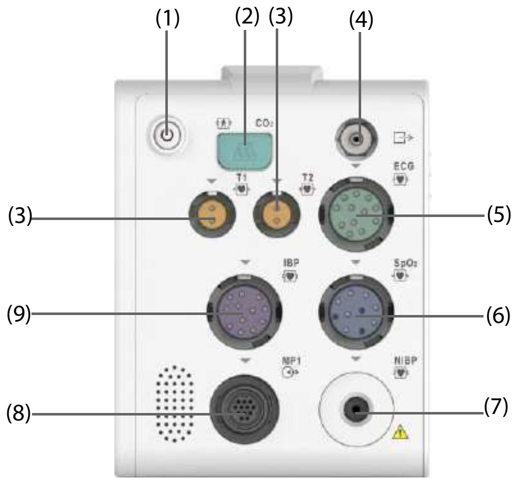
(4) Module status indicator

- On: the module works properly.
- Flashing: the module is initializing.
- Off: the module is not connected or the module fails.

(5) Patient cable connectors: the MPM module incorporates multiple measurement modules, including ECG, Resp, SpO_2, NIBP, Temp, and IBP.

2.3.5.3 BeneVision N1

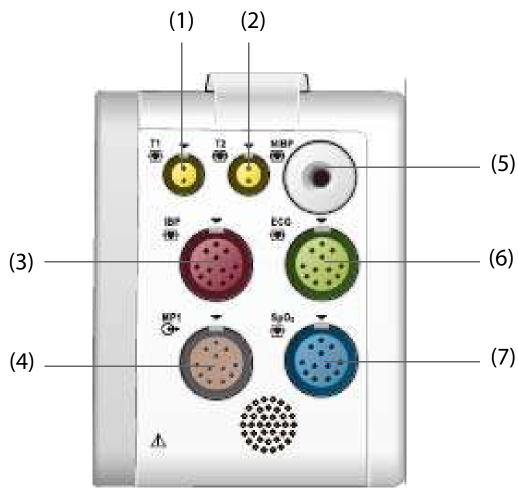
The BeneVision N1 can be connected to the monitor through the module rack (for N17, N15, N12, N12C), SMR or through the N1 Dock. It is used as an MPM module.



(1)	Power switch
(2)	Sample line connector of the sidestream CO_2
(3)	Temp probe connector
(4)	Gas outlet
(5)	ECG cable connector
(6)	SpO_2 cable connector
(7)	NIBP cuff connector
(8)	Multifunctional connector: outputting analog and defib synchronization signal.
(9)	IBP cable connector

2.3.5.4 BeneView T1

The BeneView T1 can be connected to the monitor through the module rack (for N17, N15, N12, and N12C), SMR or through the T1 docking station. It is used as an MPM module.



(1)	Connector for Temp probe 1	(2)	Connector for Temp probe 2
(3)	IBP cable connector	(4)	Multifunctional connector: outputting analog and defibrillation synchronization signal.
(5)	NIBP cuff connector	(6)	ECG cable connector
(7)	SpO_2 cable connector		

2.3.6 Cable Management Kit

The cable management kit is installed at the bottom of the SMR.

(1) Handle: you can place the NIBP cuff on the handle.

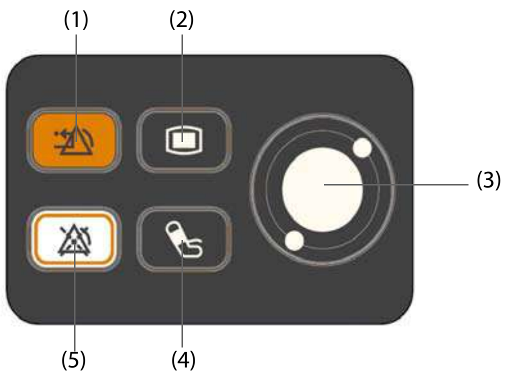
(2) Cable hooks: you can put the cables and leadwires on the hooks.

2.3.7 Input Devices

The monitor allows data entry through touchscreen, keyboard, mouse, remote controller, and barcode reader.

You can only use Mindray specified input devices. For N22 and N19, the primary display and the secondary display can have independent mouses and keyboards. When the secondary display is used as an extend display, you can use one mouse and one keyboard to control both the primary display and the secondary display.

For N22 and N19, you can also use the navigation knob to operate the monitor. The navigation knob is installed at the bottom of the display. The primary display and the secondary display can have independent navigation knob. When the secondary display is used as an extend display, you can use one navigation knob to control both the primary display and the secondary display.



(1) Alarm Reset hard key: acknowledges the on-going alarm.

(2) Main Menu hard key: enters the main menu

(3) Navigation knob

(4) NIBP Start/Stop hard key: starts an NIBP measurement or stops the current NIBP measurement

(5) Alarm Pause hard key: pauses the current alarms

2.3.8 Printing Devices

You can use Mindray specified printer and/or recorder to output patient information and data.

N17, N15, N12, and N12C can be configured with a build-in recorder. If the build-in recorder is not available, you can also use the external recorder module.

For N22 and N19, to use the recorder, insert the recorder module into the SMR.

The printer can be connected to the monitor through the network to output patient reports.

3 Getting Started

3.1 Equipment Preparation Safety Information

WARNING

- **Use only installation accessories specified by Mindray.**
- **The equipment software copyright is solely owned by Mindray. No organization or individual shall resort to modifying, copying, or exchanging it or to any other infringement on it in any form or by any means without due permission.**
- **Connect only approved devices to this equipment. Devices connected to the equipment must meet the requirements of the applicable IEC standards (e.g. IEC 60950 safety standards for information technology equipment and IEC 60601-1 safety standards for medical electrical equipment). The system configuration must meet the requirements of the IEC 60601-1 medical electrical systems standard. Any personnel who connect devices to the equipment's signal input/output port are responsible for providing evidence that the safety certification of the devices has been performed in accordance to the IEC 60601-1. If you have any questions, please contact Mindray.**
- **If it is not evident from the equipment specifications whether a particular combination with other devices is hazardous, for example, due to summation of leakage currents, please consult the manufacturer or an expert in the field. A determination must be made that the proposed combination will not negatively affect the devices themselves or the patient's safety.**
- **If the accuracy of any value displayed on the monitor, central station, or printed on a graph strip or report is questionable, determine the patient's vital signs by alternative means. Verify that all equipment is working correctly.**

CAUTION

- **The equipment should be installed by authorized Mindray personnel.**
- **When disposing of the packaging material, be sure to observe the applicable waste control regulations and keep it out of children's reach.**
- **Before use, verify whether the packages are intact, especially the packages of single use accessories. In case of any damage, do not apply it to patients.**
- **Make sure that the equipment operating environment meets the specific requirements. Otherwise unexpected consequences, e.g. damage to the equipment, could result.**
- **Observance of this manual is a prerequisite for proper product performance and correct operation and ensures patient and operator safety.**

NOTE

- **Put the equipment in a location where you can easily view and operate the equipment.**
- **Keep this manual in the vicinity of the equipment so that it can be conveniently referenced when needed.**
- **Save the packing case and packaging material as they can be used if the equipment must be reshipped.**

3.2 Monitor Installation

The monitor can be installed in various ways as required.

- Wall mount
- Installed on the medical supply unit
- Installed on the anesthesia machine

3.2.1 Unpacking and Checking

Before unpacking, examine the packing case carefully for signs of damage. If any damage is detected, contact the carrier or us.

If the packing case is intact, open the package and remove the equipment and accessories carefully. Check all materials against the packing list and check for any mechanical damage. Contact us in case of any problem.

3.2.2 Environmental Requirements

The operating environment of the equipment must meet the requirements specified in this manual.

The environment where the equipment is used shall be reasonably free from noises, vibration, dust, corrosive, flammable and explosive substances. If the equipment is installed in a cabinet, sufficient space in front and behind shall be left for convenient operation, maintenance and repair. Moreover, to maintain good ventilation, the equipment shall be at least 2 inches (5cm) away from around the cabinet.

When the equipment is moved from one place to another, condensation may occur as a result of temperature or humidity difference. In this case, never start the system before the condensation disappears.

3.3 Setting Up the Equipment

Observance of this manual is a prerequisite for proper product performance and correct operation. It ensures patient and operator safety.

3.3.1 Connecting the AC Mains

The monitor is powered by AC power supply. Before connecting the equipment to the AC mains, check that the voltage and frequency ratings of the power line are the same as those indicated besides the AC power input.

To use the AC power source, follow this procedure:

1. Connect the female end of the power cord with the AC power input.
2. Connect the male end of the power cord with a wall AC outlet.
3. Check that the AC indicator is on.

The AC indicator is off if the AC mains is not connected. When AC mains is connected, the AC indicator is illuminated in green.

WARNING

- **Always use the accompanying power cord delivered with the monitor.**
- **Before connecting the equipment to the AC mains, check that the voltage and frequency ratings of the power line are the same as those indicated besides the AC power input.**
- **Use the cable retainer to secure the power cord to prevent it from falling off.**
- **Use the battery if the integrity of the protective earth conductor or the protective earthing system in the installation is in doubt.**

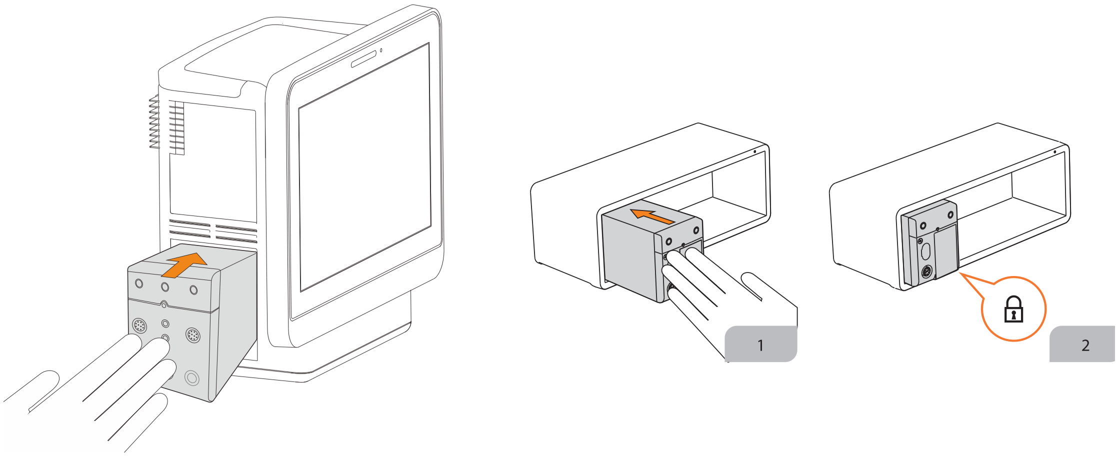
3.3.2 Connecting the Input Devices

Connect the mouse, keyboard, navigation knob, and barcode scanner if necessary.

3.3.3 Connecting the SMR

To connect the SMR, use the SMR cable (PN: 009-005121-00 or 009-005122-00) to connect the monitor connector on the rear of SMR to the SMR connector on the main unit.

3.3.4 Connecting Modules to the Module Rack or SMR



To connect a module to the SMR or module rack (for BeneVision N17/N15/N12/N12C), follow this procedure:

1. With the module properly oriented, align the module insertion guide slot with the SMR insertion guide. Push the module into the SMR until you hear a click.
2. Push the lock at the bottom of the module inwards to lock the module.

3.3.5 Removing Modules from the Module Rack or SMR

To remove a module from the SMR or module rack (for BeneVision N17/N15/N12/N12C), follow this procedure:

1. Pull outwards the lock at the bottom of the module to release the module.
2. Lift the latches at the bottom of the module and slide the module out of the SMR. Hold on the module to make sure it does not drop when it comes out.

CAUTION

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

3.4 Turning on the Monitor

Before turn on the monitor, perform the following inspections:

1. Check the monitor, SMR and modules for any mechanical damage. Make sure that all external cables, plug-ins and accessories are properly connected.
2. Connect the power cord to the AC power source.

To turn on the monitor, press the power switch. For N22/N19, if you are using the secondary display, turn it on too.

3.5 Operation and Navigation

Everything you need to operate the monitor is on its screen. Almost every element on the screen is interactive. Screen elements include parameter values, waveforms, quick keys, information fields, alarms fields and menus. Often you can access the same element in different ways. For example, you can access a parameter menu by selecting corresponding numeric area or waveform area, through the Menu hard key on the parameter module, or through the **Parameter Setup** quick key.

3.5.1 Using the Touchscreen

You can use the touchscreen to select a screen element by pressing directly on the monitor's screen.

To avoid misuse, you can temporarily disable the touchscreen. To do so, hold and press the **Main Menu** quick key and slide as directed by the arrow. A padlock symbol displays at the top of the main menu quick key if the touchscreen is disabled.

The touchscreen lock period is configurable. To do so, follow this procedure:

1. Access **Display** in either of the following ways:
   - ◆ Select the **Screen Setup** quick key → select the **Display** tab.
   - ◆ Select the **Main Menu** quick key → from the **Display** column select **Display**
2. Set **Screen Lock Duration**.

The touchscreen is enabled when the preset time is reached. If you need to manually enable the touchsceen, hold and press the **Main Menu** quick key and slide as directed by the arrow.

CAUTION

- **Check that the touchscreen is not damaged or broken. If there is any sign of damage, stop using the monitor and contact the service personnel.**
- **If the touchscreen is loose, stop using the monitor and contact the service personnel.**

3.5.2 Using the Mouse

You can use the mouse to select a screen element by moving the cursor on the element and then click on it.

3.5.3 Using the On-Screen Keyboard

The on-screen keyboard enables you to enter information:

- ■ Enter the information by selecting one character after another.
- ■ Select the Backspace key to delete single characters or select to delete the entire entry.
- ■ Select the Caps Lock key to access uppercase letters.
- ■ Select the Enter key to confirm the entry and close the on-screen keyboard.

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

3.5.4 Using the Navigation Knob (for N22/N19)

You can use the navigation knob to access the main menu, pause alarms, reset alarms, and start/stop NIBP measurements..

3.5.5 Using the Barcode Reader

The monitor supports both linear (1D) barcode reader and two-dimension (2D) barcode reader. The barcode reader is connected to the monitor's MSB connector (for N22/N19) or the USB connector (N17/N15/N12/N12C).

NOTE

- **You can use the Mindray custom barcode reader to scan both the 2D and 1D barcodes. Using other barcode readers can only output the patient's medical record number (MRN) and visit number.**

3.5.5.1 Clearing Old Data Formats (for the Mindray Custom 2D Barcode Reader)

If you are using the Mindray custom 2D barcode reader (Model HS-1R or HS-1M), before using the it for the first time, clear old data formats and configure the barcode reader.

Before configuring the Mindray custom barcode reader, clear old data formats. To do so, follow this procedure:

1. Scan the engineering barcode to clear the previous data format.
2. Scan the 2D engineering barcode which contains your hospital's data format.

NOTE

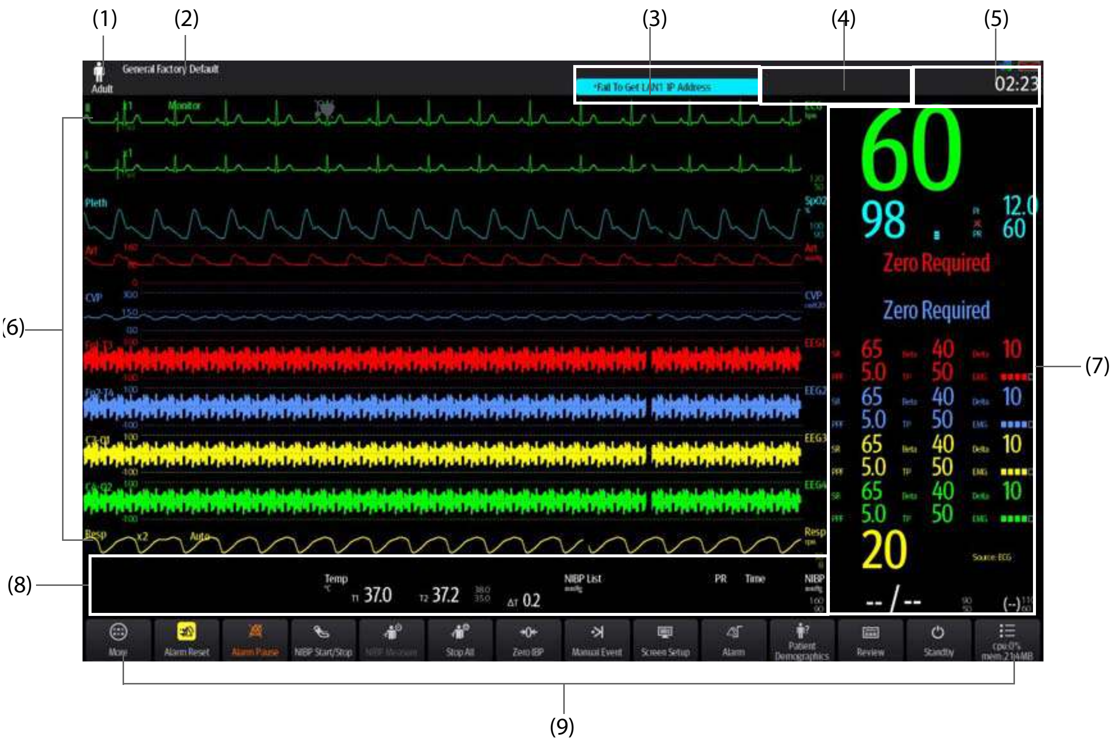
- **Contact the scanner manufacturer or Mindray to obtain the engineering barcodes for clearing data formats and containing the hospital's data format.**

3.5.6 Using the Remote Controller

You can use the remote controller to control the monitor by connecting the receiver of the remote controller to the monitor's MSB connector (for N22/N19) or the USB connector (N17/N15/N12/N12C). For more information on how to use the remote controller, see the Instructions for Use delivered with the remote controller.

3.6 Screen Display

The following figure shows the normal screen:



(1) Patient information area: displays patient information, including patient category, gender, department, room number, bed number, and so on. The displayed patient information is configurable. Selecting this area enters the **Patient Management** menu. For more information, see *5.4 Managing Patient Information*.

(2) The current configuration

(3) Technical alarm information area: displays prompt messages on the above; displays technical alarm messages at the bottom.

(4) Physiological alarm information area: displays high priority physiological alarms on the above; displays medium and low priority physiological alarms at the bottom.

(5) System status information area: displays alarm symbol, battery status, network status, currently connected CMS, storage device status, and system time. For more information, see *3.6.1 On-screen Symbols*.

(6) Parameter waveform area: displays parameter waveforms and parameter alarms. Select a waveform enters corresponding parameter menu. For more information, see *3.11.3 Displaying the Parameter List*.

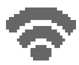
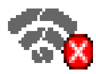
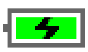
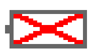
(7) Parameter numerics area: displays parameter values, alarm limits, and alarm status. This area also displays parameter list. Selecting a parameter numeric block enters corresponding parameter menu. Selecting the parameter list enters tabular trend review. For more information, see *3.11.3 Displaying the Parameter List*.

(8) Parameter waveform/numerics area: displays parameter waveforms, parameter values, alarm limits, and alarm status. Selecting a parameter numeric area or waveform area enters corresponding parameter menu. For more information, see *3.11.3 Displaying the Parameter List*.

(9) Quick key area: displays selected quick keys.

3.6.1 On-screen Symbols

The following table lists the on-screen symbols displayed on the system status information area:

Symbol	Description	Symbol	Description
	Adult, male		Adult, female
	Pediatric, male		Pediatric, female
	Neonate, male		Neonate, female
	Wireless network is connected. The solid part indicates network signal strength.		Wireless network is not connected.
	Wired network is connected.		Wired network is not connected.
	All the alarms are paused.		Individual physiological alarms are turned off or the monitor is in the alarm off status.
	Audible alarm tones are paused.		Audible alarm tones are turned off
	Alarms are acknowledged and the alarm system is reset.		The battery works correctly. The green portion represents the remaining charge.
	The battery has low power and needs to be charged.		The battery has critically low charge and needs to be charged immediately. Otherwise, the monitor will soon automatically shut down.
	The battery is being charged.		No battery is installed.
+	Indicates that the followed parameter is from an external device connected to the monitor via the BeneLink module.		

3.6.2 Menus

All menus have similar style and structure, see the figure below:

(1) Menu heading

(2) Submenu tabs

(3) Operation buttons

(4) Exit button: closes the current menu page.

(5) Main body area: includes menu items and options.

(6) Switch:

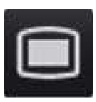
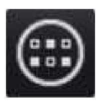
- Green: the switch is on.
- Gray: the switch is off.

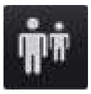
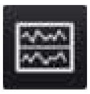
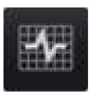
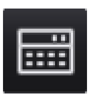
3.6.3 Quick Keys

The monitor provides quick keys for you to quickly access some functions. The quick key area is located at the bottom of the screen. Normally the quick key area displays 14 quick keys (12 quicks keys for N12 and N12C). The **Main Menu** key is permanently located the right bottom, and the **More** key is permanently located at the left bottom. Selecting the **More** quick key shows more quick keys. The quick keys displayed on the screen are configurable.

3.6.3.1 Available Quick Keys

The following table shows available quick keys.

Symbol	Label	Function	Symbol	Label	Function
	Main Menu	Enters the main menu.		More	Shows more quick keys.
	Alarm Setup	Enters the **Alarm** menu.		Alarm Reset	Acknowledges ongoing alarms and reset the alarm system.

Symbol	Label	Function	Symbol	Label	Function
	Audio Pause	Pauses alarm tone.		Alarm Pause	Pauses the current alarms.
	Review	Enters the **Review** menu.		Standby	Enters the Standby mode.
	Patient Management	Enters the **Patient Management** menu.		Screen Setup	Enters the **Screen Setup** menu.
	NIBP Start/ Stop	Starts an NIBP measurement or stops the current NIBP measurement.		Stop All	Stops all NIBP measurements.
	NIBP STAT	Starts a five-minutes continuous NIBP measurement.		NIBP Measure	Enters the **NIBP Measure** menu.
	Zero IBP	Starts IBP zero calibration.		C.O. Measure	Opens the **C.O. Measure** window.
	PAWP	Enters the **PAWP** screen.		Loops	Opens the **Loops** window.
	Venipuncture	Inflates the NIBP cuff to help venous puncture.		Start TOF	Starts/stops TOF measurement.
	Parameters Setup	Enters the **Parameters Setup** menu.		Remote View	Opens the **Remote View** window.
	Manual Event	Manually triggers and saves an event.		Minitrends	Enters the Minitrends screen.
	OxyCRG	Opens the **OxyCRG** window.		ECG Full-Screen	Enters the 12-lead ECG full screen.
	Privacy Mode	Enters the privacy mode.		Night Mode	Enters the night mode.
	CPB Mode	Enters the CPB mode.		Intubation Mode	Enters the intubation mode.
	Volume	Enters the **Volume** menu.		Freeze	Freezes waveforms.
	Calculations	Enters the **Calculations** menu.		Load Configuration	Enters the **Load Config** menu.

Symbol	Label	Function	Symbol	Label	Function
	Print	Starts printing a real-time report.		Record	Starts/Stops a recording.
	InfusionView	Enters the **InfusionView** screen.		Integrated Devices	Enters the **Integrated Device** screen
	ECG Lead/Gain	Enters the **ECG Lead/Gain** menu.		Call Help	Calls for help.
	BoA Dashboard	Enters the **BoA Dashboard** screen.		EWS	Enters the **EWS** screen.
	GCS	Enters the **GCS** menu.		SepsisSight	Enters the **SepsisSight** menu.
	HemoSight	Enters the **HemoSight** menu.		Rescue Mode	Enters the rescue mode.
	Pace View	Enters the **Pace View** window.		ECG 24h Sum	Views the 24-hour ECG summary.
	Discharge Patient	Enters the **Discharge Patient** dialog box.		Discharged Patients	Enters the **Discharged Patients** dialog box.
	End Case Report	Prints the selected end case reports		Rotate Screen (for N22/N19)	Changes the screen orientation.
	iView	Open or close the iView window.			

3.6.3.2 Configuring the Displayed Quick Keys

To select the quick keys you want to display, follow this procedure:

1. Access **Quick Key** in either of the following ways:
   - Select the **Screen Setup** quick key → the **Select Quick Keys** tab.
   - Select the **Main Menu** quick key → from the **Display** column select **Quick Keys**.
2. Select the **Current** tab to configure the quick keys you want to display on the screen: From the top of this page, select a block where you want to show a certain quick key, and then select the quick key from the quick key list. For example, if you want to show the **Screen Setup** quick key at the first block, select the first block, and then select **Screen Setup** from the list.
3. Select the **More** tab to configure the quick keys you want to display when the **More** quick key is selected.

3.7 Operating Modes

The monitor provides different operating modes. This section describes the monitoring mode and the standby mode.

3.7.1 Monitoring Mode

The monitoring mode is the most frequently used clinical mode for patient monitoring. When the monitor is turned on, it automatically enters the monitoring mode.

3.7.2 Privacy Mode

The privacy mode is a special clinical monitoring mode. In the privacy mode, the monitor does not display patient information and monitoring data. This provides controlled access to patient data and ensures confidentiality.

The privacy mode is only available when the patient admitted by the monitor is also monitored by the CMS. The monitor continues monitoring the patient, but patient data is only visible at the CMS.

3.7.2.1 Entering the Privacy Mode

To enter the privacy mode, choose either of the following ways:

- Select the **Privacy Mode** quick key → select **Ok**.
- Select the **Main Menu** quick key → from the **Display** column select **Privacy Mode** → select **Ok**.

The monitor has the following features after entering the privacy mode:

- The screen turns blank.
- Except for the low battery alarm, the monitor inactivate alarm tone and alarm light of all other alarms.
- The monitor suppresses all system sounds, including heart beat tone, pulse tone, and prompt tone.

WARNING

- **In Privacy mode, all audible alarms are suppressed and the alarm light is deactivated at the monitor. Alarms are presented only at the CMS. Pay attention to potential risk.**

NOTE

- **The privacy mode is not available if the Department is set to OR.**
- **You cannot enter the privacy mode if a low battery alarm occurs.**

3.7.2.2 Exiting the Privacy Mode

The monitor automatically exit the privacy mode in any of the following situations:

- The monitor disconnects from the CMS.
- The low battery alarm occurs.

You can also operate the touchscreen, mouse, or keyboard to manually exit the privacy mode.

3.7.3 Night Mode

The night mode is a special clinical monitoring mode. To avoid disturbing the patient, you can use the night mode.

3.7.3.1 Entering the Night Mode

To enter the night mode, follow this procedure:

1. Select the **Night Mode** quick key, or select the **Main Menu** quick key → from the **Display** column select **Night Mode**.
2. Change the night mode settings if necessary.
3. Select **Enter Night Mode**.

The night mode settings are as follows by default:

- **Brightness**: **1**

- **Alarm Volume**: **2**
- **QRS Volume**: **1**
- **Key Volume**: **0**
- **NIBP End Tone**: **Off**
- **Stop NIBP**: **Off**

CAUTION

- **Verify the night mode settings before entering the night mode. Pay attention to the potential risk if the setting value is low.**

3.7.3.2 Exiting the Night Mode

To cancel the night mode, follow this procedure:

1. Select the **Night Mode** quick key, or select the **Main Menu** quick key → from the **Display** column select **Exit Night Mode**.
2. Select **Ok**.

NOTE

- **If you monitor is connected to the CMS, it automatically exits the night mode when being disconnected from the CMS.**
- **The monitor resume the previous settings after exiting the night mode.**

3.7.4 Standby Mode

You can temperately stops patient monitoring without switching off the monitor by entering the standby mode.

3.7.4.1 Entering the Standby Mode

1. Select the **Standby** quick key, or select the **Main Menu** quick key → from the **Patient Management** column select **Standby**.
2. Set **Location** to define where the patient is when the monitor enters the standby mode.
3. Select **Ok**.

The monitor behaves as follows after entering the standby mode:

- Stops all parameter measurements.
- Disables all the alarms and prompt messages, except for the battery low alarm.
- Turns screen brightness to the dimmest after entering the standby mode for 30 seconds.

WARNING

- **Pay attention to the potential risk of placing the monitor to standby. In the standby mode, the monitor stops all parameter measurements and disable all the alarm indications, except for the battery low alarm.**

3.7.4.2 Changing the Patient Location at Standby

If you need to change the patient's location, select **Location** from the Standby screen.

3.7.4.3 Exiting the Standby Mode

To exit the standby mode, choose any of the following ways:

- Select **Resume Monitor** to exit the standby mode and resume monitoring the current patient.
- Select **Discharge Patient** to discharge the current patient.

■ Select **New Patient** to exit the standby mode and admit a new patient.

If the monitor automatically enters the standby mode after a patient is discharged, choose any of the following ways to exit the standby mode:

■ Select **New Patient** to exit the standby mode and admit a new patient.

■ Select **Pre-admit** to enter the patient information for preparing to admit a new patient.

3.8 Configuring Your Monitor

Configure your monitor before putting it in use.

3.8.1 Setting the Screen Orientation (for N22 and N19)

Both the primary display and the secondary display can be installed vertically or horizontally. Set the screen orientation accordingly. To do so, follow this procedure:

1. Access **Display** in either of the following ways:
   - ◆ Select the **Screen Setup** quick key → select the **Display** tab.
   - ◆ Select the **Main Menu** quick key → from the **Display** column select **Display**.
2. From the **Primary Screen** block select **Screen Orientation** to set the screen orientation of the primary display.
3. If you are using the secondary display, from the **Secondary Screen** block, select **Screen Orientation** to set the screen orientation of the secondary display.
   - ◆ **Portrait**: if your display is vertically installed, set **Screen Orientation** to **Portrait**.
   - ◆ **Landscape**: if your display is horizontally installed, set **Screen Orientation** to **Landscape**.

You can select the **Rotate Screen** quick key to quickly switch the screen orientation.

3.8.2 Setting the Date and Time

To set the system time, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Time**.
2. Set **Date** and **Time**.
3. Set **Date Format**.
4. If you want to use the 12-hour mode, switch off **24 Hour Time**.
5. If you want to use daylight saving time, switch on **Daylight Saving Time**. You can manually switch on or off the daylight saving time only when the auto daylight saving time function is disabled. For more information, see *39.11 The Time Settings* for details.

If your monitor is connected to a central monitoring system (CMS) or hospital clinical system (HIS), the date and time are automatically taken from the CMS. In this case, you cannot change the date and time from your monitor.

CAUTION

- **Changing the date and time affects the storage of trends and events and may result in loss of data.**

3.8.3 Adjusting the Screen Brightness

To adjust the screen brightness, follow this procedure:

1. Access **Display** in either of the following ways:
   - ◆ Select the **Screen Setup** quick key → select the **Display** tab.
   - ◆ Select the **Main Menu** quick key → from the **Display** column select **Display**.
2. If you are using the AC power, set **Brightness**. If you are using the battery to run the monitor, set **Brightness On Battery**.

NOTE

- **If you set Brightness to Auto, screen brightness automatically changes with ambient light level.**

3.8.4 Adjusting the Volume

Select the **Volume** quick key to set **Alarm Volume**, **QRS Volume**, and **Key Volume**.

3.9 Starting Monitoring a Patient

After turning on your monitor, follow this procedure to monitor a patient:

1. Admit the patient.
2. Check patient settings. Make sure that alarm limits, patient category and paced status, and so on, are appropriate for your patient. Change them if necessary.
3. Perform desired measurements. For more information, see corresponding measurement chapters.

3.10 Stopping a Parameter Measurement

To stop monitoring a parameter, follow this procedure:

1. Remove corresponding sensor from the patient.
2. Disconnect the sensor from the patient cable.
3. Disconnect the patient cable from the parameter module.
4. If you are using the disposable sensor, discard it.

3.11 General Operation

This section describes the operations that are generally used when monitoring a patient.

3.11.1 Switching On or Off a Parameter

You can also manually switch on or off a parameter when its module is connected. If setting parameter switches is not password protected, follow this procedure to set parameter switches:

1. Access **Parameters On/Off** by any of the following ways:
   - ◆ Select the **Screen Setup** quick key → select the **Parameters On/Off** tab.
   - ◆ Select the **Main Menu** quick key → from the **Parameters** column select **Parameters On/Off**.
2. Enable or disable desired parameters.

If setting parameter switches is password protected, to set parameter switches, switch on **Parameters On/Off Protected**. see *39.12 The Other Settings*.

When a parameter is switched off, the monitor stops data acquisition and alarming for this measurement.

NOTE

- **When a parameter is manually switched off and the corresponding parameter module is plugged in, you cannot monitor this parameter.**

3.11.2 Displaying Parameter Numerics and Waveforms

You can configure the parameter numerics, waveforms, and their sequence displayed on the normal screen. To do so, follow this procedure:

1. Access **Tile Layout** in either of the following ways:
   - ◆ Select the **Screen Setup** quick key → select the **Tile Layout** tab.
   - ◆ Select the **Main Menu** quick key → from the **Display** column select **Tile Layout**.

2. Select a parameter numeric area or waveform area, and then from the popup list select an element you want to display in this area. The parameters and waveforms you did not select will not displayed.

NOTE

- **ECG parameters and waveform are always displayed on the first line of the parameter numeric area and waveform area.**

3.11.3 Displaying the Parameter List

You can display trends of HR, SpO_2, RR, and NIBP/IBP in the parameter numerics area. To do so, follow this procedure:

1. Access **Tile Layout** in either of the following ways:
   - ◆ Select the **Screen Setup** quick key → select the **Tile Layout** tab.
   - ◆ Select the **Main Menu** quick key → from the **Display** column select **Tile Layout**.
2. Select the parameter numerics area where you want to display the parameter list, and then from the popup list select **Parameter List**.

3.11.4 Accessing Parameter Setup Menus

Each parameter has a setup menu in which you can adjust the alarm and parameter settings. You can enter a parameter setup menu by using any of the following methods:

- ■ Select the parameter numeric area or waveform area.
- ■ Press the setup hard key on the module front.
- ■ Select the **Parameter Setup** quick key, and then select the desired parameter.
- ■ Select the **Main Menu** quick key → from the **Parameters** column select **Setup** → select the desired parameter.

NOTE

- **In this manual, we always use the first method to enter the setup menu. But you can use any method you prefer.**

3.11.5 Changing Measurement Colors

You can set the color of measurement values and waveforms for each parameter. To do so, follow this procedure:

1. Select **Main Menu** quick key → from the **Parameters** column select **Parameter Color**.
2. Select the **Current** tab and set the colors of the currently monitoring measurement values and waveforms.
3. Select the **All** tab and set the colors of measurement values and waveforms for all parameters.

3.12 Freezing Waveforms

During patient monitoring, the freeze feature allows you to freeze the currently displayed waveforms on the screen so that you can have a close examination of the patient's status. Besides, you can select any frozen waveform for recording.

3.12.1 Freezing Waveforms

To freeze waveforms, select the **Freeze** quick key. Except waveforms of the following screens, all displayed waveforms stop refreshing and scrolling after you select the **Freeze** quick key:

- ■ **Minitrends** screen
- ■ **oxyCRG** screen
- ■ **Remote View** screen
- ■ **BoA Dashboard** screen

■ **EWS** screen

■ CQI waveform in the **Rescue Mode**

3.12.2 Viewing Frozen Waveforms

To view the frozen waveforms, follow this procedure:

■ Select the < or > button in the **Freeze** window.

■ Slide the frozen waveform leftward or rightward.

At the lower right corner of the bottommost waveform displays the freeze time. The initial frozen time is **0 s**. With the waveforms scrolling, the freeze time changes at an interval of 1 second. For example, **-2 s** means the two seconds before the frozen time. This change will be applied for all waveforms on the screen.

NOTE

- **You can view the frozen waveforms of up to 120 seconds.**
- **The frozen time is not displayed when the waveforms are frozen in the Rescue Mode.**

3.12.3 Unfreezing Waveforms

To unfreeze the frozen waveforms, select the ✕ button upper right corner of the **Freeze** window.

3.12.4 Printing Frozen Waveforms

To print the frozen waveforms, select the button at the upper left corner of the **Freeze** window.

3.13 Using Secondary Displays

You can connect external displays for the monitor.

■ For N22/N19, you can connect two external displays: one as secondary display (mirrored, extended, or independent) and one as iView display. The external displays are connected to the monitor via video output connectors. For more information, see *2.3.1.1 N22, N19 Main Unit for Integrated Installation*.

■ For N17, you can connect two external displays: one as a mirrored secondary display and one as an independent secondary display or the iView display. The external displays are connected to the monitor via digital video connectors. For more information, see *2.3.3.5 N17 Rear View*.

■ For N15/N12, you can connect one external display as a mirrored secondary display. The external display is connected to the monitor the via digital video connector. For more information, see *2.3.3.4 N15, N12, N12C Rear View*.

3.13.1 Connecting the Secondary Display Power Supply (for N22/N19)

You need a power adapter to convert the AC mains to DC so as to power the secondary display. Before connecting the power adapter, check that the power adapter meets the specification.

To connect the power supply, follow this procedure:

1. Connect one end of the power adapter to the DC-IN connector on the secondary display.
2. Connect the other end of the power adapter to the AC mains.
3. Check that the AC indicator on the secondary display is on.

To use the secondary display, turn it on before turning on the monitor. The secondary display does not support hot plug. If the secondary display is disconnected from the main unit, the primary display will present an alarm.

CAUTION

- **Use only Mindray specified power adapter.**

3.13.2 Changing Secondary Display Settings

See *3.8.3 Adjusting the Screen Brightness* for changing screen brightness for the secondary display.

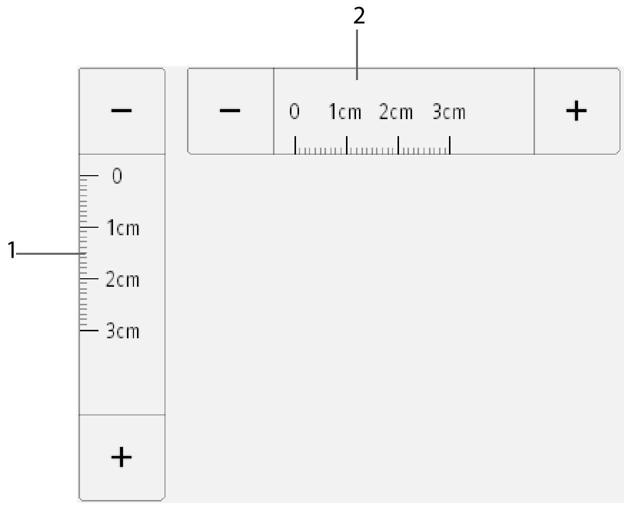
See *39.8 The Display Settings* for setting the display contents of the secondary display.

For N22/N19, see *39.8 The Display Settings* for setting alarm indications for the secondary display.

3.13.3 Setting the ECG Waveform Size for the Independent External Display (for N17/N15/N12)

For N17/N15/N12 monitors, if the independent external display is connected, you can set the speed and amplitude scales of the ECG waveforms for displays of different dimensions to achieve the best display effect. To do so, follow this procedure:

1. From the independent external display screen, select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select.
2. Select **Display** → select the **Screen Size** tab.
3. Select the screen size.
4. Set the speed and amplitude of the ECG waveform corresponding to one centimeter.
5. Restart the monitor.



(1) the amplitude ECG waveform corresponding to one centimeter

(2) the speed of the ECG waveform corresponding to one centimeter

NOTE

- **The setting of Screen Size for the independent external display takes effect only after the monitor restarts.**

3.14 Using the iView System

The iView system provides a means of running clinical applications on a monitor for obtaining other patient data. The application data from the iView can show on the monitor's display or on the iView display.

The iView is pre-installed with the Windows 7 operating system or Windows 10 operating system.

For more information on iView, see ***iView System Operator's Manual (PN: 046-008469-00 (for Windows 7) or 046-011641-00 (for Windows 10)).***

WARNING

- **Some clinical applications may show data from another patient. Be aware that some of the data on your patient monitor display may not always be from your patient.**
- **Applications running on the iView cannot act as a primary alarming device and cannot be relied upon for alarm notification. There may be no audible or visible indications apart from what is shown on the screen, and any data shown may be delayed.**

CAUTION

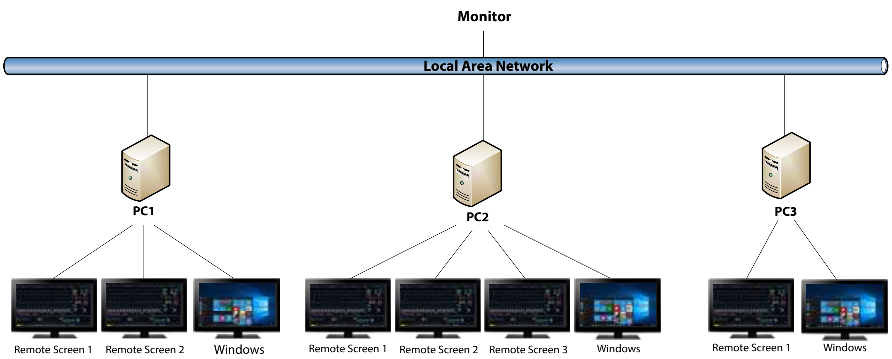
- **Always use AC mains to run the monitor if iView is in use.**
- **Ensure that any software you installed on the iView complies with all relevant local regulations.**

3.15 Using the nView Remote Displays

By using the nView, you can remotely view an independent monitor screen on a PC-based display.

The nView consists of PC-based hardware platform, application software (nView tool), and an local area network (LAN) connecting PCs and the monitor. Each PC can start three remote screens at most. A monitor supports six remote screens in total.

The remote screen is displays independently. you can operate the monitor via the remote screen. The following figure shows the nView connection:



WARNING

- **The remote screen is not a primary alarming device and cannot be relied upon for alarm notification.**
- **There are no audible or visible indications apart from what is shown on the screen and the measurement data from the monitor may be delayed.**

NOTE

- **A license is required for the nView.**

3.15.1 Recommended Hardware and Network Requirements

3.15.1.1 Hardware Requirements

Recommended requirements for PCs and nViewdisplays are as follows:

PC	Display
• Hard disk: minimum 20 G • Memory: 600 M (for one remote screen), 1200M (for two remote screens), 1400 M (for three remote screens) • CPU: i5, dual-core (for one remote screen), quad-core (for two or three remote screens)	Resolution: supports 1920×1080 pixel

3.15.1.2 Network Requirements

Recommended requirements for the LAN connecting the monitor and PCs are as follows:

- Bandwidth: 100 M
- Supports multicast
- Requirements for ports are listed in the following table:

Protocol	nView Port	Monitor Port	Function
TCP	Any	6600	Communicates with the monitor.
TCP	Any	6602	Communicates with the monitor.
TCP	Any	6603	Communicates with the monitor.
TCP	Any	6604	Communicates with the monitor.
TCP	Any	6587	Communicates with the monitor.
TCP	Any	6588	Communicates with the monitor.
UDP	6678	Any	Discovers the monitor via multicast.
TCP	6606	Any	Communicates with the monitor. 6606 is the default nView port. You can modify the port via the nView tool.

3.15.2 Installing the nView Tool

The nView tool is a Windows-based PC application. It supports Windows 7 and Windows 10 operating system.

To install the nView tool, follow this procedure:

1. Extract the installation package.
2. Run nViewSetup.exe.
3. Follow installation instructions. Check the **Import Power Policy** box if necessary.

At the completion of installation, the nView tool icon displays on the desktop.

The nView tool automatically starts when the PC is power on.

CAUTION

- **The PC for nView may have a power policy of turning off or putting into sleep after a preset time. If you need the PC always on and not sleep when running the nView, check the Import Power Policy box when installing the nView tool.**

3.15.3 Manually Starting Remote Screen

You can only start remote screens from the PC. To start a remote screen, follow this procedure:

1. Double-click the nView tool icon to run the nView tool.
2. If you are starting the remote screen for the first time, configure it first. For more information, see *3.15.4 Configuring the Remote Screen*.
3. Select the desired monitor:
   a Select the **Select Device** tab.
   b Select **Refresh Device List**.
   c From the monitor list, select the desired monitor.
4. Select the **nView Tool** tab → **Start Remote Screen**.

After the remote screen is started, the remote screen icon displays on the taskbar.

3.15.4 Configuring the Remote Screen

To configure the remote screen, follow this procedure:

1. Double-click the nView tool icon to run the nView tool.
2. Select the **Setup** tab to set the following parameters:
   - **Language**: the language of the remote screen and nView Tool user interface.
   - **Local IP Address**: the IP address of the PC. The PC must be connected to the same LAN as the monitor.
   - **Remote Screen Port**: used as the port for TCP service and shall not conflict with other applications runs on the PC.
   - **Monitor Multicast Address**: usded to discover the monitor.
   - **Start nView Screen When Monitor Online**: If this switch is on, the remote screen automatically starts when the monitor is connected to the network.
   - **Shut Down PC When Monitor Shutdown**: If this switch is on, the PC automatically shuts down when the monitor shuts down.
   - **Number of Remote Screens**: selects the number of displays used for nView. When the PC connects multiple displays, the maximum number of displays for nVeiw is 3.
   - **Remote Screen X Position**: selects where the remote screen is displayed. For example, if **Remote Screen 1 Position** is set to **Display 3**, remote screen 1 will be on display 3. To identify the displays, select **Identify Display**.
   - **Full Screen**: if this switch is on, the remote screen displays in full size. If this switch is off, you can zoom in or out the remote screen. To achieve optimal full screen, setting the display resolution to 1920×1280 is recommended.
   - **Remote Screen Always on Top**: if this switch is on, the remote screen is always on the frontground..

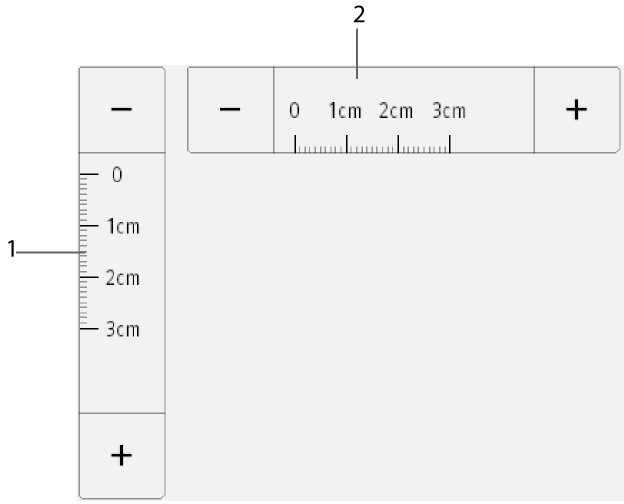
WARNING

- **If the Remote Screen Always on Top switch is off, the remote screen may be covered by other applications. If you need constant access to the patient data, make sure the remote screen is always in the foreground.**

3.15.5 Setting the ECG Waveform Size for the Remote Screen

For displays of different dimensions, you can set the speed and amplitude of the ECG waveforms for the remote screen to achieve the best display effect. To do so, follow this procedure:

1. From the remote screen, select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select.
2. Select **Display** → select the **Screen Size** tab.
3. Set the speed and amplitude of the ECG waveform corresponding to one centimeter.



(1) the amplitude ECG waveform corresponding to one centimeter

(2) the speed of the ECG waveform corresponding to one centimeter

NOTE

- **The setting of Screen Size takes effect only after the remote screen restarts.**

3.15.6 Selecting a Different Monitor for nView

To switch the monitor you want to view remotely, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **nView Tool**.
2. Select the **Select Device** tab.
3. Select **Refresh Device List**.
4. From the monitor list, select the desired monitor.
5. From the popup dialog box, select **OK** to restart the remote screen.

3.15.7 Restarting a remote screen

If you changed the settings for a remote screen, restart it for the changes to take effect. To do so, follow this procedure:

1. On the remote screen, select the **Main Menu** quick key → from the **System** column select **nView Tool** to call out the nView Tool.
2. Select the **Remote Screen** tab.
3. Select **Restart Remote Screen**.

3.15.8 Closing remote screens

Remote screens automatically close if the monitor is turned off or disconnected from the network for one minute. To manually close remote screens, follow this procedure:

1. On the remote screen,select the **Main Menu** quick key → from the **System** column select **nView Tool** to call out the nView Tool.
2. Select the **Remote Screen** tab.
3. Select the **Exit Remote Screen**. This will exit all remote screens.

If you started multiple remote screens, you can close any of them separately.

- If the remote screen is not in full screen, select the close button at the top right corner. From the popup dialog box, select **Close This Screen**.
- If the remote screen is in full screen, select the Windows key to call out the taskbar. Right-click the remote screen icon and select **Close Window**. From the popup dialog box, select **Close This Screen**.

3.16 Capturing the Screen

The monitor provides the function of screen capture. To capture the current screen display, follow this procedure:

1. For N17/N15/N12/N12C, connect the USB drive with the licenses in to the monitor's USB connector. For N22/N19. connect the USB drive to the monitor's MSB connector.
2. Press and hold the **More** quick key. Wait till it turns from blue to grey.

The captured pictures are automatically saved in the USB drive.

3.17 Checking Software Licenses

To run the following functions in your monitor, software licenses are required:

- BoA Dashboard
- HemoSight
- SepsisSight
- Early Warning Score (EWS)
- CQI
- CPR Dashboard
- ECG 24H Summary
- Pace View
- Remote Screen

To check the licenses, select the **Main Menu** quick key → select **License** → **Local**.

To install the licenses, follow this procedure:

1. For N17/N15/N12/N12C, connect the USB drive with the licenses in to the monitor's USB connector. For N22/N19. connect the USB drive to the monitor's MSB connector.
2. Select the **Main Menu** quick key →select **License** → select **External**.
3. Select **Install**.

3.18 Turning Off the Monitor

Before turn off the monitor, perform the following check:

1. Ensure that the monitoring of the patient has been completed.
2. Disconnect the cables and sensors from the patient.
3. Make sure to save or clear the patient monitoring data as required.

To turn off the monitor, press and hold the power switch for 3 seconds.

Turning off the monitor does not disconnect the monitor form the AC mains. To completely disconnect the power supply, unplug the power cord.

CAUTION

- **Press and hold the power switch for 15 seconds (for N22/N19) or 10 seconds (for N17/N15/N12/N12C) to forcibly shut down the monitor if it could not be shut down normally. This may cause loss of patient data.**

NOTE

- **The monitor that was switched on prior to a power loss automatically switched on when the power is restored.**
- **In case of a temporary power failure, if the power is restored within 30 minutes, monitoring will resume with all active settings unchanged; if the monitor is without power for more than 30 minutes, the monitor behaves the same as it is normally turned off.**

This page intentionally left blank.

4 User Screens

The monitor provides different user screens to facilitate patient monitoring in different departments and clinical applications.

4.1 Choosing a Screen

To choose a screen, follow this procedure:

1. Access the **Choose screen** page in either of the following ways:
   - ◆ Select the **Screen Setup** quick key.
   - ◆ Select the **Main Menu** quick key → from the **Display** column select **Choose screen**.
2. Select the desired screen.

4.2 Normal Screen

The normal screen is most frequently used for patient monitoring. For general department, ICU, and CCU, normal screen is used by default.

4.2.1 Entering the Normal Screen

To enter the normal screen, choose any of the following ways:

- ■ Swipe left or right on the touchscreen with two fingers to switch to the normal screen.
- ■ Select the **Screen Setup** quick key → select the **Choose Screen** tab → select **Normal Screen**.
- ■ Select the **Main Menu** quick key → from the **Display** column select **Choose Screen** → select **Normal Screen**.

4.2.2 Configuring the Normal Screen

You can configure the parameter numerics, waveforms, and their sequence displayed on the normal screen. To do so, follow this procedure:

1. Access **Tile Layout** in either of the following ways:
   - ◆ Select the **Screen Setup** quick key.
   - ◆ Select the **Main Menu** quick key → from the **Display** column select **Tile Layout**.
2. Select a parameter numeric area or waveform area, and then from the popup list select an element you want to display in this area. The parameters and waveforms you did not select will not displayed.

NOTE

- **ECG parameters and waveform are always displayed on the first line of the parameter numeric area and waveform area.**

4.3 The Big Numerics Screen

The big numerics screen displays parameter numerics in big font size.

4.3.1 Entering the Big Numerics Screen

To enter the big numerics screen, choose any of the following ways:

- ■ Swipe left or right on the touchscreen with two fingers to switch to the big numerics screen.

- Select the **Screen Setup** quick key → select the **Choose Screen** tab → select **big numerics Screen**.
- Select the **Main Menu** quick key → from the **Display** column select **Choose Screen** → select **big numerics Screen**.

4.3.2 Configuring the Big Numerics Screen

To configure the big numerics screen, follow this procedure:

1. Access **Choose screen** in either of the following ways:
   - Select the **Screen Setup** quick key .
   - Select the **Main Menu** quick key → from the **Display** column select **Choose screen**.
2. Select the **Big Numerics** tab
3. Select a parameter numeric area or waveform area, and then from the popup list select an element to display in this area.

4.4 Minitrends Screen

The Minitrends screen shows the recent graphic trends of parameters.

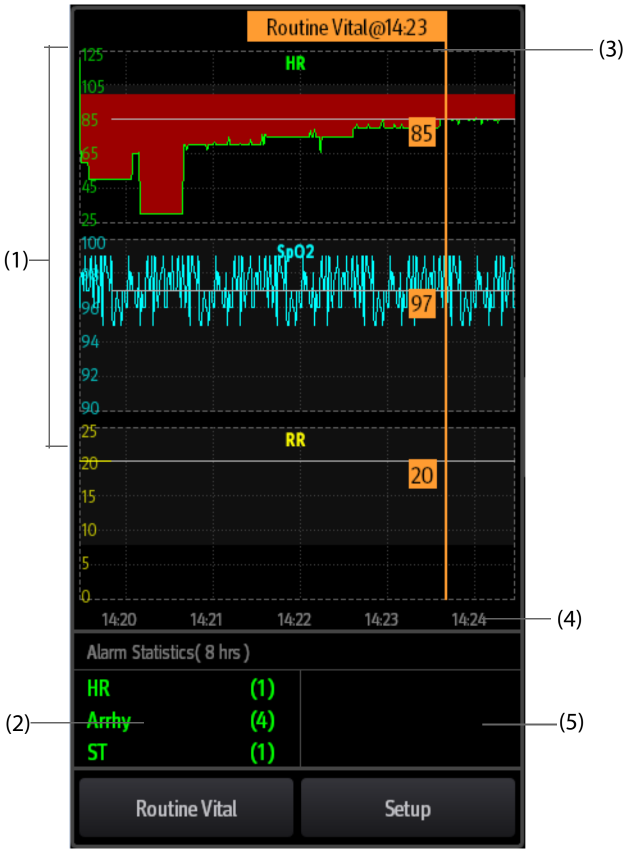
4.4.1 Entering the Minitrends Screen

Choose one of the following methods to enter the Minitrends screen:

- Select the **Minitrends** quick key.
- Select the **Screen Setup** quick key → Select the **Choose Screen** tab→ select **Minitrends**.
- Select the **Main Menu** quick key → from the **Display** column select **Choose Screen** → select **Minitrends**.

4.4.2 The Display of Minitrends Screen

The following figure shows the minitrends screen. Your display may be configured to look slightly different



(1)	Scale
(2)	**Routine Vital** button. If the department is set to **OR**, then the **Baseline** button is displayed.
(3)	Routine Vital/Baseline
(4)	Time line
(5)	Alarm statistic area

4.4.3 Setting Minitrends Parameters

To set parameters, follow this procedure:

1. Enter the Minitrends screen.
2. Select the **Setup** button.
3. Set parameters. If you want to use the default parameters, select **Default Parameter**.

4.4.4 Setting the Minitrend Length

To set the Minitrend length, follow this procedure:

1. Enter the Minitrends screen.
2. Select the **Setup** button.
3. Set the **Minitrend Length**.

4.4.5 Setting the Alarm Statistics Switch

The Minitrends screen can be configured to display the statistic number of physiological alarm in its lower half screen. To set the alarm statistics switch, follow this procedure:

1. Enter the Minitrends screen.
2. Select the **Setup** button.
3. Switch on or off the **Alarm Statistics** switch.

4.4.6 Setting the Alarm Statistics Length

The time length within which the alarms statistics are made is configurable. To set the alarm statistics length, follow this procedure:

1. Enter the Minitrends screen.
2. Select the **Setup** button.
3. Set **Alarm Statistics Duration**.

4.4.7 Routine Vital/Baseline

The Routine vital/Baseline function is used for marking the parameter measurements of certain moment for later reference. If the department is set to **OR**, then the **Baseline** button is available. For other departments, the **Routine Vital** button is available.

4.4.7.1 Manually Marking the Routine Vital/Baseline

To manually mark the Routine Vital/Baseline, follow this procedure:

1. Enter the Minitrends screen.
2. Select the **Routine Vital** button or **Baseline** button.

NOTE

- **If you do not see the Baseline button or Routine Vital button in the Minitrends screen, you can select the Setup button and switch on the Baseline switch, or set the Routine Vital to Manual or Auto.**

4.4.7.2 Configuring Automatic Routine Vital Settings

The monitor can automatically mark the routine vital sign values. To enable this function, follow this procedure:

1. Enter the Minitrends screen.
2. Select the **Setup** button.
3. Select **Auto** from the dropdown list of **Routine Vital**.
4. Select **Time** to set the time for marking the first routine vital sign values.
5. Select **Interval** to set the interval for marking the routine vital sign values.

4.5 The OxyCRG Screen

The OxyCRG screen is the default user screen when the neonatology department is selected. It displays 6-minute HR/btbHR, SpO_2 and SpO_2b trends, CO_2/Resp compressed waveform, ABD parameters, and the latest ABD events.

The OxyCRG function is intended for neonatal patents only.

4.5.1 Entering the OxyCRG Screen

To enter the OxyCRG screen, choose any of the following ways:

- Swipe left or right on the touchscreen with two fingers to switch to the OxyCRG screen.
- Select the **OxyCRG** quick key.
- Select the **Screen Setup** quick key → select the **Choose Screen** tab → select **OxyCRG**.
- Select the **Main Menu** quick key → from the **Display** column select **Choose Screen** → select **OxyCRG**.

4.5.2 OxyCRG Events

The following table lists the ABD events and their criteria:

Event type	Description	Remarks
A	Apnea event: the apnea duration exceeds the threshold. • A20: the apnea duration is greater or equal to 20 seconds. • A15: the apnea duration is between 15 to 20 seconds (excluding 20 seconds). • A10: the apnea duration is between 10 to 15 seconds (excluding 15 seconds).	A20 is a red event
B	Bradycardia event: the duration of low heart rate, bradycardia, extreme bradycardia, or asystole exceeds the threshold.	/
D	Low SpO2 event: the duration of SpO_2/SpO_2b Desat exceeds the threshold.	/
BD	Bradycardia and low SpO2 happen at the same time.	/
AB	Apnea and bradycardia happens at the same time.	Red event
AD	Bradycardia and low SpO2 happen at the same time.	Red event
ABD	Apnea, bradycardia, and low SpO2 happen at the same time.	Red event

NOTE

- **The monitor records all ABD events for OxyCRG review, but only red events displays in the ABD list of the OxyCRG screen.**

4.5.3 The Display of the ABD Event Area

The ABD event area displays parameter values of currently active OxyCRG events and lists the latest red ABD events.

4.5.4 Setting OxyCRG Parameters

Select parameter trends or compressed waveform to set parameters and the compressed waveform you want to display. The selected parameters will be used for ABD event calculation.

4.5.5 Setting the Threshold of ABD Events

Select any parameter trend or the compressed waveform to perform the following setup:

- Set the threshold of ABD events.
- Set **Event Storage Format**:
  - **1 min+3 min**: stores data one minute before and three minutes after the event.
  - **3 min+1 min**: stores data three minutes before and one minute after the event.
  - **2 min+2 min**: stores data two minutes before and two minutes after the event.

The stored data includes the trends of the OxyCRG parameters, compressed waveform, alarm thresholds, NIBP, and Temp measurements.

4.5.6 Editing ABD Events

To edit ABD events, follow this procedure:

1. Select the **Mark** button to enter the **Mark** dialog box.
2. Drag the event list upwards and downwards to select the desired event.
3. Select the patient’s status when the event happens.
4. Select **Save**.

4.6 The SpO_2 Screen

For neonatal patients, if you are only concerned with the patient's SpO_2 and pulse rate, you can use the SpO2 screen.

The SpO_2 screen displays SpO_2 related data. It also displays realtime Temp and NIBP measurements.

NOTE

- The SpO_2 screen is intended for neonatal patient only.

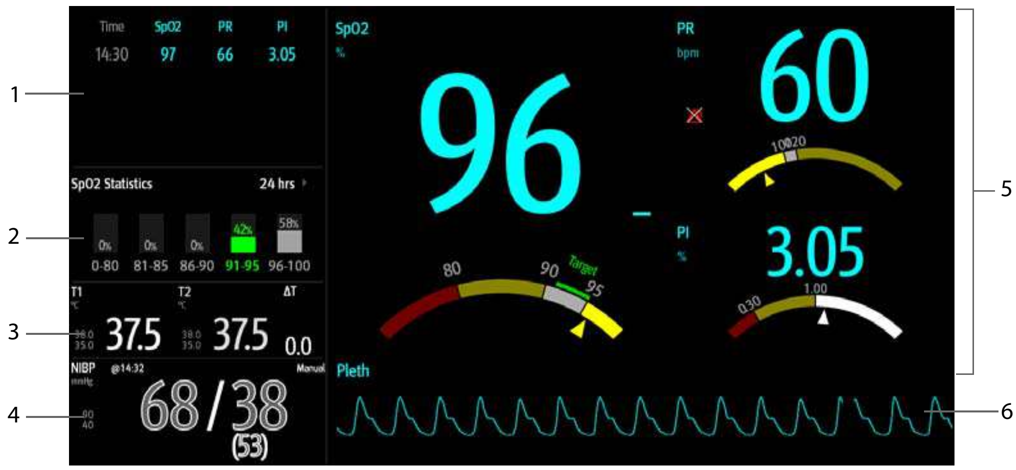
4.6.1 Entering the SpO_2 Screen

To enter the SpO_2 screen, choose any of the following ways:

- Swipe left or right on the touchscreen with two fingers to switch to the SpO_2 screen.
- Select the **Screen Setup** quick key → select the **Choose Screen** tab → select **SpO2 Screen**.
- Select the **Main Menu** quick key → from the **Display** column select **Choose Screen** → select **SpO_2 Screen**.

4.6.2 The Display of SpO_2 Screen

The following figure shows the SpO_2 screen. Your display may be configured to look slightly different.



(1) Tabular trend: displays trends of SpO_2, PR, and PI.

(2) SpO_2 statistics area: displays the statistics data of each SpO_2 section.

(3) Temp area: displays Temp measurements and alarm limits.

(4) NIBP area: displays NIBP measurements and alarm limits.

(5) SpO_2 area: displays measurements and alarm limits of PR, and PI. The dashboards show information of alarm limits. The △ pointers indicate the current measurement values.

(6) The Pleth waveform

4.6.3 Operating the SpO_2 Screen

You can access parameter setup and trends review from the SpO_2 screen. To do so, follow this procedure:

- Select the trend of SpO_2, PR, or PI to enter the **Tabular Trends** review page.
- Select the SpO_2 statistics area to enter the **SpO2 Statistics Setup** menu. Set the range of each SpO_2 section and the target section.
- Select the value of SpO_2, PR, or PI, the dashboard, or Pleth waveform to enter the **SpO2** menu.
- Select the Temp area to enter the **Temp** menu.
- Select the NIBP area to enter the **NIBP** menu.

5 Managing Patients

5.1 Discharging a Patient

Before monitoring a new patient, discharge the previous patient. After the patient is discharged, all patient data, including patient information, trend data, and physiological alarm information is be deleted from the monitor. The technical alarms is reset, and monitor settings returns to their defaults. For more information, see *6.4 Setting Default Configuration*.

After a patient is discharged, the monitor automatically admit a new patient.

WARNING

- **Always discharge the previous patient before starting monitoring a new patient. Failure to do so can lead to data being attributed to the wrong patient.**

5.2 Manually Discharging a Patient

Manually discharge a patient using any of the following methods:

- Swipe down the touchscreen with two fingers.
- Select the **Discharge Patient** quick key.
- Select the patient information area at the top left corner of the screen → **Discharge Patient**.
- Select the **Patient Management** quick key → **Discharge Patient**.
- Select the **Main Menu** quick key → from the **Patient Management** column select **Discharge**.

Select the desired item from the popup box:

- **Print End Case Report**: prints the end case report when the patient is discharged.
- **Discharge**: clears the waveform data of the current patient. The monitor loads the default configuration and goes to the standby mode. The current patient becomes a discharged patient.
- **Clear Patient Data**: discharges the current patient and clears the waveform data. The monitor still uses the current configuration and does not go to the standby mode. The current patient becomes a discharged patient.

5.3 Admitting a Patient

The monitor admits a new patient in the following situations:

- After a patient is manually discharged, the monitor automatically admit a new patient.
- After being switched off for the selected time period, the monitor automatically discharge the previous patient and admit a new patient at startup.
- If the monitor has not detected certain patient vital signs (ECG, SpO2, PR, RR, NIBP) for 30 minutes, you will be prompted whether to start monitoring a new patient if any of the above vital signs are detected again.

Always inputs patient information as soon as the patient is admitted. For more information, see*5.4.2 Editing Patient Information* for details.

WARNING

- **The settings of patient category and paced status always contain a default value, regardless of whether the patient is admitted or not. Check if the setting is correct for your patient.**
- **For paced patients, you must set Paced to Yes. If it is incorrectly set to No, the monitor could mistake a pace pulse for a QRS and fail to alarm when the ECG signal is too weak.**
- **For non-paced patients, you must set Paced to No.**

5.4 Managing Patient Information

5.4.1 Entering the Patient Management Menu

Use any of the following methods to enter the **Patient Management** menu:

- Select the patient information area at the top left corner of the screen.
- Select the **Patient Management** quick key.
- Select the **Main Menu** quick key → from the **Patient Management** column select **Patient Management**.

5.4.2 Editing Patient Information

Edit patient information after a patient has been admitted, or when patient information is incomplete, or when you want to change patient information:

To edit patient information, follow this procedure:

1. Enter the **Patient Management** menu. For more information, see*5.4.1 Entering the Patient Management Menu*.
2. Edit patient information as required.

If you connect a barcode reader with your monitor, you can scan the patient's barcode to enter patient information.

NOTE

- **The monitor will reload the configuration if you changed the patient category.**

5.4.3 Loading Patient Information from the CMS

If the monitor is connected to the central monitoring system (CMS). You can load patient information from the CMS to the monitor. To do so, follow this procedure:

1. Enter the **Find Patient** menu in either of the following ways:
   - Select the **Main Menu** quick key → from the **Patient Management** column select **Find Patient**.
   - From the **Patient Management** menu select **Find Patient**.
2. Input query criteria. If your monitor is connected with the ADT server, input query criteria from the **Discharged Patient** page.
3. Select **Search**. Then a list pops up, including all the patients that meet the query criteria.
4. Select a patient from the patient list, and then select **Import**. Corresponding patient information in the monitor will be updated.

5.4.4 Loading Patient Information from the ADT Server

If the monitor is connected with the Admit-Discharge-Transfer (ADT) server through the eGateway. You can load patient information from ADT server to the monitor. To do so, follow this procedure:

1. Enter the **Find Patient** menu in either of the following ways:
   - Select the **Main Menu** quick key → from the **Patient Management** column select **Find Patient**.
   - Select **Find Patient** from the **Patient Management** menu.
2. Input query criteria.
3. Select **Query**. Then a list pops up, including all the patients that meet the query criteria.

4. Select a patient from the patient list, and then select **Import**. Corresponding patient information in the monitor will be updated.

NOTE

- **You can load patient information from the ADT server only when ADT Query is enabled. For more information, see *7.5 Viewing Other Patients*.**
- **Loading patient information from the ADT server updates only patient information in the monitor. The patient's monitoring data is not changed and the patient is not discharged.**

5.5 Transferring Patient

You can transfer a patient via the BeneVision N1(hereafter referred to N1), BeneView T1 (hereafter referred to T1), or the MPM module (hereafter referred to MPM), to another monitor without re-entering the patient demographic information or changing the parameter settings. Transferring of patient data enables you to understand the patient's history condition.

WARNING

- **Do not discharge a patient before the patient is successfully transferred.**
- **Do not remove the N1/ T1/MPM from the monitor before parameter settings are synchronized between N1/ T1/MPM and the monitor (this takes maximum 30 seconds). Otherwise, patient information and measurement data saved in the N1/ T1/MPM may not be consistent with those in the monitor.**
- **Removing the N1/ T1/MPM when transferring historical patient data to the monitor will cause historical data saved in the monitor incomplete.**
- **After a patient is successfully transferred, check if the patient settings (especially patient category, paced status, alarm limits settings, and etc) on the monitor are appropriate for this patient.**

NOTE

- **The system automatically switches on the HR alarm and lethal arrhythmia alarm after transferring the patient data.**

5.5.1 Data Storage Introduction

Understanding the data respectively stored in the this monitor, N1, T1, or MPM helps you understand the effects incurred by transferring patients with an N1, T1, or MPM.

Type of storage		Can be stored in the monitor?	Can be transferred via MPM?	Can be transferred via T1?	Can be transferred via N1?
Data	Patient demographics	Yes	Yes	Yes	Yes
	Trend data	Yes	yes	Yes	Yes
	Calculation data	Yes	No	No	Yes
	Event data	Yes	No	Yes (only data monitored by T1)	Yes (data monitored by both N1 and the monitor)
	Full disclosure	Yes	No	No	Yes

Type of storage		Can be stored in the monitor?	Can be transferred via MPM?	Can be transferred via T1?	Can be transferred via N1?
Settings	Monitor settings (Alarm pause, alarm volume, etc.)	Yes	No	No	No
	Parameter settings (Alarm limits, measurement setting, etc.)	Yes	Yes	Yes	Yes

5.5.2 Transferring Patient Data

To transfer the patient data via N1/T1/MPM, insert the N1/T1/MPM into the module rack or SMR.

- If the patient demographics in the monitor are consistent with those of in the N1/T1/MPM, the N1/T1/MPM automatically uploads the data to the monitor.
- If the patient demographics in the monitor are not consistent with those of in the N1/T1/MPM, and **Data Transfer Strategy** is set to **Always Ask** (for more information, see*5.5.2 Transferring Patient Data*), the monitor prompts the **Select Patient** menu automatically. In this case, you need to select an operation (see the following table) according to the actual situation.

Operations	Operation Description	Examples of applications
Continue Patient in Monitor	Continue to use the patient data in the monitor. This deletes all patient data in the N1/T1/MPM and copies all data in the monitor to the N1/T1/MPM.	1. Replace N1/T1/MPM during patient monitoring. 2. After the patient is admitted, connect the N1/T1/MPM.
Continue Patient in Module	Continue to use the patient data in N1/T1/MPM. The monitor discharges the patient, and automatically admits a new patient and copies all data from N1/T1/MPM.	You are monitoring a patient using N1/T1/MPM, and you need to transfer the patient, e.g. from a ward (original monitor) to the operating room (destination monitor).
New Patient	Select this option if you will not use either the information in the monitor or that in the N1/T1/MPM. This deletes all data in the monitor and N1/T1/MPM and lets you admit a new patient on the monitor. In this case, you need to re-enter the patient demographics. The monitor will restore the settings according to the patient category.	Connect the N1/T1/MPM before admitting a new patient. However, the monitor and/or N1/T1/MPM have stored the previous patient's data and settings.
Same Patient	Select this option if the patient information in the monitor and N1/T1/MPM are different but you are sure that it is the same patient. This merges the patient's trend data in the monitor and N1/T1/MPM and copies the settings in N1/T1/MPM to the monitor as well.	A patient monitored with the N1/T1/MPM is moved to another department and again moved back. However, the patient information stored in the N1/T1/MPM was altered before connected to the original monitor.

NOTE

- **If you select Apply Module Settings, the N1/T1/MPM settings can be transferred to the monitor along with the patient data. For more information, see*5.6 Exporting Patient Data*.**

5.6 Exporting Patient Data

To export the data of the current patient and discharged patients, follow this procedure:

1. For N17/N15/N12/N12C, connect the USB drive to the monitor's USB connector. For N22/N19. connect the USB drive to the monitor's MSB connector.

2. Access the **Discharged Patients** dialog box by either of the following ways:
   - Select the **Discharged Patients** quick key.
   - Select the **Main Menu** quick key → from the **Patient Management** column select **Discharged Patients**.
3. From the patient list select desired patients.
4. Select **Transfer Data**.

5.7 Deleting Patient Data

To delete the data of discharged patients, follow this procedure:

1. Access the **Discharged Patients** dialog box by either of the following ways:
   - Select the **Discharged Patients** quick key.
   - Select the **Main Menu** quick key → from the **Patient Management** column select **Discharged Patients**.
2. From the patient list select desired patients.
3. Select **Delete**.

This page intentionally left blank.

6 Managing Configurations

6.1 Configuration Introduction

When continuously monitoring a patient, the clinical professional often needs to adjust the monitor's settings according to the patient's condition. The collection of all these settings is called a configuration. System configuration items can be classified as: parameter configuration, alarm configuration, and user maintenance. Allowing you to configure the monitor more efficiently, the monitor provides different sets of configurations to accommodate various patient categories and departments. You can change some settings from a certain set of configuration and then save the changed configuration as a user configuration.

The default configurations provided for your monitor are department-oriented. You can choose any of the following department:

- General
- OR
- ICU
- Neonatology
- CCU

WARNING

- **The configuration management function is password protected. The configuration management tasks must be performed by clinical professionals.**

6.2 Changing the Department

If the current department configuration is not the one you want to view, you can change the department by following this procedure:

1. Select the **Main Menu** quick key → from the **Configuration** column select **Manage** → input the required password → select .
2. Select **Change Department**.
3. Select a department.
4. Select **Ok**.

CAUTION

- **Changing the department will delete all current user configurations.**

6.3 Setting Default Patient Category

To set the default patient category when admitting a new patient, follow this procedure:

1. Select the **Main Menu** quick key → from the **Configuration** column select **Manage** → input the required password → select .
2. Set **Default Patient Category**.

6.4 Setting Default Configuration

The monitor will load the pre-set default configuration in the following cases:

- A patient is admitted.

- A patient is discharged.
- Patient data is cleared.
- Patient category is changed.

To set the default configuration, follow this procedure:

1. Select the **Main Menu** quick key → from the **Configuration** column select **Manage** → input the required password → select .
2. Select **Select Default Config**.
3. Select **Load the Latest Config** or **Load Specified Config**.
    - When you select **Load Specified Config**, the restored configuration is subject to the patient category (adult, pediatric or neonate). This configuration can be either factory configuration or a saved user configuration. As an example, select **Default Adult Config** and then select **Factory Default** or user configuration(s).
    - When you select **Load the Latest Config**, the latest configuration is loaded when the monitor is started or a patient is admitted.

6.5 Saving Current Settings

Current settings can be saved as a user configuration. Up to 25 user configurations can be saved.

To save current settings, follow this procedure:

1. Select the **Main Menu** quick key → from the **Configuration** column select **Manage** → input the required password → select .
2. Select **Save Current Settings**.
3. Input the configuration name.
4. Select **Ok** to save current settings as a user configuration.

6.6 Deleting a Configuration

To delete a configuration, follow this procedure:

1. Select the **Main Menu** quick key → from the **Configuration** column select **Manage** → input the required password → select .
2. Select **Delete Configuration**.
3. Select the configuration you want to delete:
    - In the **Delete Configuration** menu, selecting **Local** tab shows the existing user configurations on the monitor.
    - In the **Delete Configuration** menu, selecting **USB Drive** tab shows the existing user configurations on the USB drive.
4. Select **Delete**.
5. Select **Ok**.

6.7 Transferring a Configuration

When installing several monitors with identical user configurations, it is not necessary to set each unit separately. Use a USB drive to transfer the configuration from monitor to monitor.

6.7.1 Exporting a Configuration

To export the current monitor's configuration, follow this procedure:

1. For N17/N15/N12/N12C, connect the USB drive to the monitor's USB connector. For N22/N19. connect the USB drive to the monitor's MSB connector.
2. Select the **Main Menu** quick key → from the **Configuration** column select **Manage** → input the required password → select .

3. Select **Export Configuration**.
4. Select the configurations and **User Maintenance Settings** to export.
5. Select **Export**.

6.7.2 Importing a Configuration

To import the configuration from the USB drive to the monitor, follow this procedure:

1. Connect the USB drive to the monitor's USB port.
2. Select the **Main Menu** quick key →from the **Configuration** column select **Manage** → input the required password → select .
3. Select **Import Configuration**.
4. Select the configurations and **User Maintenance Settings** to import.
5. Select **Import**.

6.8 Printing Configurations

To print factory configurations and user configurations, follow this procedure:

1. Select the **Main Menu** quick key →from the **Configuration** column select **Manage** → input the required password → select .
2. Select **Print Configuration**.
3. Select desired configurations.
4. Select **Print**.

6.9 Loading a Configuration

You may make changes to some settings during operation. However, these changes or the pre-selected configuration may not be appropriate for the newly admitted patient. Therefore, the monitor allows you to load a desired configuration to ensure that all the settings are appropriate for your patient.

To load a configuration, follow this procedure:

1. Select the **Main Menu** quick key → from the **Configuration** column select **Load**.
2. Select the desired configuration.
   - ◆ Select the configuration on this monitor in the **Local** page.
   - ◆ Select the configuration on the USB drive in the **USB Drive** page.
3. Select **Load**.

NOTE

- **The monitor may configure some settings by default when you load a configuration of different software version with the current configuration.**

6.10 Modifying Configuration Password

To modify the configuration password, follow this procedure:

1. Select the **Main Menu** quick key → from the **Configuration** column select **Manage** → input the required password → select .
2. Select **Modify Password**.
3. Respectively input the old password and new password.
4. Select **Ok**.

This page intentionally left blank.

7 Networked Monitoring

7.1 Network Introduction

You can connect the monitor to the central monitoring system (CMS), eGateway, and other monitors through wired LAN or wireless LAN.

7.2 Network Safety Information

CAUTION

- **Wireless network designing, deploying, debugging, and maintenance should be executed by Mindray service personnel or authorized technicians.**
- **Always set the wireless network according to local wireless regulations.**
- **Data communication must be performed within a closed network or within a virtually isolated network provided by a hospital for all network functions. The hospital is responsible for ensuring the security of the virtually isolated network.**
- **Keep network authentication information, for example password, safe, protecting the network from being accessed by unauthorized users.**
- **Do not connect non-medical devices to the monitor network.**
- **If wireless network signal is poor, there may be a risk of CMS data loss.**
- **RF interference may result in wireless network disconnection.**
- **Disconnecting from the network may result in CMS data loss and function failure. Check the patient in case of network disconnection and solve the network problem as soon as possible.**
- **Ensure that the monitor IP address setting is correct. Changing the network settings may result in network disconnection. Contact your service personnel if you have any problems on setting the IP address.**

7.3 Connecting the Monitor to the CMS

You can connect the monitor to the BeneVision CMS through wired LAN or wireless LAN. When connected to the CMS, the system provides the following function.

■ The monitor can transmits parameter values, waveforms, alarm settings, and events to the CMS. From the CMS, you can check the patient's monitoring data and alarms.

■ The monitor can transmit parameter values and alarm settings getting from the connected external devices to the CMS. From the CMS you can check the patient's monitoring data and alarms obtaining from the connected external devices.

■ Patient information, alarm settings, and alarm status can be synchronized between the monitor and the CMS.

■ You can start or stop NIBP measurements from the CMS.

■ In case of network disconnection, the monitor can transmit the offline data to the CMS when network is reconnected.

For more information on the CMS, see *BeneVision Central Monitoring System Operator's Manual (PN: 046-010282-00)*.

To select a CMS, select the system status information area at the top right corner of the main screen. Select the desired CMS from the popup CMS list.

NOTE

- **You can select CMS only when the Select CMS switch is on. For more information, refer to *39.17.5 The Central Station Setup Tab*.**

7.4 Connecting the eGateway

You can connect the monitor to the eGateway through wired LAN or wireless LAN to implement interaction between the monitor and external devices. When connected to the eGateway, the system provides the following functions:

- The monitor can transmit parameter values, waveforms, alarm settings, and events to the eGateway.
- The monitor can transmit parameter values and alarm settings, getting from the connected external devices to the eGateway.
- Clock can be synchronized between the monitor and the eGateway.

7.5 Viewing Other Patients

On your monitor, you can observe alarm conditions and view real time physiological data from patients on other networked monitoring devices.

A device from a remote site is called a remote device or bed, for example, a bedside monitor or a telemetry. For N22//N19/N17, you can simultaneously watch up to 18 remote devices. For N15//N12/N12C, you can simultaneously watch up to 12 remote devices. You can also view waveforms of one remote device on your monitor.

You can watch the remote devices in the **Remote View** window, or the alarm watch tiles on the main screen.

NOTE

- **You can also view this monitor from remote devices. This monitor can be viewed by at most 32 remote devices at the same time, in which eight remote devices can watch this monitor's waveforms.**

7.5.1 Remote View

In the **Remote View** window, you can view real time parameters and waveforms from one specific device, and watch the alarms of other monitored devices at the same time.

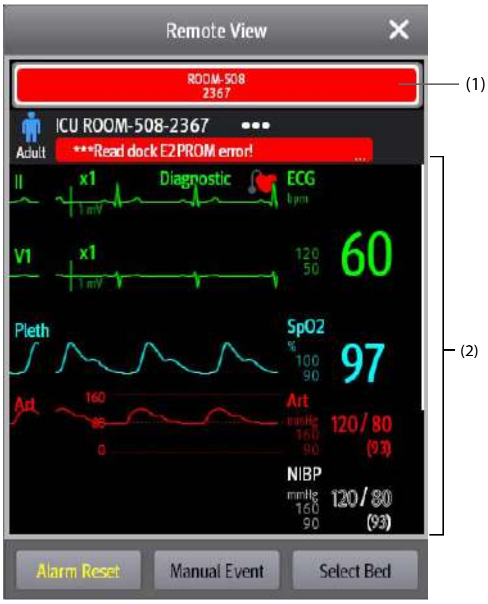
7.5.1.1 Entering the Remote View Window

To enter the **Remote View** window, choose one of the following ways:

- Select the **Remote View** quick key.
- Select the bed at the alarm watch tile on the main screen. For more information, see *7.5.2.2 Displaying the Alarm Watch Tile on the Main Screen* for configuring to display the tile on the main screen.
- Select the **Screen Setup** quick key → select the **Primary Display** tab or **Secondary Display** tab (depends on which is desirable)→ select the **Choose Screen** tab → select **Remote View**.

7.5.1.2 About the Remote View

The following figure shows the **Remote View** window..



(1) Alarm watch area

- ◆ Display all the monitored remote beds.
- ◆ Each bed displays the room number, bed number, connection status and alarm status. The background color indicates the alarm status on the corresponding bed.

Background Color	Description
Green	No alarm is occurring to the bed.
Red	The remote device is disconnected or a high priority alarm is occurring. The high priority alarm currently is the highest alarm level on the bed. If the remote device is disconnected, the icon is displayed.
Yellow	The medium priority alarm is occurring. The medium priority alarm currently is the highest alarm level on the bed.
Cyan	The low priority alarm is occurring. The low priority alarm currently is the highest alarm level on the bed.
Grey	The bed is in the standby mode.

(2) Main body

Display the patient's information, alarm status and messages, waveforms, measurements, etc. of the selected bed. This bed is called main bed.

7.5.1.3 Adding a Bed

You need to add the desired remote devices, and then the alarms from these devices can be watched on your monitor. To add a remote device, follow this procedure:

1. Enter the **Select Bed** window. To do so, choose either of the following ways:
   - ◆ In the **Remote View** window, select **Select Bed**. For more information, see *7.5.1.1 Entering the Remote View Window* for entering the **Remote View** window.
   - ◆ Select the icon at the alarm watch tile if the tile is configured to display on the main screen.
2. In the **Select Bed** window, select a desired department. All the beds under this department will be listed.
3. Select a desired tile at the A-W1, A-W2 or A-W3 areas and then select a bed from the bed list. The selected bed will appear in the tile.

NOTE

- **The added bed is indicated by a √ check mark at the right of the bed list.**

7.5.1.4 Removing a Bed

If you do not want to monitor a remote device any longer, you can remove it. To remove a remote device, follow this procedure:

1. Enter the **Select Bed** window. Choose either of the following ways:
   - ◆ In the **Remote View** window, select **Select Bed**. For more information, see *7.5.1.1 Entering the Remote View Window* for entering the **Remote View** window.
   - ◆ Select the icon in the alarm watch tile if the tile is configured to display on the main screen.
2. In the **Select Bed** window, select a bed at the A-W1, A-W2 or A-W3 areas, and then select **Clear Bed**. If you want remove all beds, select **Clear All Beds**.

7.5.1.5 Displaying the Main Bed

In the **Remote View** window, you can select a bed at the alarm watch area, then the main body of the **Remote View** window will display the real time monitoring screen of the device.

7.5.1.6 Saving a Manual Event

You can initiate a manual event by selecting **Manual Event** in the **Remote View** window.

The manual event stores in the event review of the corresponding remote device.

7.5.1.7 Resetting Alarms for Remote Devices

To reset remote device alarms, from the **Remote View** screen, select **Alarm Reset**.

NOTE

- **You can reset remote device alarms only if the Alarm Reset by Other Bed switch is on at the remote devices. For more information, see *39.4.4 The Remote View Tab***

7.5.1.8 Selecting Beds By Care Group

If configured, the monitor automatically selects beds in the same care group during the shift of care groups in the CMS. To enable this function, follow this procedure:

1. Enter the **Select Bed** window. Choose either of the following ways:
   - ◆ In the **Remote View** window, select **Select Bed**. For more information, see *7.5.1.1 Entering the Remote View Window* for entering the **Remote View** window.
   - ◆ Select the icon in the alarm watch tile if the tile is configured to display on the main screen.
2. In lower left corner of the **Select Bed** window, select **Select Beds By Care Group**.

7.5.2 Alarm Watch

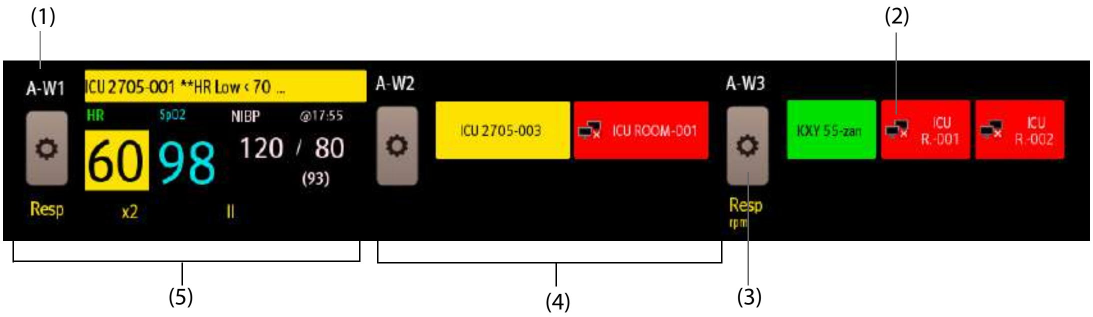
The alarm watch function provides the alarm notification by color and sound.

- ■ The monitor sounds the highest priority alarm tone from all the monitored remote devices.
- ■ The moitor displays the highest priority alarm in corresponding background color for each bed at following areas:
  - ◆ At the top of the **Remote View**. For more information, see *7.5.1.2 About the Remote View* for details.
  - ◆ On the main screen. For more information, see *7.5.2.1 About Alarm Watch Tile* for details.

7.5.2.1 About Alarm Watch Tile

The main screen can display up to three alarm watch tiles, namely A-W1, A-W2 and A-W3. Each tile can accommodate up to six beds.

The following figure shows the alarm watch tiles.



(1) Alarm watch tile label

(2) Disconnection icon: when the remote device is disconnected, this icon displays at the tile, and the tile background color is red.

(3) Select bed icon: select it to enter the **Select Bed** window.

(4) More than one bed tile: when more than one bed is assigned to a tile, the tile displays the alarm status, connection status, etc.

(5) One bed tile: when only one bed is assigned to a tile, the tile displays the parameter value and alarm message from this bed, etc.

The alarm watch tile is similar to alarm watch area in the **Remote View.** For more information, see *7.5.1.2 About the Remote View*.

7.5.2.2 Displaying the Alarm Watch Tile on the Main Screen

To configure the alarm watch tile to be displayed on the monitor's main screen, follow this procedure:

1. Select the **Main Menu** quick key → from the **Display** column select **Choose Screen** to enter the **Screen Setup** menu.
2. Select the **Tile Layout** tab.
3. Select the numeric area where you want to display the alarm watch tile, and then in the drop-down list, select **Alarm Watch** → **A-W1**, **A-W2**, or **A-W3**.

7.6 MLDAP

MLDAP refers to Mindray LDAP (Lightweight Directory Access Protocol). It is an independent process which can be installed on eGateway or other application server (Windows). MLDAP provides user identity and authentication.

The MLDAP server is connected with the hospital LDAP server. All monitoring devices are connected to the MLDAP server to implement identity and authentication for the following operations:

- Changing alarm settings
- Changing arrhythmia settings
- Accessing the **Maintenance** menu

7.7 Disconnecting the Wireless Network

To disconnect the wireless network manually, follow this procedure:

1. Swipe the screen from top down with a single finger.
2. Select .

To reconnect the wireless network after it is disconnected manually, follow this procedure:

1. Swipe the screen from top down with a single finger.
2. Select .

8 Using with the TM80 Telemetry Monitor and BP10 NIBP Module

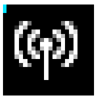
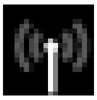
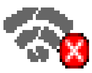
8.1 Pairing Introduction

You can connect a TM80 telemetry monitor (hereinafter called TM80) and a BP10 NIBP module (hereinafter called BP10) with the monitor to measure ECG, Resp, SpO_2, and NIBP of ambulating adult and pediatric patients.

The TM80 can be connected with the monitor either via Mindray Patient Area Network (MPAN) or Wi-Fi. The BP10 can be connected with the monitor via MPAN. The process of establishing connection between the TM80 or BP10 and the monitor is called "pairing". When the TM80 and BP10 are paired with the monitor, you can view the measurement data from these devices on the monitor screen.

8.2 Pairing and Unpairing Symbols

The following symbols may appear during and after pairing and unpairing.

Symbol	Location	Description
	■ Monitor's **Wireless Module** Menu ■ ECG,SpO_2, and NIBP parameter areas on the monitor screen ■ Prompt message area of the TM80 or BP10	Indicates that a TM80 or BP10 is found via MPAN or is paired with the monitor via MPAN.
	Prompt message area of the TM80 or BP10	Indicates that the TM80 or BP10 is not paired with the monitor via MPAN. Or the TM80 or BP10 is not connected with the monitor after paring.
	Monitor's **Wireless Module** Menu	Indicates that a TM80 or BP10 is paired with the monitor.
	■ Monitor's **Wireless Module** Menu ■ ECG and SpO_2 parameter areas on the monitor screen ■ Prompt message area of the TM80	Indicates that a TM80 is found via Wi-Fi or is paired with the monitor via Wi-Fi.
	ECG and SpO_2 parameter areas on the monitor screen	Indicates that the Wi-Fi connection between a TM80 and the monitor is interrupted.
	Prompt message area of the TM80	Indicates that the TM80 is not connected to the Wi-Fi access point.

8.3 Pairing a TM80 with the Monitor

A TM80 can be paired with the monitor via MPAN or via Wi-Fi. For pairing via MPAN, all data from the TM80 arrive with a minimal delay on the monitor screen. For pairing via Wi-Fi, all data from the TM80 arrive with a delay of several seconds on the monitor screen. You can chose the communication mode. For more information, see *8.3.1 Pairing Procedure*.

8.3.1 Pairing Procedure

Before pairing, configure the wireless network at the TM80 and at the monitor. Ensure that the TM80 and the monitor are in the same Wi-Fi network.

To pair the TM80 with the monitor, follow this procedure:

1. Select the **Main Menu** quick key → from the **Parameters** column select **Wireless Module**. The message **Updating...** appears, indicating that the wireless module list is being updated.
2. Select the desired TM80 under the **Device Name** column of the **Wireless Module** menu. If the desired TM80 is not displayed, select **Update List**.
3. Select **Add** on the right of the desired TM80.
4. Select **Continue Patient in Monitor** or **Continue Patient in Telemetry**.
   - ◆ **Continue Patient in Monitor**: uses the patient information and parameters settings in the monitor. These pieces of information and settings will be synchronized to the TM80.
   - ◆ **Continue Patient in Telemetry**: uses the patient information and parameters settings at the TM80 and CMS. These pieces of information and settings will be synchronized to the monitor.

   Upon completion of pairing, the message **Connection Completed** appears.

WARNING

- **Make sure that the desired TM80 is paired with the monitor.**

NOTE

- **When Patient Category is set to Neo, the Wireless Module option is not available in the Parameters column.**
- **When a TM80 is paired with a BP10, the TM80 will automatically disconnect with the BP10 once it is paired with the monitor.**
- **If you need to change the name of TM80, see *BeneVision TM80 Telemetry Monitor Operator's Manual (PN: 046-007479-00)*.**

8.3.2 System Responses after Pairing a TM80 with the Monitor

This section describes system responses at the monitor and at the TM80 after pairing.

8.3.2.1 System Responses at the Monitor after Pairing a TM80 with the Monitor

Once a TM80 is paired successfully with the monitor, the monitor responds as below:

- ■ In the **Wireless Module** menu, the **Add** button on the right of the paired TM80 changes to **Remove**. The symbol displays on the left of **Remove**.
- ■ The labels of parameters from the TM80 are suffixed with "-T", indicating that measurement values come from the TM80. The or symbol beside the parameter label indicates that TM80 is connected with the monitor via MPAN or Wi-Fi. The follow figure shows an example of parameter measurements from the TM80.

- ■ The system will automatically switch between MPAN and Wi-Fi to make the TM80 stay connected with the monitor.

CAUTION

- **When Wi-Fi signals are weak, the monitor may have the risk of data loss.**

NOTE

- **HR value calculated by the ECG algorithm at the monitor may have deviations. If the HR values displayed on the TM80 screen and on the monitor screen are inconsistent, both HR values are reliable. HR trend, alarms, and arrhythmia are based on the HR value calculated at the monitor.**

8.3.2.2 System Responses at the TM80 after Pairing a TM80 with the Monitor

Once a TM80 is paired successfully with the monitor, the TM80 responds as below:

- If the TM80 has communicated with the CMS before pairing, it will not communicate with the CMS after pairing. But the data measured by the TM80 will be sent to the CMS via the paired monitor. The measurement data from the TM80 will be displayed in the monitor's patient window at the CMS.
- If the TM80 is paired with the monitor via MPAN, the symbol will be changed to in the prompt message area.
- The TM80 allows you to turn on or off the screen backlight, trigger a nurse call, enter the screen lock window or the unpair menu. But it does not allow you to change any settings.

8.4 Unpairing the TM80 and the Monitor

If the patient will no longer be monitored with the TM80, or only with the TM80 and no longer with the monitor, you need to end the device pairing. You can unpair the TM80 and the monitor either via the monitor or via the TM80. After unpairing, the CMS will receive data either from the monitor or from the TM80.

8.4.1 Unpairing via the Monitor

To unpair the TM80 and the monitor, follow this procedure:

1. Select the **Main Menu** quick key → from the **Parameters** column select **Wireless Module**.
2. Select the desired TM80 under the **Device Name** column of the **Wireless Module** menu.
3. Select **Remove**.
4. Select **Continue Patient in Monitor** or **Continue Patient in Telemetry**.
   - **Continue Patient in Monitor**: the monitor disconnects with the TM80 and continues patient monitoring. The TM80 discharges the patient. **Discharged** is displayed on the TM80 screen and **Disconnection Completed** is displayed on the monitor screen.
   - **Continue Patient in Telemetry**: the monitor disconnects with the TM80 and discharges the patient. The TM80 is connected to the CMS to continue patient monitoring. **Discharged** is displayed on the monitor screen, indicating completion of unpairing.

After you select **Continue Patient in Monitor**, if a MPM or T1 is removed from the monitor, the message **Warning: Multi-parameter Module removed. Are you sure you want to enter standby mode?** appears. You need to select whether to put the monitor in standby mode.

- Select a patient location and then select **Ok**. The monitor enters standby mode.
- Select **Cancel**. The monitor does not enter standby mode and continues patient monitoring.

NOTE

- **When a TM80 is paired with the monitor, discharging a patient from the monitor automatically unpairs the TM80 with the monitor.**

8.4.2 Unpairing via the TM80

To unpair the TM80 and the monitor, follow this procedure:

1. Press the main menu button on the front panel of the TM80.

2. Input the password for the screen lock window. When **Screen Lock** is set to **Off**, skip this step.
3. Select **Yes** or **No** in the **Unpair** window.
   - **Yes**: the TM80 disconnects with the monitor but does not discharge the patient. The monitor discharges the patient. The TM80 is connected to the CMS to continue patient monitoring.
   - **No**: the TM80 disconnects with the monitor and discharges the patient. The monitor does not discharge the patient and continues patient monitoring.

8.5 Pairing a BP10 with the Monitor

A BP10 can be paired with the monitor only via MPAN.

8.5.1 Pairing Procedure

To pair a BP10 with the monitor, follow this procedure:

1. Press the MPAN button on the right panel of the BP10. The **Pairing...** message displays in the message area of the BP10.
2. Select the **Main Menu** quick key → select **Wireless Module** from the **Parameters** column at the monitor.
3. Select the desired BP10 under the **Device Name** column of the **Wireless Module** menu. If the desired BP10 is not displayed, select **Update List**.
4. Select **Add** on the right of the desired BP10.

   Upon completion of pairing, the message **Connection Completed** appears.
5. Select the **NIBP Start/Stop** quick key on the monitor screen to start one NIBP measurement. Verify that the NIBP measurement values displayed on the monitor screen and on the BP10 screen are consistent and for the same patient.

WARNING

- **Make sure that the desired BP10 is paired with the monitor.**

NOTE

- **When a BP10 is paired with a TM80, the BP10 will automatically disconnect with the TM80 once it is paired with the monitor.**
- **If you need to change the name of BP10, see *BP10 NIBP Module Operator's Manual (PN: 046-008269-00)*.**
- **When a BP10 is paired with the monitor, if the BP10 is out of the MPAN coverage area, it will be disconnected from the monitor automatically. But when it is within the MPAN coverage area again, it will be reconnected with the monitor automatically.**

8.5.2 System Responses after Pairing the BP10 with the Monitor

This section describes system responses at the monitor and at the BP10 after pairing.

8.5.2.1 System Responses at the Monitor after Pairing the BP10 with the Monitor

Once a BP10 is paired successfully with the monitor, the monitor responds as below:

- In the **Wireless Module** menu, the **Add** button on the right of the paired BP10 changes to **Remove**. The  symbol displays on the left of **Remove**.
- The NIBP label on the monitor screen is suffixed with "-T", indicating that measurement values come from the BP10 device, as shown below.
- The **ABPM** tabs are added to the **NIBP** menu. You can perform NIBP measurement in ABPM (Ambulatory Blood Pressure Monitoring) mode.

8.5.2.2 System Responses at the BP10 after Pairing the BP10 and the Monitor

Once a BP10 is paired successfully with the monitor, the BP10 responds as below:

- The  symbol is changed to  in the prompt message area.
- The BP10 allows you to start or stop NIBP measurement by pressing the start or stop NIBP button on the front panel of the BP10. But it does not allow you to change any settings.

8.6 Unpairing the BP10 and the Monitor

You can unpair the BP10 and the monitor either via the monitor or via the BP10.

8.6.1 Unpairing via the Monitor

To unpair the BP10 and the monitor, follow this procedure:

1. Select the **Main Menu** quick key → select **Wireless Module** from the **Parameters** column.
2. Select the desired BP10.
3. Select **Remove**.

   Upon completion of unpairing, the message **Disconnection Completed** appears on the monitor screen.

8.6.2 Unpairing via the BP10

To unpair the BP10 and the monitor, press the MPAN button on the right panel of the BP10.

8.7 NIBP Measurement in Sequence or ABPM Mode

When a BP10 is paired with the monitor, you can perform NIBP measurements in sequence or ABPM mode. For detailed information about NIBP measurement, see *BP10 NIBP Module Operator's Manual (PN:046-008269-00)*.

8.7.1 Performing NIBP Measurement in Sequence Mode

To perform NIBP measurement in sequence mode, follow this procedure:

1. Select the NIBP parameter area on the monitor screen to enter the **NIBP** menu.
2. Select the **Sequence** tab.
3. Set **Interval** and **Duration** for the desired measurement phases.
4. Select **Start NIBP**.

   Once NIBP measurement is completed, the sequence mode, current measurement phase, interval, and duration will be displayed on the monitor screen.

8.7.2 Performing NIBP Measurement in ABPM Mode

In ABPM mode, the NIBP measurements are automatically taken according to the configured intervals for the day and the night.

To perform NIBP measurement in ABPM mode, follow this procedure:

1. Select the NIBP parameter area on the monitor screen to enter the **NIBP** menu.
2. Select the **ABPM** tab.
3. Set **Start Time** and **Interval** for the day and night.
4. Select **Start NIBP**.

   Once NIBP measurement is completed, the ABPM mode and measurement values will be displayed on the monitor screen.

8.8 Troubleshooting

Problem	Possible Cause	Corrective Action
Telemetry Disconnected	The TM80 is out of the MPAN coverage area.	Put the TM80 in the MPAN coverage area.
	The TM80 is out of the Wi-Fi coverage area.	Put the TM80 in the Wi-Fi coverage area.
	The TM80 has been powered off.	Power on the TM80.
	A satellite module rack is not connected to the monitor properly.	Replug the satellite module rack.
	The monitor is not connected to Wi-Fi network or its wireless network settings are incorrect.	Verify that the monitor's wireless network settings are correct and the monitor has been connected to Wi-Fi network.
	The TM80 is not connected to Wi-Fi network or its wireless network settings are incorrect.	Verify that the TM80's wireless network settings are correct and the TM80 has been connected to Wi-Fi network.
	The exchanger network connected by the TM80 and the monitor does not support multicast data transfer.	Contact your service personnel.
Telemetry NIBP Disconnected	The BP10 is out of the MPAN coverage area.	Put the BP10 in the MPAN coverage area.
	The BP10 has been powered off.	Power on the BP10.
	A satellite module rack is not connected to the monitor properly.	Replug the satellite module rack.
After a TM80 is paired with the monitor, ECG waves and Pleth waveform come from the TM80 are abnormal on the monitor screen.	Wireless signal interference exists.	■ Put the TM80 in the MPAN or Wi-Fi coverage area. ■ Check the interference source and reduce or eliminate interference.
	Wireless signals are weak.	■ Put the TM80 in the MPAN or Wi-Fi coverage area with strong signals strength. ■ Remove any metallic obstructs that stand between the TM80 and the monitor.
	Insufficient network bandwidth or greater network delay leads to data transfer delay.	Contact your service personnel.
The desired BP10 is not displayed under the **Device Name** column of the **Wireless Module** menu.	The BP10 is not found.	For the BP10, follow Steps 1 to 3 in *8.5.1 Pairing Procedure*.

Problem	Possible Cause	Corrective Action
The TM80 is prone to offline occasionally.	Wireless signal interference exists.	■ Put the TM80 in the MPAN or Wi-Fi coverage area. ■ Check the interference source and reduce or eliminate interference.
	Wireless signals are weak.	■ Put the TM80 in the MPAN or Wi-Fi coverage area with strong signals strength. ■ Remove any metallic obstructs that stand between the TM80 and the monitor.
	Insufficient network bandwidth or greater network delay leads to data transfer delay.	Contact your service personnel.
The BP10 is prone to offline occasionally.	MPAN signal interference exists.	■ Put the BP10 in the MPAN coverage area. ■ Check the interference source and reduce or eliminate interference.
	MPAN signals are weak.	■ Put the BP10 in the MPAN coverage area with strong signals strength. ■ Remove any metallic obstructs that stand between the BP10 and the monitor.
Telemetry Low Battery, Telemetry Battery Depleted	The battery charge is low.	Replace with a known good battery for the TM80.
Telemetry NIBP Low Battery, Telemetry NIBP Battery Depleted	The battery charge is low.	Replace with a known good battery for the BP10.
When the TM80 is out of the MPAN coverage area, it cannot be connected to the monitor by automatically switching to Wi-Fi connection.	The TM80 is not connected to Wi-Fi network or its wireless network settings are incorrect.	Verify that the TM80's wireless network settings are correct and the TM80 has been connected to Wi-Fi network.
	The monitor is not connected to Wi-Fi network or its wireless network settings are incorrect.	Verify that the monitor's wireless network settings are correct and the monitor has been connected to Wi-Fi network.
Device Not Found	A satellite module rack is not connected to the monitor properly.	Replug the satellite module rack.
	The monitor is not connected to Wi-Fi network or its wireless network settings are incorrect.	Verify that the monitor's wireless network settings are correct and the monitor has been connected to Wi-Fi network.
	The wireless network does not support multicast data transfer.	The wireless network where the monitor and the TM80 are connected needs to support multicast data transfer.

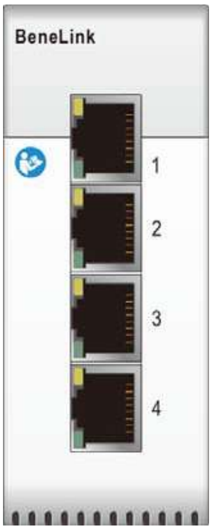
This page intentionally left blank.

9 Interfacing with External Devices

9.1 BeneLink Introduction

BeneLink module is intended for connecting external devices, such as ventilators and anesthesia machines, to the monitor. It allows information (patient data, alarms, etc.) from external devices to be displayed, saved, recorded, or printed through the monitor. If the monitor is connected with the CMS or eGateway, information from external devices can also be transmitted to the CMS or eGateway.

For more information on connecting external devices via the BeneLink module, see ***BeneLink Module Operator's Manual (PN: 046-009023-00)***.



9.2 BeneLink Safety Information

WARNING

- **Devices of the same category can not be connected to the BeneLink module simultaneously.**
- **The signal labels used on the patient monitor may be different from those given on the external device.**
- **The alarms from external devices may be delayed before transmission to the patient monitor.**
- **There can be differences between the alarm priorities displayed on your monitors and the priorities displayed on external devices interfaced through BeneLink.**

NOTE

- **The alarm messages from external devices are derived from the open protocol of corresponding external device. For more information about these alarms, please see the operator's manual of corresponding devices.**

9.3 Differences in Displayed Values

In certain cases, there may be differences between the numerics displayed on the monitor and those on external devices. The table below lists some situations and possible reasons.

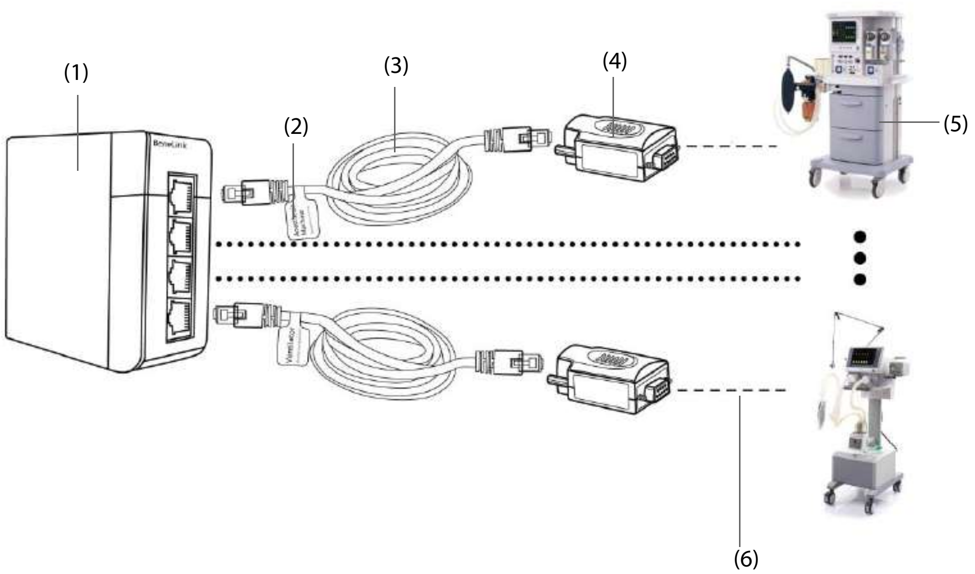
Situation	Possible Reasons
Some parameter values are displayed as invalid values on the monitor.	The patient monitor and the external device may have different parameter configuration or displaying range of values. If the patient monitor displays a parameter not configured in the external device, or a parameter value from the external device exceeds the displaying range of the monitor, corresponding parameter value is displayed on the monitor as an invalid value.
The monitor and external device display parameter values with different numbers of places of decimals.	The monitor displays parameter values from the external device based on the monitor displaying rules. Same parameter value is displayed differently when the monitor and the external device adopts different numbers of places of decimals.
Non-continuously measured values and continuously measured values have the same displaying mode in the patient monitor.	For non-continuously measured values, the monitor displays the latest measured values until a new measurement is taken by the external device.
Parameter values displayed on the patient monitor and those displayed in the external device are slightly different.	Some parameter values are converted to different units when transmitted to the monitor. Sometimes, values from the external device may be delayed before transmission to the patient monitor.

NOTE

- **When the pressure units are converted among cmH_2O, hPa and mbar, the parameter values remain unchanged, for example, $1cmH_2O$=1hPa=1mbar, which may differ from some external devices.**

9.4 Connecting an External Device

An external device is connected to the BeneLink module through an ID adapter. The ID adapter supports only its matching device.



(1) BeneLink Module	(2) Label
(3) RJ45 connecting cable	(4) ID Adapter
(5) External device	(6) Serial port adapting cable (optional)

To connect an external device, follow this procedure:

1. Insert the BeneLink module into the SMR.
2. Connect the ID adapter that matches the external device to the BeneLink module with an RJ45 connecting cable.
3. Plug the ID adapter into the RS232 port on the external device. Some external devices may have ports incompatible with the ID adapter. In this case, a serial port adapting cable is required.
4. Stick a device name label to the RJ45 connecting cable at the end close to the BeneLink module. When the BeneLink module is connected to several external devices, you can tell devices easily with these labels.Switch on the external device.

After the external device is connected to the monitor, the indicators on both the ID adapter and the BeneLink module illuminate to show that the monitor successfully communicates with the external device.

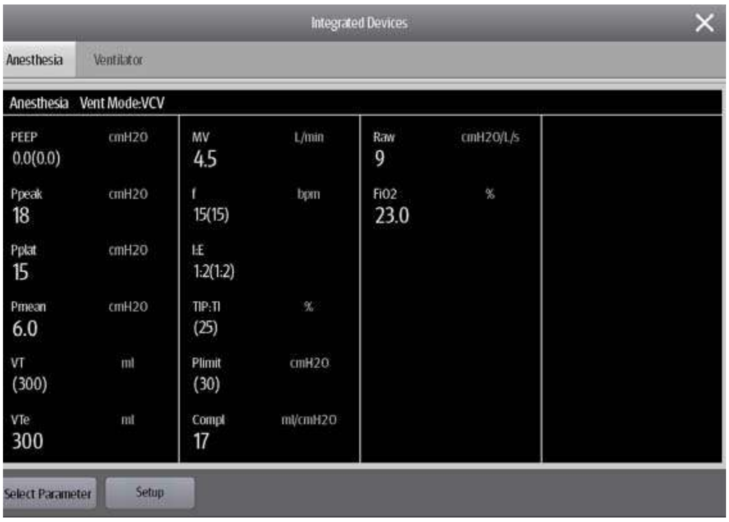
CAUTION

- **First installation and debugging should be executed by Mindray service personnel or authorized technician.**
- **Please check the compatibility of the external device and the ID adapter before connection. Otherwise, unpredictable system failure may be resulted.**
- **Ports on the BeneLink module are not conventional network connectors. They are intended for connecting with the serial port of designated devices only. Do not connect them to public network interfaces.**

9.5 Accessing the Integrated Devices Screen

You can view the information of external devices in the **Integrated Devices** screen of the monitor. To access the **Integrated Devices** screen, follow this procedure:

- Select the **Integrated Device** quick key.
- Select the **Screen Setup** quick key → select the **Choose Screen** tab → select **Integrated Devices**.
- Select the **Main Menu** quick key → from the **Display** column select **Choose Screen** → select **Integrated Devices**.
- Select the numeric area or waveform area of any parameter from the external device →select the **Integrated Device** button.



The **Integrated Devices** screen has the following features:

- For the parameters measured by the external device, the measurements display directly after the parameter labels.
- For the parameters controlled by the external device, the settings are enclosed in parenthesis after parameter labels.

- For the parameters measured and controlled by the external device, measurements and settings are displayed after parameter labels, and settings are also enclosed in parenthesis. For example, PEEP 18 (20), in which PEEP is parameter label, 18 is the measurement, and (20) is the setting.

NOTE

- **Parameters in the Integrated Devices screen are displayed in the order of priorities. If the screen cannot display all the selected parameters, only parameters with higher priorities are displayed.**

9.6 Displaying Parameters from External Devices

This monitor can display parameters from external devices in the main screen:

- Display waveforms from external devices in the waveform area.
- Display labels and measurements of parameters from external devices in the numeric area.
- Display respiratory loops of parameters from external deivices in the **Loops** screen.

NOTE

- **When displayed in the monitor main screen, parameter labels of external devices are prefixed with the plug sign "+". For example, if SpO_2 is from an external device, its label is displayed as "+SpO_2", and its waveform label is displayed as "+Pleth".**
- **If a parameter can be obtained either from the monitor or an external device, the measured value, waveform or loops coming fromthe monitor will be displayed preferentially.**

9.6.1 Setting Waveform Properties for Parameters from External Devices

To set the waveform properties for parameters from external devices, follow this procedure:

1. Access the parameter setup menu by selecting its waveform area or numeric area.
2. Set **Speed** or **Scale**.

9.6.2 Setting Alarms from External Devices

To enable or disable the storage, display, and sound of the external device alarms of a certain priority and category, follow this procedure:

1. From the **Integrated Devices** screen select **Setup**.
2. Select the switches as desired.

If the storage, display, or audio settings of a specific alarm are different from its category or priority, set them individually by adding this alarm to the alarm list. To do so, follow this procedure:

1. From the **Integrated Devices** screen select **Setup**.
2. Input the alarm ID for this alarm, and select **Add**.

To delete a specific external device alarm, select the desired alarm ID, and select **Delete**.

9.6.3 Setting Parameters from External Devices for Display

To select parameters displayed in the **Integrated Devices** screen, follow this procedure:

1. From the **Integrated Devices** screen select **Select Parameter**.
2. Select desired parameters.

In the main screen, the numeric area of some parameters from an external device, for example the +Paw parameter, can display multiple parameters. To select parameters for display, follow this procedure:

1. Select the numeric area of the parameter from the external device.
2. Select the **Select Parameter** tab.
3. Select desired parameters.

9.6.4 Setting Units for Parameters from External Devices

To set units for parameters from external devices, follow this procedure:

1. Select the numeric area of any parameter from the external device.
2. Selectthe **Unit** tab.
3. Set the unit as desired.

9.6.5 Accessing the Loops Screen

To access the **Loops** screen, follow this procedure:

1. Select **Setup** from the **Integrated Devices** screen, or select the numeric area of +Paw, +Flow, or +Vol to enter the corresponding setup menu.
2. Select **Loops**.

NOTE

- **The monitor only displays real-time loops of the external device, and these loops cannot be displayed or saved as reference loops.**

9.7 Viewing Alarms from External Devices

The monitor displays alarms from external devices in the physiological and technical alarm information areas. A plus sign "+" is added before each alarm message from external devices.

9.8 Viewing Parameter Trends from External Devices

The monitor saves parameters trends and alarm events from external devices. You can review these data in the **Tabular Trends**, **Graphic Trends**, **Events** and **Full Disclosure** pages in the **Review** window.The monitor adds a "+" before the parameter label of external devices.

For more information, see *32 Review*.

NOTE

- **Parameters from external devices are saved and displayed according to the time of the monitor.**

9.9 Recording and Printing Parameter Trends from External Devices

You can record or print parameter trends from external devices. For more information, see *32 Review*, *36 Recording*, and *37 Printing*.

This page intentionally left blank.

10 Alarms

10.1 Alarm Introduction

This chapter describes alarm functions and alarm settings.

10.2 Alarm Safety Information

WARNING

- **A potential hazard can exist if different alarm presets and default configuration settings are used for the same or similar equipment in the same care area, for example an intensive care unit or cardiac operating room.**
- **If your monitor is connected to the central monitoring system (CMS) or other monitors, alarms can be presented and controlled remotely. Remote suspension, inhibition, or reset of monitor alarms via the CMS or other monitors may cause a potential hazard. For more information, see the operator's manuals of the CMS and the other monitors.**
- **The monitors in your care area may each have different alarm settings to suit different patients. Always check that the alarm settings are appropriate for your patient before start monitoring. Always make sure that necessary alarm limits are active and set according to the patient's clinical condition.**
- **Setting alarm limits to extreme values may cause the alarm system to become ineffective. For example, high oxygen levels may predispose a premature infant to retrolental fibroplasia. If this is a consideration do not set the SpO_2 high alarm limit to 100%, which is equivalent to switching the alarm off.**
- **When the alarm sound is switched off, the monitor gives no alarm tones even if a new alarm occurs. Be careful about whether to switch off the alarm sound or not. When the alarms are off or while alarm audio is paused either temporarily or indefinitely, observe the patient frequently.**
- **When monitoring patients that are not continuously attended by a clinical operator, properly configure the alarm system and adjust alarm settings as per the patient's condition.**
- **Do not rely exclusively on the audible alarm system for monitoring. Adjustment of alarm volume to a low level may result in a hazard to the patient. Always make sure that the audio alarm volume level is adequate in your care environment. Always keep the patient under close surveillance.**

10.3 Understanding the Alarms

10.3.1 Alarm Categories

The monitor has two different types of alarms: physiological alarms and technical alarms.

- Physiological alarms are triggered by patient measurement exceeding the parameter limits, or by an abnormal patient conditions.
- Technical alarms are triggered by an electrical, mechanical, or other monitor failure, or by failure of a sensors or components. Technical alarm conditions may also be caused when an algorithm cannot classify or interpret the available data.

Apart from the physiological and technical alarms, the monitor can also prompt some messages telling the system status or patient status.

10.3.2 Alarm Priorities

By severity, the alarms are classified into the following priority levels:

- High priority alarms: indicates a life threatening situation or a severe device malfunction. High priority alarms require an immediate response.
- Medium priority alarms: indicates abnormal vital signs or a device malfunction. Medium priority alarms require a prompt response.
- Low priority alarms: indicates a discomfort condition, a device malfunction, or an improper operation. Low priority alarms require you to be aware of this condition.
- Messages: provides additional information on the patient or the equipment.

10.3.3 Alarm Indicators

When an alarm occurs, the monitor indicates it to you through visual or audible alarm indications. For more information, see the following table.

Alarm Indicator		High Priority Alarm	Medium Priority Alarm	Low Priority Alarm	Message	Comments
Alarm lamp		Red Flashing frequency: 1.4 - 2.8 Hz Duty ratio: 20 - 60%	Yellow Flashing frequency: 0.4 - 0.8 Hz Duty ratio: 20 - 60%	Cyan No flashing Duty ratio: 100%	None	None
Audible tone pattern	ISO	Repeat pattern of 2 × 5 beep tones	Repeat pattern of 3-beep tones	1-beep tone	None	None
	Mode 1	Repeat pattern of high-pitched 3-beep tones	Repeat pattern of 2-beep tones	Low-pitched 1-beep tone	None	
	Mode 2	Repeat pattern of high-pitched 3-beep tones	Repeat pattern of 2-beep tones	Low-pitched 1-beep tone	None	
Alarm message		White text inside a red box	Black text inside a yellow box	Black text inside a cyan box	White text	Alarm messages are displayed in the alarm information area at the top of the screen. You can select the alarm messages to show the alarm list.
Alarm priority indicator		***	**	*	None	The indicator shows in front of corresponding alarm message.
Parameter value		White text inside a flashing red box	Black text inside a flashing yellow box	Black text inside a flashing cyan box	None	None

NOTE

- **When multiple alarms of different priority levels occur simultaneously, the monitor select the alarm of the highest priority to light the alarm lamp and issue the alarm tone.**
- **When multiple technical alarms of different priority levels occur simultaneously and should be displayed in the same area, the monitor only displays the messages of the highest priority alarm.**
- **When multiple physiological alarms of different priority levels occur simultaneously and should be displayed in the same area, the monitor displays the high priority alarm, while the medium and low priority alarms are displayed circularly.**
- **When multiple alarms of the same priority levels occur simultaneously and should be displayed in the same area, all the alarm messages are displayed circularly.**

10.3.4 Alarm Status Symbols

Apart from the alarm indicators as described in ***10.3.3 Alarm Indicators***, the monitor uses the following symbols to indicate the alarm status:

	Alarm pause:	indicates that all the alarms are paused.
	Alarm off:	indicates that individual measurement alarms are turned off or the system is in the alarm off status.
	Audio pause:	indicates that audible alarm tones are paused.
	Audio off:	indicates that audible alarm tones are turned off.
	Alarm reset:	indicates that alarms are acknowledged and the alarm system is reset.

10.4 Accessing On-screen Help for Technical Alarms (AlarmSight)

In the technical alarm list, alarm messages followed by **Detail** include help messages or pictures to help you identify the problem. This function is called AlarmSight. To access AlarmSight, follow this procedure:

1. Select the technical alarm information area to enter the **Alarms** window.
2. Select the **Technical Alarms** tab.
3. From the alarm list select the desired alarm.

10.5 Checking Physiological Alarm List

To check the physiological alarm list, follow this procedure:

1. Select the physiological alarm information area to enter the **Alarms** window.
2. Select the **Physiological Alarms** tab.

10.6 Changing Alarm Settings

Select the **Alarm Setup** quick key or from the **Alarm** column of the main menu select desired buttons to set alarm properties.

10.6.1 Setting Parameter Alarm Properties

To set parameter alarm properties, follow this procedure:

1. Access the **Limits** page in either of the following ways:
   - ◆ Select the **Alarm Setup** quick key.
   - ◆ Select the **Main Menu** quick key → from the **Alarm** column select **Limits.**

2.Select a parameter tab and set alarm properties as desired. Enter the password if required. For more information, refer to *39.13 The Authorization Setup Settings*.

You can also change the alarm properties of individual parameter from corresponding parameter menu.

10.6.2 Setting Alarm Tone Properties

10.6.2.1 Changing the Alarm Volume

To change the alarm volume, follow this procedure:

1. Access the **Setup** page in either of the following ways:
   - ◆ Select the **Alarm Setup** quick key → select the **Setup** tab.

- ◆ Select the **Main Menu** quick key → from the **Alarm** column select **Setup.**

2. Set **Alarm Volume**. The optional alarm volume is between X to 10, in which X is the minimum volume, depending on the setting of minimum alarm volume, and 10 is the maximum volume.
3. Select **High Alarm Volume** to set the volume of the high priority alarm.
4. Select **Reminder Volume** to set the volume of the reminder tone.

NOTE

- **When the alarm volume is set to 0, the alarm sound is turned off and the audio off symbol appears on the screen.**
- **You cannot set the volume of high priority alarms if Alarm Volume is set to 0.**

10.6.2.2 Password Protected Audio Alarm Settings

The following alarm settings are password protected:

- Minimum alarm volume
- Alarm sound pattern
- Alarm interval
- Alarm sound escalation switch and delay

For more information, see *39.4.1 The Audio Tab*.

10.6.3 Setting the Auto Limits for New Patient Switch

If the **Auto Limits for New Patient** function is enabled, a dialog box pops up to ask you whether to set alarm limits basing on the latest parameter measurements for a newly admitted patient. To set the **Auto Limits for New Patient** switch, follow this procedure:

1. Enter the alarm setup page in any of the following ways:
   - ◆ Select the **Alarm Setup** quick key → select the **Setup** tab.
   - ◆ Select the **Main Menu** quick key → from the **Alarm** column select **Setup**.
2. Set the **Auto Limits for New Patient** switch.

When **Auto Limits for New Patient** is switched on, the confirmation dialog box pops up if all of the following requirements are met:

- Within 10 minutes after the patient is admitted.
- Continuous measurements are stable.
- An NIBP measurement has been taken
- HR alarm switch is on.
- No fatal alarms are triggered.
- The patient is not in poor perfusion condition.
- Alarm limit of any parameter was not manually changed.
- The monitor is not in intubation mode, rescue mode, private mode, or CPB mode.

NOTE

- **The Auto Limits for New Patient function is intended for newly admitted patients only.**
- **The automatically set alarm limits take effect only after being confirmed.**

10.6.4 Initiating Auto Alarm Limits

The monitor provides the auto alarm limits function to automatically adjust alarm limits according to the patient's vital signs using. When auto limits are selected, the monitor calculates safe auto limits based on the latest measured values. To get accurate auto alarm limits, you need to collect a set of measured vital signs as a baseline.

To initiate auto alarm limits, follow this procedure:

1. Access the **Limits** page in either of the following WAYS:
   - ◆ Select the **Alarm Setup** quick key → select the **Limits** tab.
   - ◆ Select the **Main Menu** quick key → from the **Alarm** column select **Limits.**
2. From the **Limits** page, select **Auto Limits** at the left bottom.
3. Select **Ok** from the popup dialog box.

Then the monitor will automatically calculate alarm limits basing on the latest measured values. Before applying these automatically created alarm limits, confirm if they are appropriate for your patient from the **Limits** menu. If not, you can adjust them manually. These alarm limits will remain unchanged until you select auto limits again or adjust them manually.

The monitor calculates auto limits basing on the following rules:

Module	Parameter	Lower Limit		Upper Limit		Auto Limit Range
		Adult/ pediatric	Neonate	Adult/ pediatric	Neonate	
ECG	HR/PR (bpm)	HR × 0.8 or 40 (whichever is greater)	(HR - 30) or 90 (whichever is greater)	HR × 1.25 or 240 (whichever is smaller)	(HR + 40) or 200 (whichever is smaller)	Adult/pediatric: 35 to 240 Neonate: 55 to 225
Resp	RR (rpm)	RR × 0.5 or 6 (whichever is greater)	(RR - 10) or 30 (whichever is greater)	(RR × 1.5) or 30 (whichever is smaller)	(RR + 25) or 85 (whichever is smaller)	Adult/pediatric: 6 to 55 Neonate: 10 to 90
SpO_2	SpO_2 (%)	Same as the default alarm limit	Same as the default alarm limit	Same as the default alarm limit	Same as the default alarm limit	Same as the measurement range
NIBP	NIBP-S (mmHg)	(SYS × 0.68 + 10)	(SYS - 15) or 45 (whichever is greater)	(SYS × 0.86 + 38)	(SYS + 15) or 105 (whichever is smaller)	Adult: 45 to 270 Pediatric: 45 to 185 Neonate: 35 to 115
	NIBP-D (mmHg)	(Dia × 0.68 + 6)	(Dia - 15) or 20 (whichever is greater)	(Dia × 0.86 + 32)	(Dia + 15) or 80 (whichever is smaller)	Adult: 25 to 225 Pediatric: 25 to 150 Neonate: 20 to 90
	NIBP-M (mmHg)	(Mean × 0.68 + 8)	(Mean - 15) or 35 (whichever is greater)	(Mean × 0.86 + 35)	(Mean + 15 or 95) (whichever is smaller)	Adult: 30 to 245 Pediatric: 30 to 180 Neonate: 25 to105
Temp (xx refers to temperat ure site)	Txx (°C)	(Txx - 0.5)	(Txx - 0.5)	(Txx + 0.5)	(Txx + 0.5)	1 to 49
	TD (°C)	Same as the default alarm limit	Same as the default alarm limit	Same as the default alarm limit	Same as the default alarm limit	Same as the measurement range
TempIF	T (°C)	(T - 0.5)	(T - 0.5)	(T + 0.5)	(T + 0.5)	33.6 to 41.4
IBP: ART/ Ao/UAP/ BAP/FAP/ LV/P1-P4 (Arterial pressure)	IBP-S (mmHg)	SYS × 0.68 + 10	(SYS - 15) or 45 (whichever is greater)	SYS × 0.86 + 38	(SYS + 15) or 105 (whichever is smaller)	Adult: 45 to 270 Pediatric: 45 to 185 Neonate: 35 to 115
	IBP-D (mmHg	(Dia × 0.68 + 6)	(Dia - 15) or 20 (whichever is greater)	(Dia × 0.86 + 32)	(Dia + 15) or 80 (whichever is smaller)	Adult: 25 to 225 Pediatric: 25 to 150 Neonate: 20 to 90
	IBP-M (mmHg)	Mean × 0.68 + 8	(Mean - 15) or 35 (whichever is greater)	Mean × 0.86 + 35	(Mean + 15) or 95 (whichever is smaller)	Adult: 30 to 245 Pediatric: 30 to180 Neonate: 25 to 105

<table>
<tr><th rowspan="2">Module</th><th rowspan="2">Parameter</th><th colspan="2">Lower Limit</th><th colspan="2">Upper Limit</th><th rowspan="2">Auto Limit Range</th></tr>
<tr><th>Adult/ pediatric</th><th>Neonate</th><th>Adult/ pediatric</th><th>Neonate</th></tr>
<tr><td rowspan="3">IBP: PA</td><td>IBP-S (mmHg)</td><td>SYS × 0.75</td><td>SYS × 0.75</td><td>SYS × 1.25</td><td>SYS × 1.25</td><td>3 to 120</td></tr>
<tr><td>IBP-D (mmHg</td><td>Dia × 0.75</td><td>Dia × 0.75</td><td>Dia × 1.25</td><td>Dia × 1.25</td><td>3 to 120</td></tr>
<tr><td>IBP-M (mmHg)</td><td>Mean × 0.75</td><td>Mean × 0.75</td><td>Mean × 1.25</td><td>Mean × 1.25</td><td>3 to 120</td></tr>
<tr><td>IBP: CPP</td><td>CPP (mmHg)</td><td>CPP × 0.68 + 8</td><td>(CPP-15) or 35, (whichever is greater)</td><td>CPP × 0.86 + 35</td><td>(CPP+15) or 95, (whichever is smaller)</td><td>Adult: 20 to 235
Pediatric: 25 to175
Neonate: 25 to 100</td></tr>
<tr><td>IBP: CVP/ LAP/ RAP/ UVP/P1-P4 (Venous pressure)</td><td>IBP-M</td><td>Mean × 0.75</td><td>Mean × 0.75</td><td>Mean × 1.25</td><td>Mean × 1.25</td><td>3 to 40</td></tr>
<tr><td rowspan="7">CO_2</td><td rowspan="5">$EtCO_2$ (mmHg)</td><td>0 to 32: remains the same</td><td>0 to 32: remains the same</td><td>0 to 32: remains the same</td><td>0 to 32: remains the same</td><td>Same as the measurement range</td></tr>
<tr><td>33 to 35: 29</td><td>33 to 35: 29</td><td>33 to 35: 41</td><td>33 to 35: 41</td><td>Same as the measurement range</td></tr>
<tr><td>36 to 45: ($EtCO_2$ - 6)</td><td>36 to 45: ($EtCO_2$ - 6)</td><td>36 to 45: ($EtCO_2$ + 6)</td><td>36 to 45: ($EtCO_2$ + 6)</td><td>Same as the measurement range</td></tr>
<tr><td>46 to 48: 39</td><td>46 to 48: 39</td><td>46 to 48: 51</td><td>46 to 48: 51</td><td>Same as the measurement range</td></tr>
<tr><td>>48: remains the same</td><td>>48: remains the same</td><td>>48: remains the same</td><td>>48: remains the same</td><td>Same as the measurement range</td></tr>
<tr><td>$FiCO_2$</td><td>None</td><td>None</td><td>Same as the default alarm limit</td><td>Same as the default alarm limit</td><td>Same as the measurement range</td></tr>
<tr><td>awRR (rpm)</td><td>awRR × 0.5 or 6 (whichever is greater)</td><td>(awRR - 10) or 30 (whichever is greater)</td><td>awRR × 1.5 or 30 (whichever is smaller)</td><td>(awRR+25) or 85 rpm (whichever is smaller)</td><td>Adult/pediatric: 6 to 55
Neonate: 10 to 90</td></tr>
<tr><td rowspan="6">AG</td><td>$EtCO_2$</td><td colspan="5">Same as the CO_2 module</td></tr>
<tr><td>$FiCO_2$</td><td colspan="5">Same as the CO_2 module</td></tr>
<tr><td>awRR (rmp)</td><td>awRR × 0.5 or 6 (whichever is greater)</td><td>(awRR - 10) or 30 (whichever is greater)</td><td>awRR × 1.5 or 30 (whichever is smaller)</td><td>awRR+25 or 85 (whichever is smaller)</td><td>Adult/pediatric: 6 to 55
Neonate: 10 to 90</td></tr>
<tr><td>FiAA/EtAA</td><td>Same as the default alarm limit</td><td>Same as the default alarm limit</td><td>Same as the default alarm limit</td><td>Same as the default alarm limit</td><td>Same as the measurement range</td></tr>
<tr><td>FiO_2/$EtCO_2$</td><td>Same as the default alarm limit</td><td>Same as the default alarm limit</td><td>Same as the default alarm limit</td><td>Same as the default alarm limit</td><td>Same as the measurement range</td></tr>
<tr><td>FiN_2O/ EtN_2O</td><td>Same as the default alarm limit</td><td>Same as the default alarm limit</td><td>Same as the default alarm limit</td><td>Same as the default alarm limit</td><td>Same as the measurement range</td></tr>
</table>

Module	Parameter	Lower Limit		Upper Limit		Auto Limit Range
		Adult/ pediatric	Neonate	Adult/ pediatric	Neonate	
C.O.	TB (°C)	Adult: (TB - 1) Pediatric: N/A	N/A	Adult: (TB + 1) Pediatric: N/A	N/A	Same as the measurement range
	C.I.	N/A	N/A	N/A	N/A	N/A
	TFC	N/A	N/A	N/A	N/A	N/A
RM	RR (rpm)	awRR × 0.5 or 6 (whichever is greater)	N/A	awRR × 1.5 or 30 (whichever is smaller)	N/A	Adult/pediatric: 6 to 55 Neonate: 10 to 90
	PEEP (cmH_2O)	(PEEP - 5)	N/A	(PEEP + 5)	N/A	Same as the measurement range
	PIP (cmH_2O)	PIP - 10	N/A	PIP + 10	N/A	Same as the measurement range
	MVe (L/min)	MVe - 2	N/A	MVe + 2	N/A	Same as the measurement range
SvO_2	SvO_2 (%)	SvO_2- 5	N/A	SvO_2 + 5	N/A	Same as the measurement range
	$ScvO_2$ (%)	$ScvO_2$ - 5	N/A	$ScvO_2$ + 5	N/A	Same as the measurement range
rSO_2	rSO_2	Same as the default alarm limit	Manual mode: same as the default alarm limit Auto mode: remains unchanged	Same as the default alarm limit	Manual mode: same as the default alarm limit Auto mode: remains unchanged	15 to 95

10.6.5 Setting the Alarm Delay Time

For continuously measured parameters, you can set the alarm delay time. If the alarm condition is resolved within the delay time, the monitor does not present the alarm.

This setting is password protected. For more information, see *39.4.6 The Other Tab*.

The setting of **Alarm Delay** is not applied to the apnea alarms and the ST alarms. You can set **Apnea Delay** and **ST Alarm Delay** separately.

10.6.5.1 Setting the Apnea Delay Time

To set the apnea delay time, follow this procedure:

1. Access the **Setup** page in either of the following waysin either of the following ways:
   - ◆ Select the **Alarm Setup** quick key → select the **Setup** tab.
   - ◆ Select the **Main Menu** quick key → from the **Alarm** column select **Setup.**
2. Select **Apnea Delay** to set the apnea delay time.

10.6.6 Adjusting the Alarm Light Brightness

This setting is password protected. For more information, see *39.4.6 The Other Tab*.

NOTE

- **If you set alarm light brightness to Auto, the monitor automatically adjusts the alarm light brightness according to the ambient light. The stronger the ambient light is, the brighter the alarm light is.**

10.6.7 Restoring the Default Alarm Settings

To reset all alarm settings to the defaults, follow this procedure:

1. Access the **Alarm** page in either of the following ways:
   - ◆ Select the **Alarm Setup** quick key.
   - ◆ Select the **Main Menu** quick key → from the **Alarm** column select **Limits.**
2. Select **Defaults** at the bottom.

10.6.8 Setting the Length of Printed Waveforms

You can define the length of printed waveforms when an alarm is triggered. To do so, follow this procedure:

1. Access the **Setup** page in either of the following ways:
   - ◆ Select the **Alarm Setup** quick key → select the **Setup** tab.
   - ◆ Select the **Main Menu** quick key → from the **Alarm** column select **Setup.**
2. Set **Printing Duration On Alarm**.

10.6.9 Setting the Switch of the SpO_2 Desat Alarm Off

You can choose whether switching off the SpO_2 Desat alarm is permissible or not. This setting is password protected. For more information, see *39.4.6 The Other Tab*.

WARNING

- **If you switch off the SpO2 Desat alarm, the monitor will not alarm when the patient's SpO_2 is extremely low. This may result in a hazard to the patient. Always keep the patient under close surveillance.**

10.6.10 Setting the Switch of the Apnea Alarm Off

You can choose whether switching off the apnea alarm is permissible or not. This setting is password protected. For more information, see *39.4.6 The Other Tab*.

WARNING

- **If you switch off the apnea alarm, the monitor will not issue the apnea alarm in case that apnea happens. This may result in a hazard to the patient. Keep the patient under close surveillance.**

10.7 Pausing Alarms/Pausing Alarm Tones

10.7.1 Defining the Pause Function

You can either pause alarms or pause alarm tones. This depends on the pause setting. This setting is password protected. For more information, see *39.4.2 The Pause/Reset Tab*.

10.7.2 Pausing Alarms

If the pause function is designated as pausing alarms, pressing the **Alarm Pause** quick key can temporarily disable alarm indicators. When alarms are paused, the following rules are followed:

- ■ No physiological alarm will be presented.
- ■ For technical alarms, alarm sounds are paused, but alarm lamps and alarm messages remain presented.
- ■ The remaining alarm pause time is displayed in the physiological alarm information area.

- The alarm pause symbol is displayed in the system information area.

When the alarm pause time expires, the alarm paused status is automatically deactivated. You can also cancel the alarm paused status by pressing the **Alarm Pause** quick key.

The following alarm pause and alarm reset settings are password protected.

- Alarm pause time
- Priorities of paused alarms
- Alarm reset setting
- Reminder tone settings

For more information, see *39.4.2 The Pause/Reset Tab*.

10.7.3 Switching Off All Alarms

If **Pause Time** is set to **Permanent** (see *39.4.2 The Pause/Reset Tab*), pressing the **Alarm Pause** quick key permanently switches off all alarms. The alarm off status has the following features:

- Physiological alarms are switched off. The alarm lamp does not flash and alarm sound is not issued.
- Alarm sound of technical alarms is switched off, but alarm lamp flashes and alarm messages are presented.
- The message **Alarm Off** with red background is displayed in the physiological alarm information area.
- The alarm off symbol is displayed in the system status information area.

To exit the alarm off status, press the **Alarm Pause** quick key again.

WARNING

- **Pausing or switching off alarms may result in a hazard to the patient.**

10.7.4 Pausing Alarm Sound

If the pause function is defined as **Audio Pause**, pressing the **Audio Pause** key pauses alarm tone. When alarm tones are paused, the following rules are followed:

- The sound of all physiological alarms and technical alarms are switched off.
- The remaining audio pause time is displayed in the physiological alarm information area.
- The audio pause symbol is displayed in the system information area.

When the audio pause time expires, the audio paused status is automatically deactivated. You can also cancel the audio paused status by pressing the **Audio Pause** quick key.

10.7.4.1 Setting the Alarm Tone Pause Time

The alarm tone pause time can be set to **1 min**, **2 min**, **3 min**, or **Permanent**. The default audio pause time is two minutes.

This function is password protected. For more information, see *39.4.2 The Pause/Reset Tab*.T

10.7.4.2 Prolonging the Alarm Tone Pause Time

You can temporarily prolong the alarm tone pause time after the monitor enters the alarm tone paused status. This function is password protected. For more information, see *39.4.2 The Pause/Reset Tab*.

NOTE

- **Prolonging alarm pause time does not affect the setting of alarm tone pause time.**

10.7.4.3 Setting the Priority of Audio Paused Alarms

You can select alarm sound of what priority can be paused.This function is password protected. For more information, see *39.4.2 The Pause/Reset Tab*.

10.7.4.4 Switching Off Alarm Sound

If **Pause Time** is set to **Permanent** (see *39.4.2 The Pause/Reset Tab*), pressing the **Audio Pause** quick key permanently switches off all alarm sound. The audio off status has the following features:

- Alarm sound of both physiological alarms and technical alarms is switched off.
- The audio off symbol is displayed in the system information area.

To exit the audio off status, press the **Audio Pause** quick key again.

WARNING

- **Pausing or switching off alarm sound may result in a hazard to the patient.**

10.8 Resetting Alarms

Pressing the **Alarm Reset** quick key to acknowledge the ongoing alarms and reset the alarm system. When the alarm system is reset, the alarm reset symbol displays in the system status information area for alarm symbols.

NOTE

- **If a new alarm is triggered after the alarm system is reset, the alarm reset icon will disappear and the alarm light and alarm tone will be reactivated.**

10.8.1 Resetting Physiological Alarms

Physiological alarms give different alarm indicators when the alarm system is reset:

- The alarm sound is silenced.
- A √ appears before the alarm message, indicating that the alarm is acknowledged.
- The color of the parameter numeric background corresponds with the alarm priority, but the parameter numeric does not flash.

10.8.2 Resetting Technical Alarms

Technical alarms give different alarm indicators when the alarm system is reset:

- Some technical alarms are cleared. The monitor gives no alarm indications.
- Some technical alarms are changed to the prompt messages.
- For some technical alarms, the alarm is silenced and a √ appears before the alarm message, indicating that the alarm is acknowledged.

For details about the indications of technical alarms when the alarm system is reset, see *D.2 Technical Alarm Messages*.

10.9 Latching Alarms

The latching setting for physiological alarms defines how alarm indicators behave if you do not reset the alarms.

- If you do not "latch" physiological alarms, their alarm indications disappear when the alarm condition ends.
- If you "latch" physiological alarms, all visual and audible alarm indications remains until you reset the alarms. For latched alarms the time when the alarm is last triggered is displayed behind the alarm message.

You can separately latch visual indications or simultaneously latch the visual and the audible indications.

- When visual indications are latched, visual indications, including alarm lamp, alarm message and its background remains when the alarm condition ends and the time when the alarm last triggered is displayed behind the alarm message.
- When audible indications are latched, the monitor issues alarm sounds when the alarm condition ends.

The alarm latch settings is password protected. For more information, see *39.4.3 The Latching Tab*.

NOTE

- **Changing alarm priority may affect the latching status of corresponding alarm. Determine if you need to reset the alarm latching status if you changed the alarm priority.**
- **When the alarm system is reset, latched physiological alarms are cleared.**

10.10 Nurse Call

The monitor provides a nurse call connector to output nurse call signal when a user-defined alarm occurs. To obtain nurse call signal, use the nurse call cable to connect the hospital nurse call system with the monitor's nurse call connector.

Alarms are indicated on the nurse call device only when the following conditions are met:

- The nurse call system is enabled.
- A user-defined alarm occurs.
- Alarms are not paused or reset.

WARNING

- **Do not rely exclusively on the nurse call system for alarm notification. Remember that the most reliable alarm notification combines audible and visual alarm indications with the patient's clinical condition.**

10.11 Calling for Help

In case of needing a help, you can call monitors in the same department, the central station, and the nurse call system from your monitor so that nearby doctors and nurses can come for help.

To call help, select the **Call Help** quick key and select **OK** from the popup dialog box. If you did not select **OK**, the monitor will automatically send out the call help signal in five seconds.

After the call help signal is sent out, the **Call Help** quick key flashes in red. If you need to stop calling for help, select the **Call Help** quick key again.

Monitors receiving the call help signal issue a sound and a dialog box pops up indicating which monitor is calling. Select **OK** to acknowledge the call and stop the sound at this monitor.

NOTE

- **The call help function works only when the monitor is connected to the network.**
- **The call help sound may disturb patients in the same department.**

10.12 CPB Mode

The CPB (Cardiopulmonary Bypass) mode is activated only if you set the department to **OR**.

In the CPB mode, except for BIS, EEG, NMT, tcGas, and rSO_2 related alarms, all the physiological alarms and technical alarms are switched off. So when performing CPB, you can put the monitor in the CPB mode in order to inactivate unnecessary alarms.

10.12.1 Entering the CPB Mode

To enter the CPB mode, choose either of the following ways:

- Select the **CPB Mode** quick key.
- Select the **Main Menu** quick key → from the **Alarm** column select **CPB Mode**.

In the CPB mode, **CPB Mode** is displayed in the physiological alarm area with a red background color.

NOTE

- **When the CPB mode is entered, the monitor stops all NIBP measurements. You can restart NIBP measurements after entering the CPB mode.**

10.12.2 Exiting the CPB Mode

To exit the CPB mode, choose either of the following ways:

- Select the **CPB Mode** quick key.
- Select the **Main Menu** quick key → from the **Alarm** column select **Exit CPB Mode**.

10.13 Intubation Mode

Intubation mode is available for Resp, CO_2, AG and RM monitoring. When performing intubation during general anesthesia, you can put the monitor in the intubation mode in order to inactivate unnecessary alarms.

In the intubation mode, Resp, CO_2, RM, and AG related physiological alarms are switched off.

10.13.1 Entering the Intubation Mode

To enter the intubation mode, choose either of the following ways:

- Select the **Intubation Mode** quick key.
- From the bottom of the **Resp**, **CO2**, **AG**, or **RM** menu, select **Intubation Mode**.
- Select the **Main Menu** quick key → from the **Alarm** column select **Intubation Mode**.

10.13.2 Exiting the Intubation Mode

To exit the intubation mode, choose either of the following ways:

- Select the **Exit Intubation Mode** quick key.
- From the bottom of the **Resp**, **CO2**, **AG**, or **RM** menu, select **Exit Intubation Mode**.
- Select the **Main Menu** quick key → from the **Alarm** column→ select **Exit Intubation Mode**.

10.14 Testing Alarms

The monitor automatically performs a selftest at startup. Check that an alarm tone is heard, the alarm lamp illuminates, one after the other, in red, yellow, and cyan. This indicates that the visible and audible alarm indicators functions correctly.

To further test individual measurement alarms, perform measurements on yourself or using a simulator. Adjust alarm limits and check that appropriate alarm behavior is observed.

10.15 Actions When an Alarm Occurs

When an alarm occurs, observe the following steps and take proper actions:

1. Check the patient's condition.
2. Confirm the alarming parameter or alarm category.
3. Identify the source of the alarm.
4. Take proper action to eliminate the alarm condition.
5. Make sure the alarm condition is corrected.

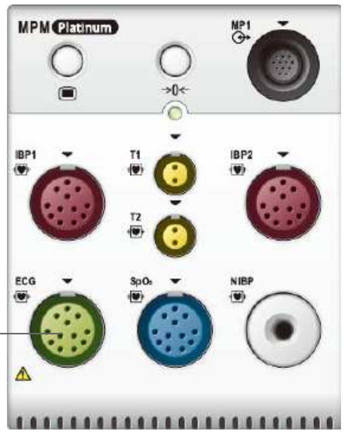
For more information, see *D Alarm Messages*.

11 Monitoring ECG, Arrhythmia, ST and QT

11.1 ECG Introduction

The electrocardiogram (ECG) measures the electrical activity of the heart and displays it on the monitor as waveforms and numerics. The monitor's ECG module is integrated into the MPM module. ECG monitoring provides 3-, 5-, 6-, and 12-lead ECG monitoring, ST-segment analysis, arrhythmia analysis, and QT/QTc measurements.

(1)



(1) ECG cable connector

11.2 ECG Safety Information

WARNING

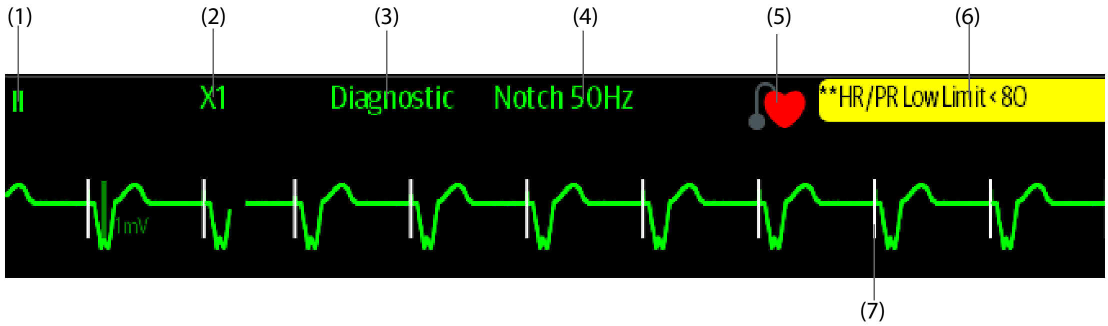
- **This equipment is not intended for direct cardiac application.**
- **Make sure the conductive parts of electrodes and associated connectors, including the neutral electrode, do not contact any other conductive parts including earth.**
- **Use defibrillation-proof ECG cables during defibrillation.**
- **Do not touch the patient or metal devices connected to the patient during defibrillation.**
- **To reduce the hazard of burns during high-frequency surgical procedure, ensure that the monitor's cables and transducers never come into contact with the electrosurgery unit (ESU).**
- **To reduce the hazard of burns during use of high-frequency surgical unit (ESU), the ECG electrodes should not be located between the surgical site and the ESU return electrode.**

CAUTION

- **Only use parts and accessories specified in this manual. Follow the instructions for use and adhere to all warnings and cautions.**
- **Periodically inspect the electrode application site to ensure skin integrity. If the skin quality changes, replace the electrodes or change the application site.**
- **Interference from ungrounded instrument near the patient and electrosurgery interference can induce noise and artifact into the waveforms.**

11.3 ECG Display

The following figures show the ECG waveform and numeric areas. Your display may be configured to look slightly different.



(1) ECG lead label of the displayed waveform, When 6-lead placement is used to derive 12-lead ECG (D12L), all derived leads are marked with a "d" in front of the lead label, for example "dV1".

(2) ECG waveform gain

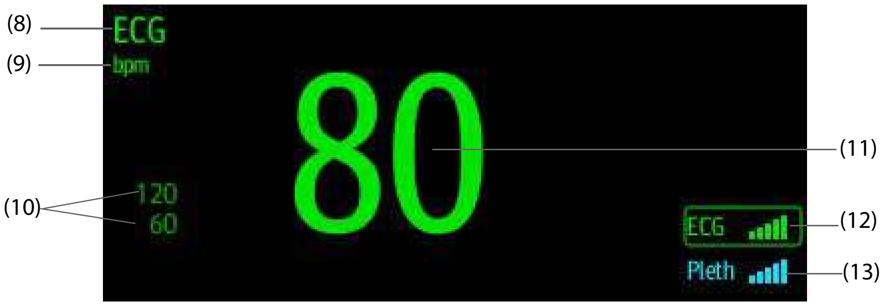
(3) ECG filter mode

(4) Notch filter status

(5) Paced status: If **Paced** is set to **Yes**,  is displayed. If **Paced** is set to **No**,  is displayed.

(6) HR/PR alarm message

(7) Pace pulse mark: If **Paced** is set to **Yes**, the pace pulse markers "|" are displayed corresponding to detected pace pulse on each ECG waveform.



(8) Parameter label

(9) HR unit

(10) HR alarm limits

(11) HR value

(12) ECG signal quality index (ECG SQI)

(13) Pleth signal quality index (Pleth SQI)

SQI with five highlighted bars indicates the best signal. SQI with one highlighted bar indicates the poorest signal. If the SQI is poor, check ECG electrodes or SpO_2 sensor application. Reposition the electrodes or sensor if necessary.

The CrozFusion™ function analyzes the ECG signal and the Pleth wave signal together to achieve more accurate arrhythmia analysis result and HR/PR measurements. To view the on-screen help for the CrozFusion™ function, select the **CrozFusion** tab from the **ECG** menu.

The ECG SQI, Pleth SQI, and signal fusion status are displayed when the CrozFusion™ function is enabled. The following table lists SQI indications of different signal fusion status:

	The quality of both ECG and Pleth signal is good. ECG signal and Pleth signal are independently analyzed.
	The quality of Pleth signal is poor. The PR value may be erroneous. The ECG signal is being used to correct the PR value.

The quality of ECG signal is poor. The HR value and arrhythmia analysis may be erroneous. The Pleth signal is being used to correct the HR value and for arrhythmia analysis.

If the CrozFusion™ function is disabled, ECG signal and the Pleth wave signal will not be analyzed together, and the ECG SQI and Pleth SQI are not displayed. For more information, see *11.6.6 Disabling the CrozFusion™ Function*.

NOTE

- **The ECG numeric area and waveform area are configured to be different for different lead type and ECG settings.**
- **The CrozFusion™ function uses ECG arrhythmia analysis leads according to the Analysis Mode setting. So the ECG SQI indicates the signal quality of the ECG arrhythmia analysis leads.**

11.4 Preparing for ECG Monitoring

11.4.1 Preparing the Patient Skin

Proper skin preparation is necessary to ensure good signal quality at the electrode sites, as the skin is a poor conductor of electricity. To properly prepare the skin, choose flat areas and then follow this procedure:

1. Shave hair from skin at chosen electrode sites.
2. Gently rub skin surface at sites to remove dead skin cells.
3. Thoroughly cleanse the site with a mild soap and water solution.
4. Dry the skin completely before applying electrodes.

11.4.2 Applying Electrodes

To connect ECG cables, follow this procedure:

1. Check that electrode packages are intact and the electrodes are not past the expiry date. Make sure the electrode gel is moist. If you are using snap electrodes, attach the snaps to the electrodes before placing electrodes on the patient.
2. Place the electrodes on the prepared sites. Make sure that all electrodes have good skin contact.
3. Connect the leadwires to the patient cable if not already connected.
4. Plug the patient cable into the ECG connector.

NOTE

- **Store the electrodes at room temperature.**
- **Only open the electrode package immediately prior to use.**
- **Never mix patient electrode types or brands. This may lead to problem due to impedance mismatch.**
- **When applying the electrodes, avoid bony area, obvious layers of fat, and major muscles. Muscle movement can result in electrical interference. Applying electrodes on major muscles, for example on muscles of the thorax, may lead to erroneous arrhythmia alarms due to excessive muscle movement.**

11.4.3 Lead Wire Color Code

The following table lists the color coding of leadwires for both AHA and IEC standards:

Lead	IEC		AHA	
	Label	**Color**	**Label**	**Color**
Right arm	R	Red	RA	White
Left arm	L	Yellow	LA	Black
Right leg (neutral)	N	Black	RL	Green
Left leg	F	Green	LL	Red
Chest 1	C1	White/Red	V1	Brown/Red
Chest 2	C2	White/Yellow	V2	Brown/Yellow
Chest 3	C3	White/Green	V3	Brown/Green
Chest 4	C4	White/Brown	V4	Brown/Blue
Chest 5	C5	White/Black	V5	Brown/Orange
Chest 6	C6	White/Violet	V6	Brown/Violet

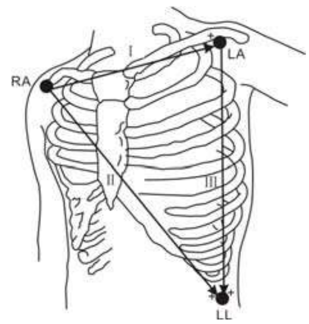
11.4.4 ECG Electrode Placements

In this section, electrode placement is illustrated using the AHA naming convention.

11.4.4.1 3-leadwire Electrode Placement

The following is an electrode configuration when a 3-leadwire cable is used:

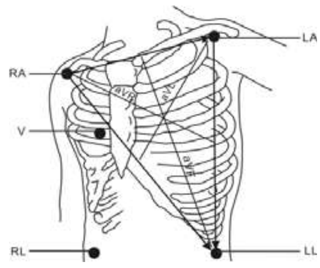
- RA placement: directly below the clavicle and near the right shoulder.
- LA placement: directly below the clavicle and near the left shoulder.
- LL placement: on the left lower abdomen.



11.4.4.2 5-leadwire Electrode Placement

The following is an electrode configuration when when 5-leadwires is used:

- RA placement: directly below the clavicle and near the right shoulder.
- LA placement: directly below the clavicle and near the left shoulder.
- RL placement: on the right lower abdomen.
- LL placement: on the left lower abdomen.
- V placement: on the chest.



11.4.4.3 6-leadwire Electrode Placement

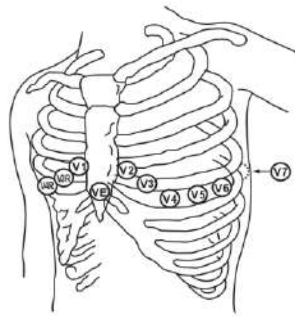
For 6-leadwire placement, you can use the position for the 5 -leadwire placement but with two chest leads. The two chest leads (Va and Vb) can be positioned at any two of the V1 to V6 positions. For more information, see *11.4.4.4 Chest Electrode Placement*. The Va and Vb lead positions are configurable. For more information, see *11.6.4.4 Changing Va and Vb Labels*.

When 6-lead placement is used to derive 12-lead ECG, Va and Vb shall use any of the following combinations.

- V1 and V3, V1 and V4, V1 and V5
- V2 and V4, V2 and V5
- V3 and V5, V3 and V6

11.4.4.4 Chest Electrode Placement

The chest electrode can be placed at the following positions:



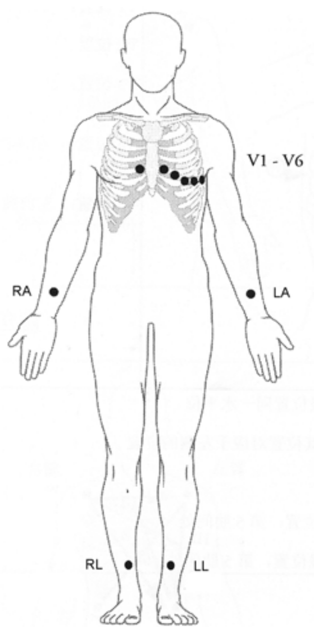
- V1 placement: on the fourth intercostal space at the right sternal border.
- V2 placement: on the fourth intercostal space at the left sternal border.
- V3 placement: midway between the V2 and V4 electrode positions.
- V4 placement: on the fifth intercostal space at the left midclavicular line.
- V5 placement: on the left anterior axillary line, horizontal with the V4 electrode position.
- V6 placement: on the left midaxillary line, horizontal with the V4 electrode position.
- V3R-V6R placement: on the right side of the chest in positions corresponding to those on the left.
- VE placement: over the xiphoid process.
- V7 placement: on posterior chest at the left posterior axillary line in the fifth intercostal space.
- V7R placement: on posterior chest at the right posterior axillary line in the fifth intercostal space.

NOTE

- **For the 5-leadwire and 6-leadwire placement, place the precordial electrode according to the physician's preference.**

11.4.4.5 10-leadwire Electrode Placement

12-lead ECG uses 10 electrodes, which are placed on the patient's four limbs and chest. The limb electrodes should be placed on the limb extremities and the chest electrodes placed according to the physician's preference. The picture at the right shows the conventional 10-leadwire electrode placement.



11.4.4.6 Lead Placement for Surgical Patients

The surgical site should be taken into consideration when placing electrodes on a surgical patient. For example, for open-chest surgery, the chest electrodes can be placed on the lateral chest or back. To reduce artifacts and interference from electrosurgical units, you can place the limb electrodes close to the shoulders and lower abdomen and the chest electrodes on the left side of the mid-chest. Do not place the electrodes on the upper arm. Otherwise, the ECG waveform will be very small.

WARNING

- **To reduce the hazard of burns during use of electrosurgical units (ESU), the ECG electrodes should not be located between the surgical site and the ESU return electrode.**
- **Never entangle the ESU cable and the ECG cable together.**
- **When using ESU, never place ECG electrodes near the grounding plate of the ESU, as this can cause a lot of interference on the ECG signal.**

11.4.5 Choosing the ECG Lead Type

To choose ECG lead type, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** menu.
2. Select the **Setup** tab.
3. Set **Lead Set** according to the lead type you are going to use. The default lead type is **Auto**. In this case, the monitor automatically detects the lead type.

11.4.6 Checking Paced Status

It is important to correctly set the paced status before you start monitoring ECG. The paced symbol is displayed when **Paced** is set to **Yes**. The pace pulse markers "|" are shown on each ECG waveform when the patient has a paced signal. If **Paced** is set to **No** or if the patient's paced status is not selected, the symbol will be shown in the ECG waveform area.

To change the paced status, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** menu.
2. Select the **Pacer** tab.
3. Set **Paced** to **Yes** or **No**.

You can also change the patient's paced status from the Patient Management menu. For more information, see *5.4.1 Entering the Patient Management Menu*.

If you did not set the paced status, the monitor issues a prompt tone when pace pulse is detected. At the same time, the paced symbol flashes and the message **Please check if the patient has a pacemaker?** appears in the ECG waveform area. Check and set the patient's paced status.

WARNING

- **For paced patients, you must set Paced to Yes. If it is incorrectly set to No, the monitor could mistake a pace pulse for a QRS complex and fail to alarm when the ECG signal is too weak. On ventricular paced patients, episodes of ventricular tachycardia may not always be detected.Do not rely entirely upon the system's automated arrhythmia detection algorithm.**
- **False low heart rate or false asystole alarms may result with certain pacemakers because of pacemaker artifacts, such as electrical overshoot of the pacemaker overlapping the true QRS complexes.**
- **Do not rely entirely on heart rate meter alarms when monitoring patients with pacemakers. Always keep these patients under close surveillance.**
- **The auto pacer recognition function is not applicable to pediatric patient, neonatal patients, or patients with NMT monitoring.**
- **For non-paced patients, you must set Paced to No.**

11.4.7 Enabling Pacer Rejection

The pace pulse rejection function is disabled by default. To enable this function, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** menu.
2. Select the **Pacer** tab.
3. Switch on **Pacer Reject**.

NOTE

- **When pace pulses are detected, the pace pulse marks "|" are shown on the ECG waveforms. Pacer Rejection setting has no impact on the display of pace pulse marks "|".**
- **You can switch on pacer rejection only when Paced is set to Yes. If Paced is set to no, the setting of Pacer Reject is disabled.**

11.5 Using 6-lead Placement to Derive 12-lead ECG (D12L)

The monitor supports using the 6-lead placement to derive 12-lead ECG. This function is called D12L. When D12L is enabled, the monitor can derive four additional chest leads according to directly acquired ECG signals. D12L provides a non-diagnostic 12-lead view, including ECG waveforms and ST/QT measurements. D12L is intended for adult patients only.

The available Va and Vb combinations supporting D12L are:

- V1 and V3, V1 and V4, V1 and V5
- V2 and V4, V2 and V5
- V3 and V5, V3 and V6

D12L is disabled by default. To enable D12L, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** menu.
2. Select the **Setup** tab.
3. Select the positions of Va and Vb. You shall use an available Va and Vb combination.
4. Switch on **D12L**.

WARNING

- **D12L is not intended for pediatric and neonatal patients.**
- **The positions of Va and Vb shall be consistent with the settings of Va and Vb. Otherwise D12L does not work properly.**
- **The derived 12-lead ECGs and their measurements are approximations to conventional 12-lead ECGs. The derived leads cannot be used for heart rate calculation and arrhythmia analysis.**
- **The derived 12-lead ECGs should not be used for diagnostic interpretations.**

NOTE

- **You shall use the available Va and Vb combination supporting D12L. I f you choose other combinations, D12L does not work and the message "D12L not available" is prompted.**

11.6 Changing ECG Settings

11.6.1 Choosing an ECG Screen

When monitoring ECG, you can choose the screen as desired.

- For 3-lead ECG monitoring, only normal screen is available.
- For 5-lead ECG monitoring, besides the normal screen, you can also choose 7-lead full screen or 7-lead half screen.

- For 6-lead ECG monitoring, besides the normal screen, you can also choose 8-lead full screen or 8-lead half screen.
- For 12-lead ECG monitoring, besides the normal screen, you can also choose 7-lead full screen, 7-lead half screen, and 12-lead full screen.

To choose the desired screen configuration, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** menu.
2. From the bottom of the menu, select **Full-Screen**, **Half-Screen**, or **12-lead** (for 12-lead ECG monitoring).

11.6.2 Setting ECG Alarm Properties

To set ECG alarm properties, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** menu.
2. Select the **Alarm** tab.
3. Enter the password if required. For more information, refer to *39.13 The Authorization Setup Settings*.
4. Set alarm properties as desired.

11.6.3 Setting the Analysis Mode

Multiple leads analysis enhances detection sensitivity and reduces false alarms. However, when most leads are noisy or with low amplitude, choosing the optimal lead as calculation lead and single lead analysis is recommended.

To set the ECG analysis mode, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** menu.
2. Select the **Setup** tab.
3. Set the **Analysis Mode**.
    - **Multiple Leads**: the monitor uses four leads (ECG1 to ECG 4) as calculation leads.
    - **Single Lead**: the monitor uses one lead (ECG1) as calculation lead.

NOTE

- **It is difficult for the monitor to differentiate an aberrantly conducted beat from a ventricular beat. An aberrantly conducted beat may be misclassified as a ventricular beat. In this case, choose the lead with a narrow R-wave for ECG1 and select Single Lead.**
- **When a 3-lead ECG cable is used, the monitor always uses single lead as calculation lead and the Analysis Mode option is not available.**

11.6.4 Changing ECG Wave Settings

11.6.4.1 Selecting the Leads of Displayed ECG Waveforms

To select the leads of displayed ECG waveforms, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** menu.
2. Select the **Setup** tab.
3. Select **ECG** to set the lead of each ECG waveform.
4. If more than three ECG waveforms are displayed, select the **More Leads** tab, and then select **ECG** to set leads of other ECG waveforms.

The waveform of selected lead should have the following characteristics:

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

CAUTION

- **Ensure that you have selected the optimal leads with the best waveform amplitude and the highest signal-to-noise ratio. Selecting the optimal leads is important for detecting beats, classifying beats, and detecting ventricular fibrillation.**

NOTE

- **If D12L is enabled, you cannot select the derived leads as ECG1 or ECG2.**

11.6.4.2 Setting the ECG Waveform Layout

To set the ECG waveform layout, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** menu.
2. Select the **Setup** tab.
3. Set **Waveform Layout**.
   - **Standard**: the waveform sequence is I, II, III, aVR, aVL, aVF, V1, V2, V3, V4, V5, V6.
   - **Cabrera**: the waveform sequence is aVL, I, -aVR, II, aVF, III, V1, V2, V3, V4, V5, V6.

For the Glasgow algorithm, the sequence of the chest leads depends on the setting of **V3 placement**. If **V3 placement** is set to **V4R**, the sequence of chest leads is V4R, V1, V2, V4, V5, V6.

11.6.4.3 Changing ECG Waveform Size

If the ECG waveform is too small or clipped, you can change its size by selecting an appropriate **Gain** setting. To do so, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** menu.
2. Select the **Setup** tab.
3. Select **ECG gain** to set the size of each ECG waveform.
4. If more than three ECG waveforms are displayed, select the **More Leads** tab, and then select **ECG Gain** to change the sizes of other ECG waveforms. If you select **Auto**, the monitor automatically adjusts the size of the ECG waveforms.

11.6.4.4 Changing Va and Vb Labels

When monitoring ECG with 6-leadwire. You can change the labels of Va and Vb leads. To do so, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** menu.
2. Select the **Setup** tab.
3. Set **Va** and **Vb** according to the Va and Vb electrode sites. Default settings are **Va** and **Vb**.

11.6.4.5 Changing ECG Waveform Speed

To change ECG waveform speed, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** menu.
2. Select the **Setup** tab.
3. Set **Speed**.

11.6.4.6 Setting the ECG Filter

To set the ECG waveform filter mode, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** menu.
2. Select the **Setup** tab.
3. Set **Filter**.

- **Diagnostic**: use when diagnostic quality ECG is required. The unfiltered ECG waveform is displayed so that changes such as R-wave notching or discrete elevation or depression of the ST segment are visible.
- **Monitor**: use under normal measurement conditions.
- **Surgery**: use when the signal is distorted by high frequency or low frequency interference. High frequency interference usually results in large amplitude spikes making the ECG signal look irregular. Low frequency interference usually leads to wandering or rough baseline. The surgery filter reduces artifacts and interference from electrosurgical units. Under normal measurement conditions, selecting **Surgery** may suppress certain features or details of the QRS complexes.
- **ST**: recommended for ST monitoring.

11.6.4.7 Switching On or Off the Notch Filter

The notch filter removes the line frequency interference. To switch on or off the notch filter, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** menu.
2. Select the **Setup** tab.
3. Switch on or off **Notch Filter**.

NOTE

- **The notch filter can only be switched on or off when ECG Filter is set to Diagnostic. In other filter modes, the notch filter is always on.**

11.6.5 Disabling the Smart Lead Off Function

The monitor provides the smart lead off function . When the lead of the first ECG wave is detached but another lead is available, the monitor automatically switches to the available lead to recalculate heart rate, and to analyze and detect arrhythmias. When you reconnect the detached leads, the monitor automatically switches back to the original lead.

The smart lead off function is enabled by default. To disable this function, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** menu.
2. Select the **Setup** tab.
3. Switch off **Smart Lead**.

11.6.6 Disabling the CrozFusion™ Function

The CrozFusion™ function is enabled by default. However, in some situations you may need to disable this function, or the CrozFusion™ function may not be able to work. You shall disable the CrozFusion™ function in the following situation:

- Administrating CPR
- Performing CPB
- Administrating IABP
- Other situations that the CrozFusion™ function is not applicable

To disable the CrozFusion™ function, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the ECG menu.
2. Select the **Setup** tab.
3. Switch off **CrozFusion**.

WARNING

- **The monitor is used for single patient at a time. Simultaneously monitoring more than one patient may result in a hazard to the patient.**

- **ECG signal and Pleth signal from different patient may result in incorrect signal fusion.**

11.6.7 Adjusting the QRS Volume

To adjust the QRS volume, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** menu.
2. Select the **Setup** tab.
3. Set **QRS Volume**.

When valid SpO_2 measurements are available, the monitor adjusts the pitch of QRS tone based on the SpO_2 value.

11.6.8 Adjusting the Minimum QRS Detection Threshold

To avoid false asystole alarm due to low R wave amplitude, and to avoid tall T waves and P waves being mistaken for QRS complexes, the monitor provides a means to manually adjust the minimum QRS detection threshold.

To adjust the minimum QRS detection threshold, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** menu.
2. Select the **Setup** tab and set **Filter** to **Monitor**.
3. Select the **QRS Threshold** tab.
4. Select up or down arrow buttons to adjust the minimum threshold for QRS detection. Selecting **Default** resets the QRS threshold to the default value (0.16 mV).

CAUTION

- **The setting of the QRS detection threshold can affect the sensitivity for arrhythmia, ST, QT/QTc detection, and heart rate calculation.**
- **If QRS amplitude is low, the monitor might not be able to calculate heart rate and false asystole calls may occur.**

NOTE

- **The minimum QRS detection threshold can only be adjusted when the ECG filter is set to Monitor.**

11.7 Monitoring Arrhythmia

Arrhythmia monitoring is intended for adult, pediatric, and neonatal patients.

11.7.1 Arrhythmia Safety Information

WARNING

- **Heart rate reading may be affected by cardiac arrhythmias. Do not rely entirely on heart rate alarms when monitoring patients with arrhythmia. Always keep these patients under close surveillance.**
- **The arrhythmia analysis program is intended to detect ventricular arrhythmias and atrial fibrillation. It is not designed to detect atrial or supraventricular arrhythmias. It may incorrectly identify the presence or absence of an arrhythmia. Therefore, a physician must analyze the arrhythmia information with other clinical findings.**
- **Atrial fibrillation (Afib) detection function is not intended for pediatric and neonatal patients.**

CAUTION

- **Since the arrhythmia detection algorithm sensitivity and specificity are less than 100%, sometimes there may be some false arrhythmias detected and also some true arrhythmia events may not be detected. This is especially true when the signal is noisy.**
- **The ECG size and minimum QRS detection threshold settings affect arrhythmia detection and heart rate calculation sensitivity.**
- **If QRS amplitude is low, the monitor might not be able to calculate heart rate and false asystole calls may occur.During the learning phase of the algorithm, arrhythmia detection may not be available. So you should closely monitor patient condition during and for several minutes after the learning phase to allow the algorithm to reach optimal detection performance.**

11.7.2 Arrhythmia Events

This section lists all arrhythmia events and their criteria.

11.7.2.1 Lethal Arrhythmia Events

Arrhythmia message	Description
Asystole	No QRS complex detected within the set time interval in the absence of ventricular fibrillation or chaotic signal.
V-Fib/V-Tach	A fibrillatory wave for 6 consecutive seconds. A dominant rhythm of adjacent PVCs and the ventricular rate is greater than the V-tach rate limit.
V-Tach	The number of consecutive PVCs is greater than or equal to the V-Tach PVCs limit, and the ventricular rate is greater than or equal to the V-Tach rate limit.
Vent Brady	The number of consecutive PVCs is greater than or equal to V brady PVC limit and the ventricular rate is less than the V-Brady Rate limit.
Extreme Tachy	The heart rate is greater than the extreme tachycardia limit.
Extreme Brady	The heart rate is less than the extreme bradycardia limit.

11.7.2.2 Nonlethal Arrhythmia Events

Arrhythmia message	Description
R on T	R on T PVC is detected.
Run PVCs	More than two consecutive PVCs, but lower than the V-Brady PVCs limit, and the ventricular rate is lower than the V-Tach rate limit.
Couplet	A Pair of PVCs detected in between normal beats.
Multiform PVC	Multiform PVCs detected in Multif. PVC's Window (which is adjustable).
PVC	One PVC detected in between normal beats.
Bigeminy	A dominant rhythm of N, V, N, V, N, V.
Trigeminy	A dominant rhythm of N, N, V, N, N, V, N, N, V.
Tachy	The heart rate is greater than the tachycardia limit.
Brady	The heart rate is lower than the bradycardia limit.
Pacer not Capture	No QRS complex detected for 300 ms following a pace pulse (for paced patients only).
Pacer not Pacing	No pace pulse detected for 1.75 x average R-to-R intervals following a QRS complex (for paced patients only).
Missed Beat	At least 3 consecutive Ns, and The current RR interval is greater than 1.5 x previous RR interval, and The next RR interval is lower than 1.5 x average RR interval, and HR lower than 100 and the current RR interval is greater than 1.75 x average RR interval , or HR is greater than or equal to 100 and the current RR interval is greater than 1000 ms.
Nonsus V-Tach	The number of consecutive PVCs is lower than the V-Tach PVCs limit but greater than 2, and the ventricular rate is greater than or equal to the V-Tach Rate limit.
Vent Rhythm	The number of consecutive PVCs is greater than or equal to the V-Brady PVCs limit, and ventricular rate is greater than or equal to the V-Brady Rate limit but lower than V-Tach Rate limit.
Pause	No QRS complex is detected within the set time threshold of pause.
Irr Rhythm	Consistently irregular rhythm (N, irregular RR interval change is greater than 12.5%)
Afib	P wave is absent and normal beat RR intervals are irregular.
PVCs/min	PVCs/min exceeds high limit.
Pauses/min	Pauses/min exceeds high limit.
Irr. Rhythm End	Irregular rhythm no longer detected for the irregular rhythm end delay time.
Afib End	Atrial fibrillation no longer detected for the Afib end delay time.

Note: N: normal beat; V: ventricular beat

11.7.3 Displaying Arrhythmia Information

You can display the arrhythmia information in the numeric area. To do so, follow this procedure:

1. Access **Tile Layout** by either of the following ways:
   - ◆ Select the **Screen Setup** quick key → select the **Tile Layout** tab.
   - ◆ Select **Main Menu** quick key → from the **Display** column select **Tile Layout**.
2. Click the numeric area where you want to display the arrhythmia information, and then select ECG → **Arrhythmia**.

11.7.4 Changing Arrhythmia Settings

11.7.4.1 Changing Arrhythmia Alarm Settings

To set the arrhythmia alarm properties, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** menu.
2. Select the **Arrhythmia** tab→ **Alarm** tab.
3. Enter the password if required. For more information, refer to *39.13 The Authorization Setup Settings*.
4. Set alarm properties as desired.

NOTE

- **You can switch off lethal arrhythmia alarms only when you have enabled Lethal Arrhys Off. For more information, see *11.7.4.2 Setting the Lethal Arrhythmia Alarms Switch*.**
- **The priority of lethal arrhythmia alarms is always high. It cannot be altered.**

11.7.4.2 Setting the Lethal Arrhythmia Alarms Switch

You can choose whether switching off lethal arrhythmia alarms is permissible or not. This function is password protected. For more information, see *39.4.6 The Other Tab*.

WARNING

- **If you switch off all arrhythmia alarms, the monitor will not alarm for any arrhythmia event. This may result in a hazard to the patient. Always keep the patient under close surveillance.**

NOTE

- **If any of the lethal arrhythmia alarms is switched off, the ECG waveform area displays the "Lethals Off" message.**

11.7.4.3 Changing Arrhythmia Alarm Threshold Settings

You can change threshold settings for some arrhythmia alarms. When an arrhythmia violates its threshold, an alarm will be triggered. To do so, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** menu.
2. Select the **Arrhythmia** tab → select the **Threshold** tab.
3. Enter the password if required. For more information, refer to *39.13 The Authorization Setup Settings*.
4. Set the threshold of desired arrhythmia alarms.

NOTE

- **The asystole delay time relates to ECG relearning. When heart rate is less than 30 bpm, it is recommended to set Asystole Delay to 10 sec.**

11.7.4.4 Arrhythmia Threshold Range

Arrhythmia	Threshold Range
Asystole Delay	3 s to 10 s
Tachy (HR High)	60 bpm to 295 bpm
Brady (HR Low)	16 bpm to 120 bpm

Arrhythmia	Threshold Range
Extreme Tachy	65 bpm to 300 bpm
Extreme Brady	15bpm to 115 bpm
Multif PVCs Window	3 beats to 31 beats
V-Tach Rate	100 bpm to 200 bpm
V-Brady Rate	15 bpm to 60 bpm
V-Tach PVCs	3 beats to 99 beats
V-Brady PVCs	3 beats to 99 beats
PVCs/min	1 to 100
Pauses/min	1 to 15
Pause Threshold	1.5s, 2.0s, 2.5s, 3.0s
AF/Irr Rhy End Time	0, 1 min, 2 min, 3 min, 4 min, 5 min, 10 min, 15 min, 30 min

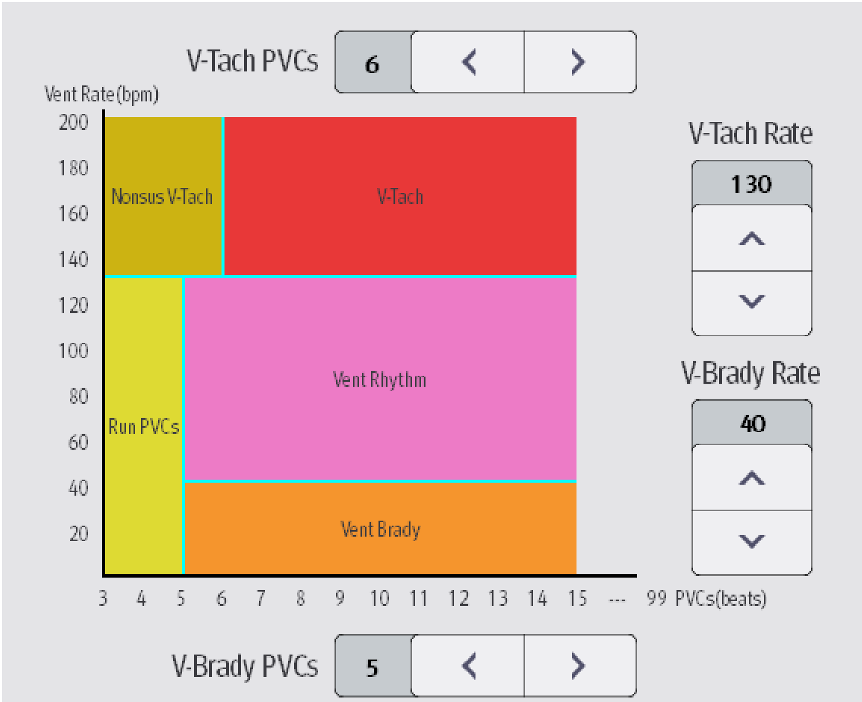
11.7.4.5 Setting Thresholds for PVC-Related Alarms

PVC-related alarms are detected on the basis of the current PVC rate and the number of consecutive PVCs.

To set the required thresholds for PVC-related alarms, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** menu.
2. Select the **Arrhythmia** tab → select the **More Threshold** tab.
3. Enter the password if required. For more information, refer to *39.13 The Authorization Setup Settings*.
4. Adjust **V-Tach PVCs**, **V-Tach Rate**, V-Brady PVCs, and V-Brady Rate to set the threshold of desired PVC-related alarms.

The following figure illustrates the conditions under which PVC alarms will be generated if **V-Tach PVCs** is set to 6, **V-Tach Rate** is set to 130, V-Brady PVCs is set to 5, and V-Brady Rate is set to 40.



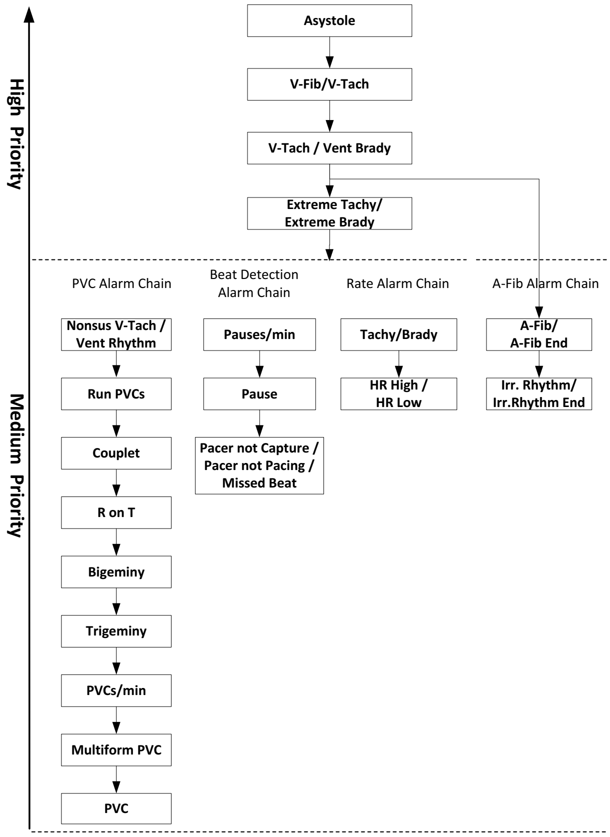
- If both V-Tach PVCs and V-Tach Rate are greater than or equal to the limits, a V-Tach alarm is generated.
- If the number of consecutive PVCs is lower than the V-Tach PVCs limit (6) but greater than 2, and PVC rate is greater or equal to the V-Tach Rate limit (130), a Nonsus V-Tach alarm is generated.
- If the number of consecutive PVCs is greater than or equal to the V-Brady PVCs limit (5), and PVC rate is lower than the V Brady limit (40), a Vent Brady alarm is generated.
- If both the V-Brady PVCs and V-Brady Rate are lower than the limits, but V-Brady PVCs is greater than 2, a Run PVCs alarm is generated.
- If the V-Brady PVCs and V-Brady Rate are greater than or equal to limits, but the Vent rate is is lower than V-Tach Rate (130), a Vent Rhythm alarm is generated.

11.7.5 Arrhythmia Alarms Timeout

Normally, an arrhythmia alarm is presented when an alarm condition is detected. However, there are certain situations that can inhibit audible and visible alarm indications even though an alarm condition was detected. For more information, see *11.7.5.1 Arrhythmia Alarm Chains* and *11.7.5.2 Setting Arrhythmia Alarm Timeout Period*.

11.7.5.1 Arrhythmia Alarm Chains

If multiple alarms overlap, announcing all of the detected alarm conditions would be confusing, and a more serious condition might be overlooked. So arrhythmia alarms are prioritized by alarm "chains".



11.7.5.2 Setting Arrhythmia Alarm Timeout Period

The arrhythmia algorithm can disable alarm light and alarm tone for designated period of time when certain arrhythmia alarms are detected.

This function is password protected. For more information, see *C.4.6 The Other Tab*.

NOTE

- **For the following alarms, alarm light and alarm tone cannot be disabled: HR high, HR low, Tachycardia, Bradycardia, Afib End, Irr. Rhythm End.**
- **The timeout period is only applicable to the alarms in the medium priority chains and atrial fibrillation chain. For the alarms in the high priority chain, alarm tone and alarm light are presented as soon as the alarm condition is detected.**
- **Alarm indication rules for alarms in the atrial fibrillation chain are the same with those for the medium priority chains.**

11.7.5.3 Arrhythmia Alarm Timeout Rules

The following table explains how auidble and visual alarm indicate during arrhythmia alarm timeout.

Previous alarm	Current alarm	Alarm indication
Alarm in high priority chain	Alarm in high priority chain	Alarm light and alarm tone
	Alarm in medium priority chain	During timeout period, alarm light and alarm tone are disabled. When the timeout period is reached, alarm light and alarm tone are reactivated.
Alarm in medium priority chain	Alarm in high priority chain	Alarm light and alarm tone
	Alarm in the same medium priority chain, but with higher priority	Alarm light and alarm tone
	The same alarm reoccurs	During timeout period, alarm light and alarm tone are disabled. When the timeout period is reached, alarm light and alarm tone are reactivated.
	Alarm in the same medium priority chain, but with lower priority	During timeout period, alarm light and alarm tone are disabled. When the timeout period is reached, alarm light and alarm tone are reactivated.
	Alarm in other medium priority chain	Alarm light and alarm tone

11.8 ST Segment Monitoring

ST monitoring is intended for adult, pediatric and neonatal patient.

11.8.1 ST Safety Information

WARNING

- **ST values may be affected by such factors as some drugs or metabolic and conduction disturbances.**
- **ST deviation is often calculated at a fixed offset from the J point. Changes in heart rate may affect ST.**
- **The ST deviation measurement algorithm has been tested for accuracy. The significance of ST segment changes needs to be determined by a physician.**
- **This monitor provides ST deviation level change information. The clinical significance of the ST level change information should be determined by a physician.**

11.8.2 Enabling ST Monitoring

The ST monitoring function is disabled by default. Before you start ST monitoring, enable the ST function. To do so, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** menu.
2. Select the **ST** tab→ select the **Setup** tab.
3. Switch on **ST Analysis**.

Reliable ST monitoring cannot be ensured under the following situations:

- You are unable to get a lead that is not noisy.
- Arrhythmias, such as atrial fib or flutter, cause irregular baseline.
- The patient is continuously ventricularly paced.
- The patient has left bundle branch block.

In these cases, you may consider switching off ST monitoring.

11.8.3 Displaying ST Numerics

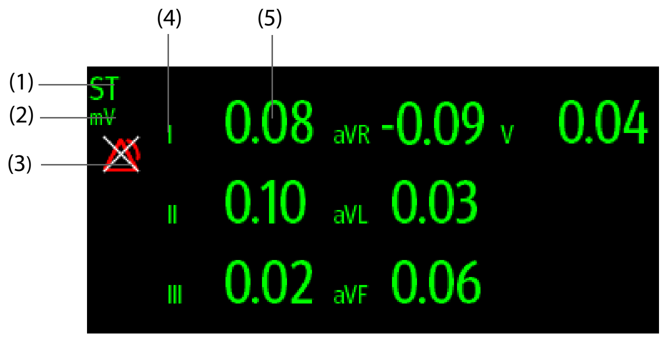
To display ST numerics and Segments, follow this procedure:

1. Access **Tile Layout** by either of the following ways:
   - Select the **Screen Setup** quick key → select the **Tile Layout** tab.
   - Select **Main Menu** quick key → from the **Display** column select **Tile Layout**.
2. Click the numeric area where you want to display the ST numerics, and then select **ECG** → **ST**.

The display of ST parameters area is different according to the lead type:

- When you are using the 3-lead ECG leadwires, the ST numeric area does not display. A ST value displays in the ECG numeric area.
- When you are using the 5-lead ECG leadwires, the ST numeric area displays 7 ST values: ST-I, ST-II, ST-III, ST-aVR, ST-aVL, ST-aVF, ST-V.
- When you are using the 6-lead ECG leadwires, the ST numeric area displays 8 ST values: ST-I, ST-II, ST-III, ST-aVR, ST-aVL, ST-aVF, ST-Va, ST-Vb.
- When you are using the 6-lead ECG placement to derive 12-lead ECG (D12L), the ST numeric area displays 12 ST values: ST-I, ST-II, ST-III, ST-aVR, ST-aVL, ST-aVF, ST-V1, ST-V2, ST-V3, ST-V4, ST-V5, ST-V6, in which two chest leads are directly measured and four are derived. The derived leads are marked with a "d" in front of the lead label, for example "dV1".
- When you are using the 12-lead ECG leadwires, the ST numeric area displays12 ST values: ST-I, ST-II, ST-III, ST-aVR, ST-aVL, ST-aVF, ST-V1, ST-V2, ST-V3, ST-V4, ST-V5, ST-V6.

This example shows the ST numeric area when 5-lead ECG cable is used. Your monitor screen may look slightly different:



(1) Parameter label. When 6-lead placement is used to derive 12-lead ECG (D12L), all derived leads are marked with a "d" in front of the lead label, for example "dV1".

(2) ST unit (3) ST alarm off symbol (4) Lead labels

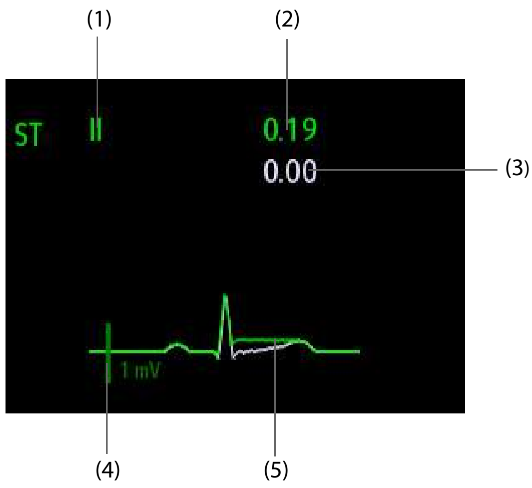
(5) ST numerics: a positive value indicates ST segment elevation, and a negative value indicates ST segment depression.

11.8.4 Displaying ST Segments in the Waveform Area

You can display ST segments in the waveform area. To do so, follow this procedure:

1. Access **Tile Layout** by either of the following ways:
   - Select the **Screen Setup** quick key → select the **Tile Layout** tab.
   - Select **Main Menu** quick key → from the **Display** column select **Tile Layout**.
2. Select the waveform area where you want to display the ST segments, and then select **ST**→ **ST Segment**.

The waveform area displays the current and baseline ST segments. It also displays the current and baseline ST values. In the following picture, the current ST segment and value are in green, while the baseline ST segment and value are in white.



(1) ST lead (2) Current ST value

(3) Baseline ST value (4) 1 mV scale

(5) Current ST segment (green) and baseline ST segment (white)

11.8.5 Entering the ST View

The ST View shows a complete QRS segment for each ST lead. The color of current ST segments and ST values is consistent with the color of ECG waveforms, normally green. The color of baseline ST segments and ST values is white.

You can enter the ST view either by selecting the ST segment in the waveform area or by the following ways:

1. Select the ST numeric area, ECG numeric area, or ECG waveform area to enter the **ECG** menu.
2. Select the **ST** tab.
3. From the bottom of the menu, select **ST View**.

NOTE

- **In the ST view, the derived leads are marked with a "d" in front of the lead label, for example "dV1".**

11.8.6 Saving the Current ST as Baseline

ST deviation is typically monitored as a relative change from a baseline value. Set an ST baseline when ST values become stable. If you did not set the ST baseline, the monitor automatically saves the baseline when valid ST values appear for 5 minutes. To set the ST baseline, follow this procedure:

1. From the **ST View** window, select **Set Baseline**.
2. From the pop-up dialog box, select **Ok** to set the current ST segments and values as the baseline.

From the **ST View** window, you can also perform the following operations:

- Display or hide ST baseline by selecting **Display Baseline** or **Hide Baseline**.
- Display or hide the position of ISO point, J point and ST point by selecting **Display Marker** or **Hide Marker**.

CAUTION

- **Updating ST baseline affects ST alarms.**

NOTE

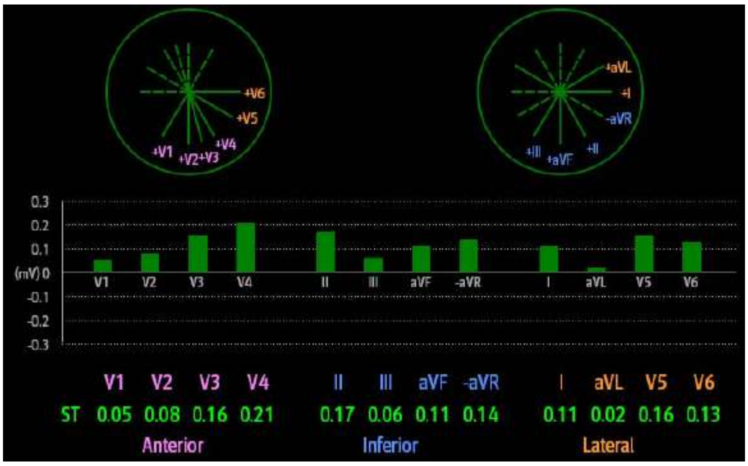
- **If you set the ST baseline with D12L enabled, the baseline time is followed by "(D12L)", for example "Baseline 2017-04-06 20:30 (D12L) ".**

11.8.7 Entering the ST Graphic Window

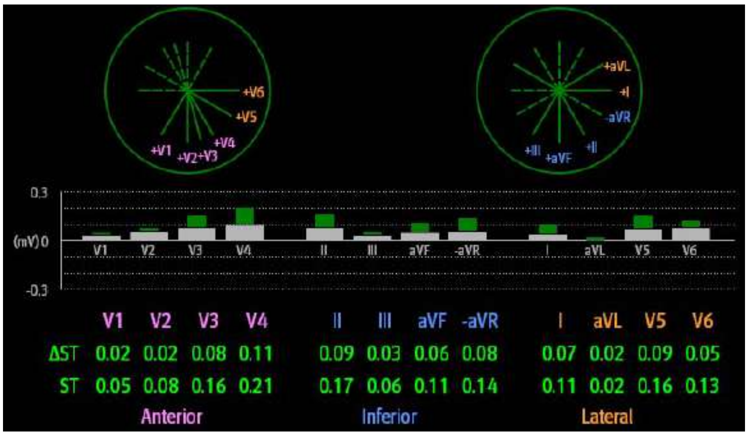
To display **ST Graphic** window, follow this procedure:

1. Select ST numeric area, ECG numeric area, or ECG waveform area to enter the **ECG** menu.
2. Select the **ST** tab.
3. From the bottom of the menu, select **ST Graphic**.

The following figure shows the ST Graphic when **ST Alarm Mode** is set to **Absolute**. The height of the bar indicates the ST value of corresponding ST lead. The color of the bar indicates ST alarm status: green indicates that corresponding ST value is within alarm limits; cyan, yellow and red indicate that the ST value exceeds the alarm limits. The color matches ST alarm priority.



The following figure shows the ST Graphic when **ST Alarm Mode** is set to **Relative**. The height of grey bar indicates the baseline ST value and the green bar (cyan, yellow or red if an alarm occurs) indicates ΔST.



NOTE

- **In the ST Graphic, the derived leads are marked with a "d" in front of the lead label, for example "dV1".**

11.8.8 Changing ST Settings

11.8.8.1 Setting ST Alarm Properties

To set ST alarm properties, follow this procedure:

1. Select the ST numeric area, ECG numeric area, or ECG waveform area to enter the **ECG** menu.
2. Select the **ST** tab→ **Alarm** tab.
3. Set **ST Alarm Mode** to **Absolute** or **Relative**.

- ◆ **Absolute**: you can separately set the alarm properties for each ST alarm.
- ◆ **Relative**: you can set the alarm properties for **ST Single** and **ST Dual** alarms.

4. Set ST alarm properties.

11.8.8.2 Changing Leads for ST Display

The monitor automatically selects the three most deviated leads for ST display. You can also manually select the leads. To do so, follow this procedure:

1. Select the ST numeric area, ECG numeric area, or ECG waveform area to enter the **ECG** menu.
2. Select the **ST** tab → select the **Setup** tab.
3. Set **ST Segment**. You can select up to 3 leads.

11.8.8.3 Showing ISO Point, J Point, and ST Point Marks

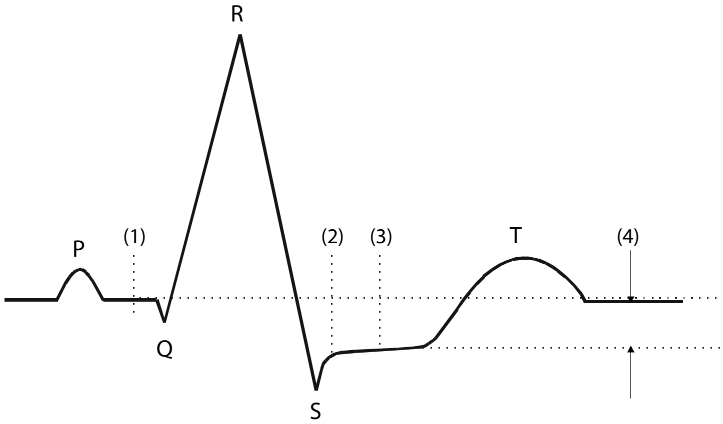
In the waveform area, the ISO point, J point, and ST point mark do not display on the ST segments by default. To show these marks, follow this procedure:

1. Select the ST numeric area, ECG numeric area, or ECG waveform area to enter the **ECG** menu.
2. Select the **ST** tab→ select the **Setup** tab.
3. Switch on **Show Markers**.

11.8.9 Adjusting ST Measurement Points

11.8.9.1 About ST Point, ISO Point, and J Point

The ST deviation value for each beat is the potential difference between the isoelectric (ISO) point and the ST point. The ISO point provides the baseline. The ST point is at the midpoint of the ST segment. The J point is the end of the QRS complex. As the J point is a fixed distance away from the ST point, it can be useful to help you correctly position the ST point.



(1) ISO point (2) J point (3) ST point (4) ST deviation

11.8.9.2 Setting ST Point, ISO Point, and J Point

CAUTION

- **You need to adjust the ST points before starting monitoring, or if the patient's heart rate or ECG morphology changes significantly, as this may affect the size of the QT interval and thus the placement of the ST point. Artifactual ST segment depression or elevation may occur if the isoelectric point or the ST point is incorrectly set.**
- **Always make sure that the positions of ST points are appropriate for your patient.**

To set ST point, ISO point, and J point, follow this procedure:

1. Select the ST numeric area, ECG numeric area, or ECG waveform area to enter the **ECG** menu.
2. Select the **ST** tab→ select the **Adjust** tab.
3. Set **ST Point**.

The setting of **Auto Adjust** defines the method of adjusting the ISO point and J point. **Auto Adjust** is enabled by default. In this case, positions of ISO point and J point are automatically adjusted accordingly. If you disable when **Auto Adjust**, you need to manually adjust the position of ISO point and J point by selecting the arrows at the right sides of **ISO** and **J**.

- The ISO point (isoelectric) position is given relative to the R-wave peak. Position the ISO point in the middle of the flattest part of the baseline (between the P and Q waves).
- The J point position is given relative to the R-wave peak and helps locating the ST point. Position the J point at the end of the QRS complex and the beginning of the ST segment.
- The ST point is positioned a fixed distance from the J point. Move the J point to position the ST point at the midpoint of the ST segment. Position the ST point relative to the J point at **J+60/80ms**, **J+40ms**, **J+60ms** or **J+80ms**. When **J+60/80ms** is selected, the ST point will be positioned 80 ms (heart rate 120 bpm or less) or 60 ms (heart rate more than 120 bpm) from the J point.

11.9 QT/QTc Interval Monitoring

The QT interval is defined as the time between the beginning of the Q-wave and the end of the T-wave. It measures the total duration of ventricular depolarization (QRS duration) and repolarization (ST-T). QT interval monitoring can assist in the detection of long QT syndrome.

The QT interval has an inverse relationship to heart rate. Faster heart rates shorten the QT interval and slower heart rates prolong the QT interval. Therefore, several formulas can be used to correct the QT interval for heart rate. The heart rate corrected QT interval is abbreviated as QTc.

QT/QTc interval monitoring is intended for adult, pediatric, and neonatal patients.

11.9.1 QT/QTc Monitoring Limitations

Some conditions may make it difficult to achieve reliable QT/QTc monitoring, for example:

- R-wave amplitudes are too low
- The presence of frequent ventricular ectopic beats
- Unstable RR intervals
- P-waves tending to encroach on the end of the previous T-wave at high heart rates
- The T-wave is very flat or T-wave are not well defined
- The end of the T-wave is difficult to delineate because of the presence of U-waves
- QTc measurements are not stable
- In the presence of noise, asystole, ventricular fibrillation, atrial fibrillation, and ECG lead off

For these cases you should select a lead with good T-wave amplitude and no visible flutter activity, and without a predominant U-wave or P-wave.

Some conditions such as left or right bundle branch block or hypertrophy can lead to a widened QRS complex. If a long QTc is observed you should verify it to ensure that it is not caused by QRS widening.

Because normal beats followed by ventricular beats are not included in the analysis, no QT measurement will be generated in the presence of a bigeminy rhythm.

If the heart rate is extremely high (over 150bpm for adults and over 180bpm for pediatrics and neonates), QT will not be measured. When the heart rate changes, it can take several minutes for the QT interval to stabilize. For reliable QTc calculation it is important to avoid measurements when the heart rate is changing.

11.9.2 Enabling QT/QTc Monitoring

The QT monitoring function is disabled by default. Before you start QT monitoring, enable the QT function. To do so, follow this procedure:

1. Select the QT numerics area, ECG numeric area, or waveform area to enter the **ECG** menu.
2. Select the **QT** tab→ select the **Setup** tab.
3. Switch on **QT Analysis**.

11.9.3 Displaying QT/QTc Numerics and Segments

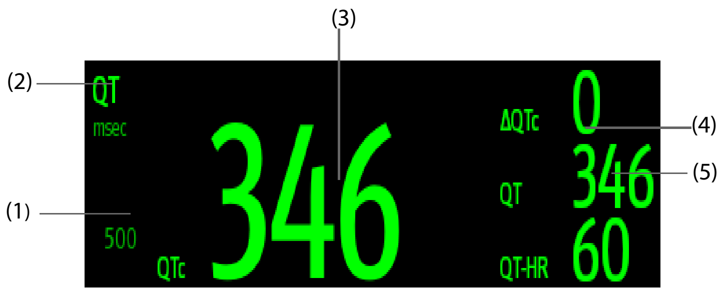
To display QT/QTc numerics and Segments, follow this procedure:

1. Access **Tile Layout** by either of the following ways:
   - Select the **Screen Setup** quick key → select the **Tile Layout** tab.
   - Select **Main Menu** quick key → from the **Display** column select **Tile Layout**.
2. Click the parameter numeric area where you want to display the QT numerics, and then select **ECG** → **QT/ QTc**.

NOTE

- **QTc values are calculated based on the QT-HR, not the ECG HR. For more information, see *11.9.4 Entering the QT View*.**

The following picture shows the QT numeric area. Your monitor screen may look slightly different:



(1) QTc alarm limit (if QTc alarm is off, the alarm off symbol is displayed)

(2) Parameter label

(3) QTc value

(4) ΔQTc value (the difference between the current and baseline QTc values)

(5) QT value

NOTE

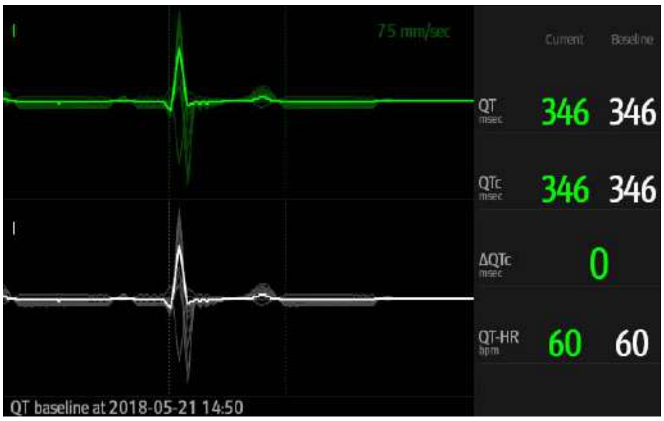
- **The display of the QT numeric area differs as related settings change.**

11.9.4 Entering the QT View

QT View shows the current and baseline QT parameter values and waveforms. To enter the QT View, follow this procedure:

1. Select the QT numerics area, ECG numeric area, or waveform area to enter the **ECG** menu.
2. Select the **QT** tab.
3. From the bottom of the menu, select **QT View**.

The following picture shows the QT view.



■ The current waveform is shown in the upper half in green.

■ The baseline waveform is shown below in white.

■ The start of QRS complex and the end of the T wave are marked with a vertical line.

■ In some conditions, no QT measurement can be calculated. Then the cause of failed QT measurement is shown at the bottom of the QT numerics area and the message "Cannot Analyze QT" is shown in the technical alarm area.

Select the left or right arrow to switch leads. Corresponding waveform will be highlighted.

NOTE

- **In the QT view, the derived leads are marked with a "d" in front of the lead label, for example "dV1".**

11.9.5 Saving the Current QTc as Baseline

In order to quantify changes in the QTc value, you can set a QTc baseline. If no baseline has been set for this patient within the first five minutes after getting valid QT values, the monitor will automatically set a baseline. To set the current values as baseline, follow this procedure:

1. From the **QT View** window, select **Set Baseline**.
2. From the pop-up dialog box, select **Ok**. This baseline will then be used to calculate ΔQTc.

If you set a new baseline the previous baseline is discarded.

From the **QT View** window, you can also perform the following operations:

- Select the left or right arrow to select a lead label to highlight corresponding waveform.
- Select **Display Baseline** or **Hide Baseline** to display or hide baseline waveform.

CAUTION

- **Updating QTc baseline affects ΔQTc value and alarm.**

11.9.6 Changing QT Settings

11.9.6.1 Setting QT Alarm Properties

To set QT alarm properties, follow this procedure:

1. Select the QT numerics area, ECG numeric area, or ECG waveform area to enter the **ECG** menu.
2. Select the **QT** tab→ select the **Alarm** tab.
3. Set QTc and ΔQTc alarm properties.

11.9.6.2 Selecting Leads for QT Calculation

You can select one lead or all leads for QT calculation. To do so, follow this procedure:

1. Select the QT numerics area, ECG numeric area, or ECG waveform area to enter the **ECG** menu.
2. Select the **QT** tab→ select the **Setup** tab.
3. Set **QT Leads**. **All** is selected by default. This means all leads are used for QT calculation.

11.10 ECG Relearning

Changes in ECG template could result in incorrect arrhythmia alarms and/or inaccurate heart rate. ECG relearning allows the monitor to learn new ECG template so as to correct arrhythmia alarms and HR value. Once learning is complete, the dominant QRS complex is stored as a reference template. The reference template is used as a normal morphology of that patient and it is compared with incoming beats to identify possible arrhythmias.

11.10.1 Auto ECG Relearning

Auto arrhythmia relearning happens in the following situation:

- The ECG lead type or lead label is changed.
- ECG leads are off and are not reconnected within 60 seconds.
- The patient's paced status is changed.

11.10.2 Initiating an ECG Relearning Manually

If you suspect that abnormal arrhythmia alarms are presented, you may need to manually initiate an ECG relearning. To do so , follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** menu.

2. Select **Relearn** at the bottom left corner of the menu.

CAUTION

- **Take care to initiate ECG relearning only during periods of predominantly normal rhythm and when ECG signal is relatively noise-free. If ECG learning takes place during arrhythmia, the ectopics may be incorrectly learned as normal QRS complex. This may result in missed detection of subsequent events of arrhythmia.**

11.11 Calibrating ECG

The ECG signal may be inaccurate due to hardware or software problems. As a result, the ECG waveform amplitude becomes greater or smaller. In that case, you need to calibrate the ECG module. For more information, see *39.6.1 The ECG Tab*.

11.12 Defibrillation Synchronization Pulse Output

The MPM module provides an analog out connector to output defibrillation synchronization pulse. If a defibrillator is connected, it receives a synchronization pulse (100 ms, +5 V) through the analog out connector each time an R-wave is detected.

WARNING

- **Improper use of a defibrillator may cause injury to the patient. The operator should determine whether to perform defibrillation or not according to the patient's condition.**
- **According to AAMI specifications the peak of the synchronized defibrillator discharge should be delivered within 60 ms of the peak of the R wave. The signal at the ECG output (sync pulse) on the monitor is delayed by maximum of 30 ms. Your biomedical engineer should verify that your ECG/ Defibrillator combination does not exceed recommended maximum delay of 60 ms.**
- **Before defibrillation, the user must ensure both defibrillator and monitor has passed the system test and can be safely used together.**

11.13 ECG Troubleshooting

This section lists the problems that might occur. If you encounter problems when using the monitor or accessories, check the table below before requesting for services. If the problem persists after you have taken corrective actions, contact your service personnel.

Problem	Corrective Actions
Noisy ECG traces	1. Check that electrodes are not detached or dry. Replace with fresh and moist electrodes if necessary. 2. Check that leadwires are not defective. Replace leadwires if necessary. 3. Check that patient cable or leadwires are routed too close to other electrical devices. Move the patient cable or leadwires away from electrical devices.
Excessive electrosurgical Interference	Use ESU-proof ECG cables. For more information, see *43.1 ECG Accessories*.
Muscle Noise	Inadequate skin preparation, tremors, tense subject, and/or poor electrode placement. 1. Perform skin preparation again and re-place the electrodes. For more information, see *11.4.1 Preparing the Patient Skin* and *11.4.2 Applying Electrodes*. 2. Apply fresh, moist electrodes. Avoid muscular areas.

Problem	Corrective Actions
Intermittent Signal	1. Check that cables are properly connected. 2. Check that electrodes are not detached or dry. Perform skin preparation again as described in *11.4.1 Preparing the Patient Skin* and apply fresh and moist electrodes. 3. Check that the patient cable or leadwires are not damaged. Change them if necessary.
Excessive alarms: heart rate, lead fault	1. Check that electrodes are not dry. Perform skin preparation again and re-place the electrodes. For more information, see *11.4.1 Preparing the Patient Skin* and *11.4.2 Applying Electrodes*. 2. Check for excessive patient movement or muscle tremor. Reposition the electrodes. Replace with fresh and moist electrodes if necessary.
Low Amplitude ECG Signal	1. Check that the ECG gain is not set too low. Adjust the gain as required. For more information, see *11.6 Changing ECG Settings*. 2. Perform skin preparation again and re-place the electrodes. For more information, see *11.4.1 Preparing the Patient Skin* and *11.4.2 Applying Electrodes*. 3. Check electrode application sites. Avoid bone or muscular area. 4. Check that electrodes are not dry or used for a prolonged time. Replace with fresh and moist electrodes if necessary.
No ECG Waveform	1. Check that the ECG gain is not set too low. Adjust the gain as required. For more information, see *11.6.3 Setting the Analysis Mode*. 2. Check that the leadwires and patient cables are properly connected. 3. Change cable and lead wires. 4. Check that the patient cable or leadwires are not damaged. Change them if necessary.
Base Line Wander	1. Check for excessive patient movement or muscle tremor. Secure leadwires and cable. 2. Check that electrodes are not detached or dry and replace with fresh and moist electrodes if necessary. For more information, see *11.4.1 Preparing the Patient Skin* and *11.4.2 Applying Electrodes*. 3. Check for ECG filter setting. Set ECG Filter mode to **Monitor** to reduce baseline wander on the display.

12 Resting 12-Lead ECG Analysis

12.1 Resting 12-Lead ECG Analysis Introduction

The monitor can be configured with either Glasgow 12-lead ECG analysis algorithm or Mindray 12-lead ECG analysis algorithm.

The Glasgow algorithm is intended for adult, pediatric, and neonatal patients. The Mindray algorithm is intended for adult patients only.

The MPM module providing the 12-lead ECG analysis function has a 12-lead label. The MPM module incorporating the Glasgow algorithm is labelled with the logo of Glasgow.

For more information on the Glasgow algorithm, refer to *12-Lead ECG Interpretive Program Physician's Guide (PN: 046-004817-00)* for detail.

12.2 Entering the 12-Lead Screen

To enter the 12-Lead screen, follow this procedure:

1. Select the ECG numeric area or waveform area to enter the **ECG** menu.
2. From the bottom of the **ECG** menu, select **12-Lead**.

You can also enter the 12-Lead screen by following this procedure:

- Select the **Screen Setup** quick key → select **ECG 12-Lead**.
- Select **Main Menu** quick key → from the **Display** column select **Choose Screen** → select **ECG 12-Lead**.

12.3 Initiating Resting 12-Lead ECG Analysis

Before 12-lead ECG interpretation, check that all electrodes are correctly connected to the lead wires and the ECG trunk cable is properly connected. Check that patient information is correct. Keep the patient still.

To initiate 12-Lead ECG analysis, select **Analyze** from the left bottom of the 12-Lead screen.

12.4 Changing 12-Lead ECG Analysis Settings

On the ECG 12-Lead screen, you can set the high frequency filter, baseline drift removal (BDR) switch, and the waveform layout.

12.4.1 Setting the High Frequency Filter

The high frequency filter attenuates muscle artifact by restricting the included frequencies. The setting of the high frequency filter is 35 Hz by default. To change the setting, follow this procedure:

1. On the ECG 12-Lead screen, select the ECG numeric area or waveform area to enter the **ECG** menu.
2. Select the **Setup** tab.
3. Set **High Freq Cut-off**.

The high frequency filter is a low-pass filter. That is to say signal that exceeds the set frequency is filtered out. For example, if you set **High Freq Cut-off** to **35 Hz**, only signal at 35 Hz or less displays. Signal exceeding 35 Hz is attenuated.

12.4.2 Setting the Baseline Drift Removal

The baseline drift removal (BDR) suppresses most baseline drift interference and also is able to preserve the fidelity of the ST-segment level. BDR is switched on by default. To set the BDR, follow this procedure:

1. On the ECG 12-Lead screen, select the ECG numeric area or waveform area to enter the **ECG** menu.
2. Select the **Setup** tab.
3. Switch on or off **Baseline Drift Removal**. If BDR is switched off, the 0.05 Hz high pass filter is used.

NOTE

- **BDR introduces around 1-second delay. We recommend using BDR except when the delay is unacceptable.**

12.5 Glasgow Resting 12-lead ECG Analysis Algorithm Settings

For the Glasgow algorithm, besides filter mode, BDR, and waveform layout, you can also perform the following operation:

- Editing patient information
- Changing tachycardia and bradycardia thresholds.
- Setting the 12-lead ECG report

12.5.1 Editing Patient Information (For Glasgow Algorithms)

Some patient information may directly affect ECG analysis. Complete and correct patient information is helpful for accurate diagnosis and treatment of the patient. Enter patient information before taking an ECG measurement.

To enter patient information, follow this procedure:

1. On the ECG 12-Lead screen, select **Setup** to enter the **12-Lead Setup** menu.
2. On the **Patient Demographics** page, input or edit patient information.

NOTE

- **Check that patient information is correct before resting 12-lead analysis.**
- **We recommend using pediatric lead placement V4R, V1, V2, V4 - V6 if the patient is under 16 years of age. Please record V4R using the V3 electrode. Also set V3 Electrode to V4R. This is a normal practice for a patient of this age.**

12.5.2 Setting Tachycardia and Bradycardia Thresholds (For Glasgow Algorithms)

To set tachycardia and bradycardia thresholds, follow this procedure:

1. On the ECG 12-Lead screen, select **Setup** to enter the **12-Lead Setup** menu.
2. Select the **Setup** tab.
3. Set **Tachy** and **Brady**.

NOTE

- **The tachycardia threshold only applies to patients whose age exceeds 180 days.**
- **The bradycardia threshold only applies to patients whose age exceeds 2191 days.**

12.5.3 Setting the 12-Lead Interpretation Report (For Glasgow Algorithms)

To set the 12-lead interpretation report, follow this procedure:

1. On the ECG 12-Lead screen, select **Setup** to enter the **12-Lead Setup** menu.
2. Select the **Report** tab.
3. Set the format and items included in the 12-lead interpretation report.

12.6 Saving the 12-Lead Interpretation Report

At the completion of 12-lead ECG interpretation, select **Save** to save the report. You can review the saved 12-lead interpretation reports. For more information, see *32.2.10 12-Lead ECG Review Page*.

12.7 Printing the 12-Lead Interpretation Report

At the completion of 12-lead ECG interpretation, select **Print** or **Record** to output the report via the printer or recorder.

12.8 Exiting the ECG 12-Lead Screen

To exit the ECG 12-Lead screen, select **Exit** on the ECG 12-Lead screen.

This page intentionally left blank.

13 Monitoring Respiration (Resp)

13.1 Resp Introduction

Impedance respiration is measured across the thorax. When the patient is breathing or ventilated, the volume of air changes in the lungs, resulting in impedance changes between the electrodes. Respiration rate (RR) is calculated from these impedance changes, and a respiration waveform appears on the patient monitor screen.

Respiration monitoring is intended for adult, pediatric and neonatal patients.

13.2 Resp Safety Information

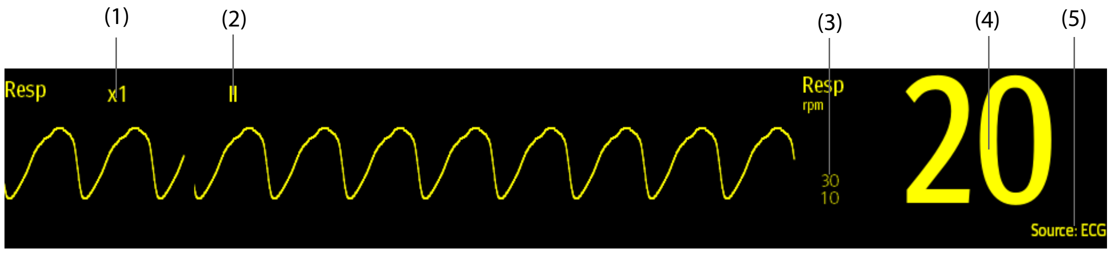
WARNING

- **When monitoring the patient's respiration, do not use ESU-proof ECG cables.**
- **If you do not set the detection level for the respiration correctly in manual detection mode, it may not be possible for the monitor to detect apnea. If you set the detection level too low, the monitor is more likely to detect cardiac activity, and to falsely interpret cardiac activity as respiratory activity in the case of apnea.**
- **The respiration measurement does not recognize the cause of apneas. It only indicates an alarm if no breath is detected when a pre-adjusted time has elapsed since the last detected breath. Therefore, it cannot be used for diagnostic purpose.**
- **If operating under conditions according to the EMC Standard IEC 60601-1-2 (Radiated Immunity 3V/m), field strengths above 3V/m may cause erroneous measurements at various frequencies. Therefore, it is recommended to avoid the use of electrically radiating equipment in close proximity to the respiration measurement unit.**
- **The impedance respiration measurement may cause rate changes in Minute Ventilation Rate Responsive Pacemakers. Set the pacemaker rate responsive mode off or disable the impedance respiration measurement on the monitor.**
- **When using the electrosurgery unit, ensure proper contact of the ESU return electrode to the patient to avoid burns at monitor measurement sites. Also ensure that the ESU return electrode is near the operating area.**

CAUTION

- **Only use parts and accessories specified in this manual.**
- **Respiration monitoring is not for use on the patients who are very active, as this will cause false alarms.**

13.3 Resp Display



(1) Resp waveform gain
(2) Resp lead label
(3) Alarm limits
(4) Respiration rate (RR)
(5) RR source

NOTE

- **If ESU-proof ECG cables are used, the Resp waveform area will display the message "Check Leads". Replace the ECG cable if necessary.**

13.4 Preparing for Resp Monitoring

13.4.1 Preparing the Patient

Follow this procedure to prepare the patient:

1. Shave hair from skin at chosen sites.
2. Gently rub skin surface at sites to remove dead skin cells.
3. Thoroughly cleanse the site with a mild soap and water solution.
4. Dry the skin completely before applying the electrodes.

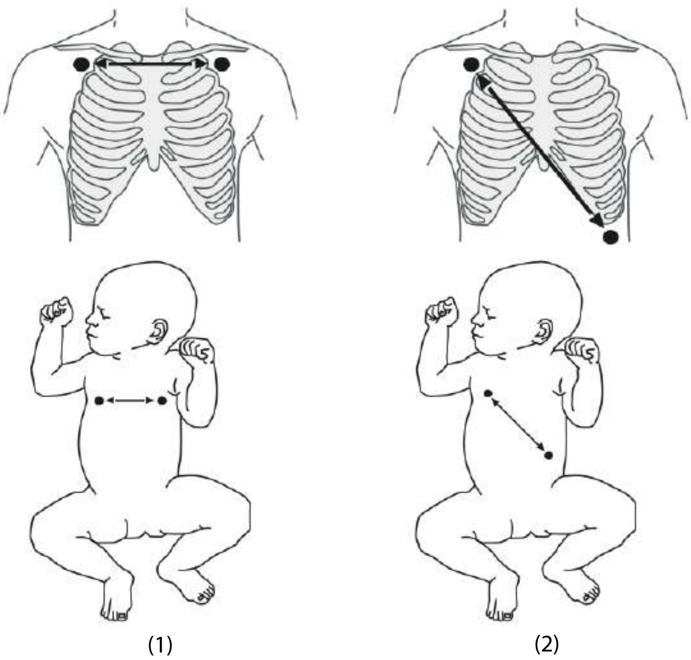
CAUTION

- **Proper skin preparation is necessary for good signal quality at the electrode site, as the skin is a poor conductor of electricity.**

13.4.2 Placing the Electrodes

As the Respiration measurement adopts the standard ECG electrode placement, you can use different ECG cables. Since the respiration signal is measured between two ECG electrodes, if a standard ECG electrode placement is applied, the two electrodes should be RA and LA of ECG Lead I, or RA and LL of ECG Lead II.

For more information, see *11.4.4 ECG Electrode Placements*.



(1) Lead I (2) Lead II

CAUTION

- **Correct electrodes placement can help to reduce cardiac overlay: avoid the liver area and the ventricles of the heart in the line between the respiratory electrodes. This is particularly important for neonates.**
- **Some patients with restricted movements breathe mainly abdominally. In these cases, you may need to place the left leg electrode on the left abdomen at the point of maximum abdominal expansion to optimize the respiratory wave.**
- **In clinical applications, some patients (especially neonates) expand their chests laterally, causing a negative intrathoracic pressure. In these cases, it is better to place the two respiration electrodes in the right midaxillary and the left lateral chest areas at the patient's maximum point of the breathing movement to optimize the respiratory waveform.**
- **To optimize the respiration waveform, place the RA and LA electrodes horizontally when monitoring respiration with ECG Lead I; place the RA and LL electrodes diagonally when monitoring respiration with ECG Lead II.**
- **Periodically inspect the electrode application site to ensure skin quality. If the skin quality changes, replace the electrodes or change the application site.**

NOTE

- **Store the electrodes at room temperature. Open the electrode package immediately prior to use.**
- **Check that the electrode packages are intact and not expired. Make sure the electrode gel is moist.**

13.5 Changing Resp Settings

13.5.1 Setting the Resp Alarm Properties

To set the Resp alarm properties, follow this procedure:

1. Select the Resp numeric area or waveform area to enter the **Resp** menu.
2. Select the **Alarm** tab.
3. Enter the password if required.
   - Set alarm properties as desired.

NOTE

- **You can switch off the apnea alarm only when Apnea Alarm Off is enabled.**

13.5.2 Setting the RR Source

To set RR source, follow this procedure:

1. Select the Resp numeric area or waveform area to enter the **Resp** menu.
2. Select the **Setup** tab.
3. Choose **RR Source** from the dropdown list.

When you select **Auto**, the system automatically selects the RR source according to the priority. The priority of RR source is first CO_2, and then RM, and finally ECG. When the current RR source does not have valid measurement, the system automatically switches the **RR Source** to **Auto**.

13.5.3 Choosing the Respiration Lead

To set the respiration lead, follow this procedure:

1. Select the Resp numeric area or waveform area to enter the **Resp** menu.
2. Select the **Setup** tab.
3. Set **Resp Lead**.

If you cannot get optimal Resp waveform or you suspect the Resp value after choosing the Resp lead, you may need to optimize the electrode placement.

13.5.4 Setting the Resp Waveform Size

To set the Resp waveform size, follow this procedure:

1. Select the Resp numeric area or waveform area to enter the **Resp** menu.
2. Select the **Setup** tab.
3. Set **Gain**.

13.5.5 Setting the Resp Waveform Speed

To set the Resp waveform speed, follow this procedure:

1. Select the Resp numeric area or waveform area to enter the **Resp** menu.
2. Select the **Setup** tab.
3. Set **Speed**.

13.5.6 Setting the Auto Detection Switch

To set the auto detection switch, follow this procedure:

1. Select the Resp numeric area or waveform area to enter the **Resp** menu.
2. Select the **Setup** tab.
3. Switch on or off **Auto Threshold Detection**.
   - If **Auto Threshold Detection** is switched on, the monitor automatically adjusts the Resp waveform detection level, or threshold.
   - If **Auto Threshold Detection** is switched off, you have to manually adjusts the Resp waveform threshold. For more information, see *13.5.7 Adjusting the Resp Waveform Detection Threshold*.

In the auto detection mode, if you are monitoring Resp and ECG is switched off, the monitor cannot compare the ECG and Resp rates to detect cardiac overlay. The respiration detection level is automatically set higher to prevent the detection of cardiac overlay as respiration.

In the manual detection mode, cardiac overlay can in certain situations trigger the respiration counter. This may lead to a false indication of a high respiration or an undetected apnea condition. If you suspect that cardiac overlay is being registered as breathing activity, raise the detection level above the zone of cardiac overlay. If the Resp wave is so small that raising the detection level is not possible, you may need to optimize the electrode placement.

13.5.7 Adjusting the Resp Waveform Detection Threshold

Use the manual detection mode in the following situations:

- The respiration rate and the heart rate are close.
- Patients have intermittent mandatory ventilation.
- Respiration is weak. Try repositioning the electrodes to improve the signal.

To set the Resp waveform threshold to the desired level, follow this procedure:

1. Select the Resp numeric area or waveform area to enter the **Resp** menu.
2. Select the **Threshold** tab.
3. Select the up and down arrows below **Upper Line** and **Lower Line** to define the Resp waveform threshold.

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

13.6 Resp Troubleshooting

For more information, see *D Alarm Messages*.

This page intentionally left blank.

14 Monitoring Pulse Oxygen Saturation (SpO_2)

14.1 SpO_2 Introduction

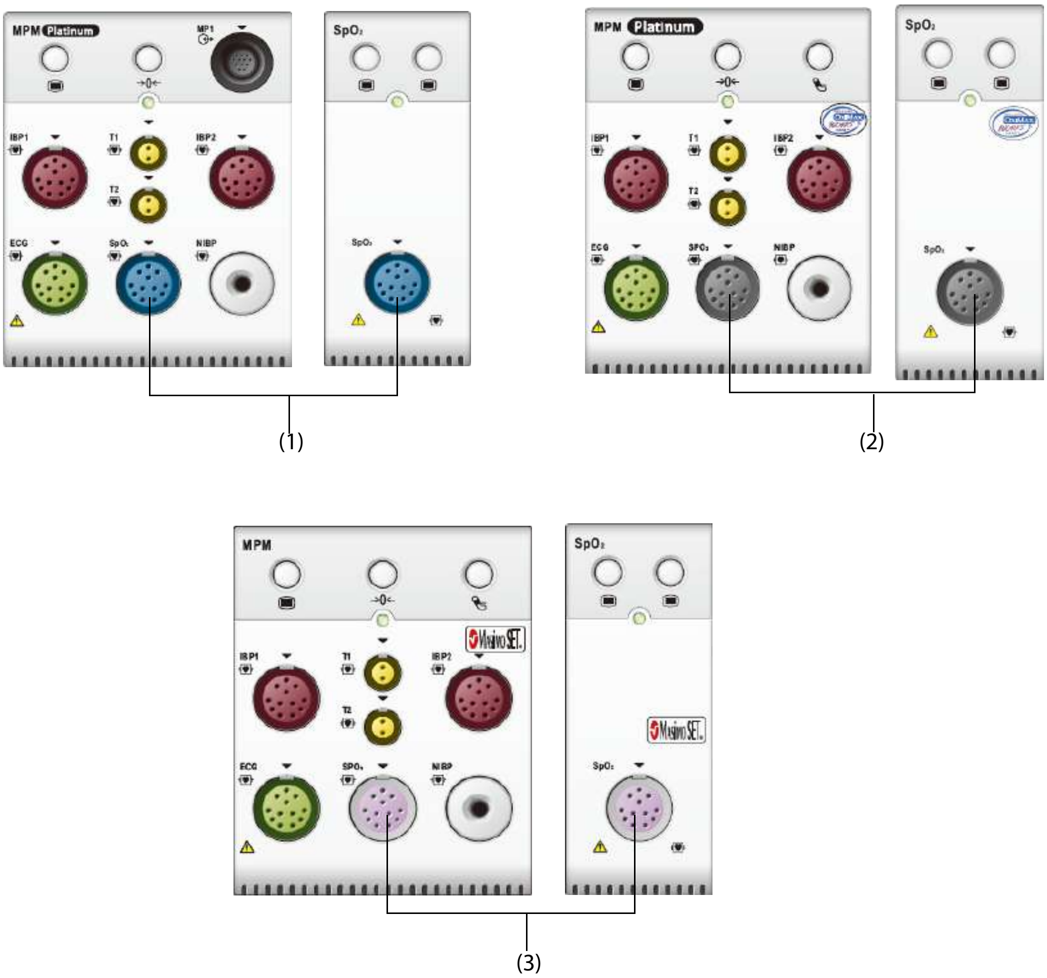
Pulse Oxygen Saturation (SpO_2) monitoring is a non-invasive technique used to measure the amount of oxygenated haemoglobin and pulse rate by measuring the absorption of selected wavelengths of light. The light generated in the emitter side of the probe is partly absorbed when it passes through the monitored tissue. The amount of transmitted light is detected in the detector side of the probe. When the pulsative part of the light signal is examined, the amount of light absorbed by the haemoglobin is measured and the pulse oxygen saturation can be calculated. This device is calibrated to display functional oxygen saturation.

SpO_2 monitoring is intended for adult, pediatric and neonatal patients.

You can simultaneously measure SpO_2 from two different measurement sources: the MPM module and the SpO_2 module. The measurement from the MPM module is labelled SpO_2 and the measurement from the SpO_2 module is labelled SpO_2b.

The following types of SpO_2 can be configured for MPM and SpO_2 modules:

- Mindray SpO_2: the connector is blue and no logo is on the module's front panel.
- Nellcor SpO_2: the connector is grey and the logo of Nellcor is on the module's front panel.
- Masimo SpO_2: the connector is purple and the logo of Masimo SET is on the module's front panel.



(1) Connector of Mindray SpO_2 (2) Connector of Nellcor SpO_2 (3) Connector of Masimo SpO_2

NOTE

- **If you need to measure SpO_2 by both the MPM module and the SpO_2 module, select the same type of SpO_2. Otherwise, the SpO_2 module will be disabled. For example, if an MPM module configured with the Nellcor SpO_2 and an SpO_2 module configured with the Mindray SpO_2 are simultaneously applied, the SpO_2 module will be automatically disabled.**
- **The SpO_2 extension cable should be compatible with the SpO_2 connectors. For example, you can only connect the Mindray SpO_2 extension cable to the Mindray SpO_2 connectors.**
- **A functional tester or SpO_2 simulator can be used to determine the pulse rate accuracy.**
- **A functional tester or SpO_2 simulator cannot be used to assess the SpO_2 accuracy.**

14.2 SpO_2 Safety Information

WARNING

- **When a trend toward patient deoxygenation is indicated, analyze the blood samples with a laboratory co-oximeter to completely understand the patient's condition.**
- **Do not use SpO_2 sensors during magnetic resonance imaging (MRI). Induced current could potentially causes burns. The sensor may affect the MRI image, and the MRI unit may affect the accuracy of the oximetry measurements.**
- **Prolonged continuous monitoring may increase the risk of undesirable changes in skin characteristics, such as irritation, reddening, blistering or burns. Inspect the sensor site every two hours and move the sensor if the skin quality changes. Change the application site every four hours. For neonates, or patients with poor peripheral blood circulation or sensitive skin, inspect the sensor site more frequently.**
- **If the sensor is too tight because the application site is too large or becomes too large due to edema, excessive pressure for prolonged periods may result in venous congestion distal from the application site, leading to interstitial edema and tissue ischemia.**
- **When patients are undergoing photodynamic therapy they may be sensitive to light sources. Pulse oximetry may be used only under careful clinical supervision for short time periods to minimize interference with photodynamic therapy.**
- **Setting alarm limits to extreme values may cause the alarm system to become ineffective. For example, high oxygen levels may predispose a premature infant to retrolental fibroplasia. If this is a consideration, do not set the high alarm limit to 100%, which is equivalent to switching off the alarm.**
- **SpO_2 is empirically calibrated in healthy adult volunteers with normal levels of carboxyhemoglobin (COHb) and methemoglobin (MetHb).**

CAUTION

- **Change the application site or replace the sensor and/or patient cable when a persistent SpO2 Low Signal Quality message is displayed on the equipment. These messages may indicate that patient monitoring time is exhausted on the patient cable or sensor.**
- **Replace the cable or sensor when a "SpO2 Sensor Off", "SpO2 No Sensor", or "SpO2 Low Signal Quality" message is consistently displayed while monitoring consecutive patients after completing troubleshooting steps listed in this manual.**
- **Variation in measurements may be profound and may be affected by sampling technique as well as the patient's physiological conditions. Any results exhibiting inconsistency with the patient's clinical status should be repeated and/or supplemented with additional test data. Blood samples should be analyzed by laboratory instruments prior to clinical decision making to completely understand the patient's condition.**
- **Use only SpO_2 sensors specified in this manual. Follow the SpO_2 sensor's instructions for use and adhere to all warnings and cautions.**

NOTE

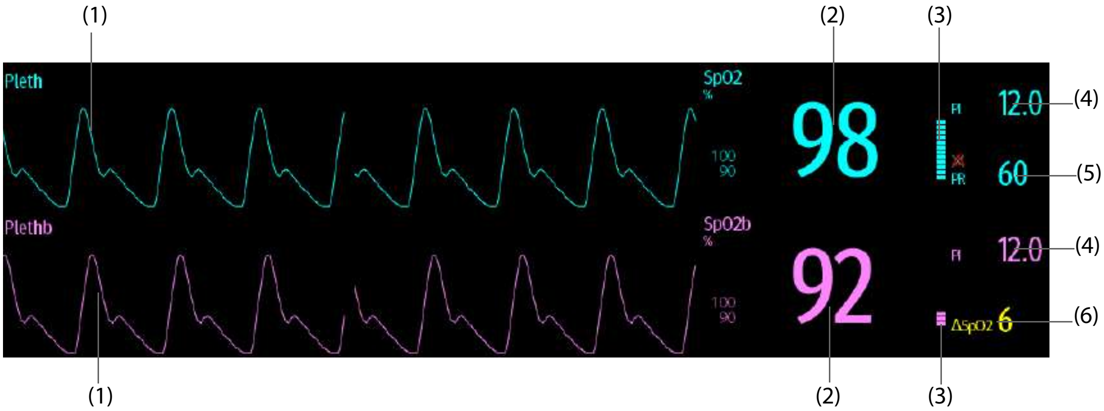
- **Additional information specific to the Masimo sensors compatible with the equipment, including information about parameter/measurement performance during motion and low perfusion, may be found in the sensor's directions for use (DFU).**
- **Masimo cables and sensors are provided with X-Cal™ technology to minimize the risk of inaccurate readings and unanticipated loss of patient monitoring. Refer to the Cable or Sensor DFU for the specified duration of the patient monitoring time.**

14.3 SpO_2 Measurement Limitations

The following factors may influence the accuracy of SpO_2 measurement:

- Patient physiological characteristics:
  - Cardiac arrest
  - Hypotension
  - Darkly pigmented skin
  - Shock
  - Severe vasoconstriction
  - Hypothermia
  - Severe anemia
  - Ventricular septal defects (VSDs)
  - Venous pulsations
  - Poor perfusion
  - Dysfunctional hemoglobin, such as carboxyhemoglobin (COHb) and methemoglobin (MetHb)
  - Elevated levels of bilirubin
  - Vasospastic disease, such as Raynaud's, and peripheral vascular disease
  - Hemoglobinopathies and synthesis disorders such as thalassemias, Hb s, Hb c, sickle cell, etc.
  - Hypocapnic or hypercapnic conditions
  - Birthmark(s), tattoos, skin discolorations, moisture on skin, deformed or abnormal fingers. etc.
- Interfering substances:
  - Intravascular dyes (such as indocyanine green, methylene blue, indigo carmine, etc.)
  - Dyes in the measure site, such as nail polish.
- Environmental conditions:
  - Excessive ambient light
  - Electrosurgery equipment
  - Defibrillation (may cause inaccurate reading for a short amount of time)
  - Excessive patient/sensor motion
  - Electromagnetic field
  - Arterial catheters and intra-aortic balloon
- Others
  - Inappropriate positioning of the SpO_2 sensor, or use of incorrect SpO_2 sensor
  - Cuff or arterial blood pressure measurement device on the same limb as the SpO_2 sensor.

14.4 SpO_2 Display



(1) Pleth waveform (Pleth/Plethb): visual indication of patient's pulse. The waveform is not normalized.

(2) Oxygen saturation of arterial blood (SpO_2/SpO_2b): percentage of oxygenated hemoglobin in relation to the sum of oxyhemoglobin and deoxyhemoglobin.

(3) Perfusion indicator: the pulsatile portion of the measured signal caused by arterial pulsation.

(4) Perfusion index (PI): gives the numerical value for the pulsatile portion of the measured signal caused by arterial pulsation. PI is an indicator of the pulsatile strength. You can also use it to assess the SpO_2 signal strength.

- Above 1 is optimal.
- Between 0.3 and 1 is acceptable.
- Below 0.3 indicates low perfusion. Set **Sensitivity** to **Maximum** first. Reposition the SpO_2 sensor or find a better site. If low perfusion persists, choose another method to measure oxygen saturation if possible.

(5) Pulse rate (derived from the pleth wave): detected pulsations per minute.

(6) SpO_2 difference (ΔSpO_2): $\Delta SpO_2 = |SpO_2 - SpO_2b|$.

NOTE

- **PI is only available for Mindray SpO_2 and Masimo SpO_2.**

14.5 Preparing for SpO_2 Monitoring

To prepare to monitor SpO_2, follow this procedure:

1. Select an appropriate sensor according to the module type, patient category and weight.
2. Clean the contact surface of the reusable sensor.
3. Remove colored nail polish from the application site.
4. Apply the sensor to the patient according to the instruction for use of the sensor.
5. Select an appropriate extension cable according to the connector type and plug the cable into the SpO_2 connector.
6. Connect the sensor to the extension cable.

CAUTION

- **Do not apply sensor too tightly as this results in venous pulsation which may severely obstruct circulation and lead to inaccurate measurements.**
- **At elevated ambient temperatures be careful with measurement sites that are not well perfused, because this can cause burns after prolonged application.**
- **Avoid placing the sensor on extremities with an arterial catheter, an NBP cuff or an intravascular venous infusion line.**

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

NOTE

- **Up to two measurement sites are available simultaneously.**

14.6 Changing the SpO_2 Settings

14.6.1 Changing the SpO_2 Alarm Settings

To change the SpO_2 alarm settings, follow this procedure:

1. Select the SpO_2 numeric area or waveform area to enter the **SpO2** menu.
2. Select the **Alarm** tab.
3. Enter the password if required.
4. Set the alarm properties of SpO_2 and SpO_2 Desat.

   For SpO_2b, you can also set alarm properties for ΔSpO_2.

NOTE

- **You can switch off the SpO2 Desat alarm only when SpO2 Desat Alarm Off in enabled.**

14.6.2 Nellcor Sat-Seconds Alarm Management

With traditional alarm management, high and low alarm limits are set for monitoring oxygen saturation. During monitoring, once an alarm limit is violated, an audible alarm immediately sounds. When the patient SpO_2 fluctuates near an alarm limit, the alarm sounds each time the limit is violated. Such frequent alarms can be distracting. Nellcor's Sat-Seconds alarm management technique is used to reduce these nuisance alarms.

The Sat-Seconds feature is available with the Nellcor SpO_2 to decrease the likelihood of false alarms caused by motion artifacts. With Sat-Seconds alarm management, high and low alarm limits are set in the same way as those with traditional alarm management. A Sat-Seconds limit is also set. The Sat-Seconds limit controls the amount of time that SpO_2 saturation may be outside the set limits before an alarm sounds.

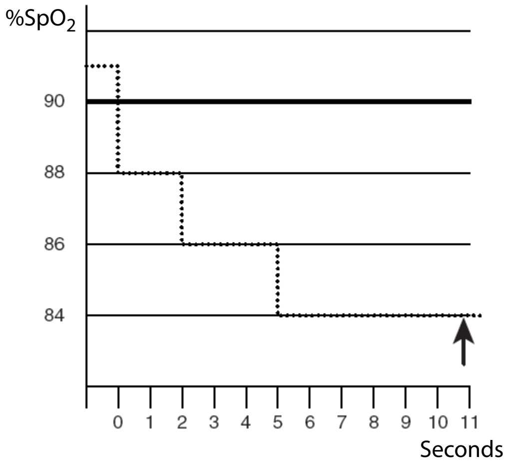
The method of calculation is as follows: the percentage points of the SpO_2 saturation falling outside the alarm limit is multiplied by the number of seconds remaining outside the limit. This can be stated as the equation:

Sat-Seconds = Points × Seconds

Only when the Sat-Seconds limit is reached, the monitor gives a Sat-Seconds alarm. For example, the figure below demonstrates the alarm response time with a Sat-Seconds limit set at 50 and a low SpO_2 limit set at 90%. In this example, the patient SpO_2 drops to 88% (2 points) and remains there for 2 seconds. Then it drops to 86% (4 points) for 3 seconds, and then to 84% (6 points) for 6 seconds. The resulting Sat-Seconds are:

% SpO_2	Seconds	Sat-Seconds
2×	2=	4
4×	3=	12
6×	6=	36
Total Sat-Seconds=		52

After approximately 10.9 seconds, a Sat-Second alarm would sound, because the limit of 50 Sat-Seconds would have been exceeded.



Saturation levels may fluctuate rather than remaining steady for a period of several seconds. Often, the patient SpO_2 may fluctuate above and below an alarm limit, re-entering the non-alarm range several times. During such fluctuation, the monitor integrates the number of SpO_2 points, both positive and negative, until either the Sat-Seconds limit is reached, or the patient SpO_2 re-enters the non-alarm range and remains there.

NOTE

- **The SpO_2 Too Low or SpO_2 Too High alarm is presented in the case that SpO_2 value violates the alarm limits for 3 times within one minute even if the setting of Sat-Seconds is not reached.**

14.6.3 Setting the Nellcor SpO_2 Sat-Seconds

To set the Sat-Seconds, follow this procedure:

1. Select the SpO_2 numeric area or waveform area to enter the **SpO2** menu.
2. Select the **Alarm** tab.
3. Set **Sat-Seconds**.

14.6.4 Setting SpO_2 Sensitivity (for Masimo SpO_2)

For Masimo SpO_2, selects the **Sensitivity** as per signal quality and patient motion.

Normal sensitivity is the recommended for patients who are experiencing some compromise in blood flow or perfusion. It is advisable for care areas where patients are observed frequently, such as the intensive care unit (ICU).

Adaptive Probe Off Detection (APOD) sensitivity is the recommended sensitivity mode where there is a high probability of the sensor becoming detached. It is also the suggested mode for care areas where patients are not visually monitored continuously. This mode delivers enhanced protection against erroneous pulse rate and arterial oxygen saturation readings when a sensor becomes inadvertently detached from a patient due to excessive movement.

Maximum sensitivity is recommended for use on patients with weak signals (e.g. high ambient noise and/or patients with very low perfusion) and for use during procedures or when clinician and patient contact is continuous such as in higher acuity settings.The settings of sensitivity in the SpO_2 module and SpO_2b module are linked.

To set SpO_2 sensitivity, follow this procedure:

1. Select the SpO_2 numeric area or waveform area to enter the **SpO2** dialog.
2. Select the **SpO2 Setup** tab.
3. Set **Sensitivity** to **Maximum, Normal, or APOD**.

CAUTION

- **When using the Maximum Sensitivity setting, performance of "Sensor Off" detection may be compromised. If the equipment and the sensor becomes detached from the patient, the potential for false readings may occur due to environmental noise such as light, and vibration.**

NOTE

- **The settings of sensitivity in the SpO_2 module and SpO_2b module are linked.**

14.6.5 Changing Averaging Time (for Masimo SpO_2)

The SpO_2 value displayed on the monitor screen is the average of data collected within a specific time. The shorter the averaging time is, the quicker the monitor responds to changes in the patient's oxygen saturation level. Contrarily, the longer the averaging time is, the slower the monitor responds to changes in the patient's oxygen saturation level, but the SpO_2 measurement is more stable. For critically ill patients, selecting a shorter averaging time will help with understanding the patient's state.

To set the averaging time, follow this procedure:

1. Select the SpO_2 numeric area or waveform area to enter the **SpO2** dialog.
2. Select the **SpO2 Setup** tab.
3. Set **Averaging**.

14.6.6 Changing Sensitivity (for Mindray SpO_2)

The SpO_2 value displayed on the monitor screen is the average of data collected within a specific time. The shorter the averaging time is, the quicker the monitor responds to changes in the patient's oxygen saturation level. Contrarily, the longer the averaging time is, the slower the monitor responds to changes in the patient's oxygen saturation level, but the SpO_2 measurement is more stable. For critically ill patients, selecting shorter averaging time will help understanding the patient's state.

To set the averaging time, follow this procedure:

1. Select the SpO_2 numeric area or waveform area to enter the **SpO2** menu.
2. Select the **SpO2 Setup** tab.
3. Select **Sensitivity**, and then toggle between **High**, **Med** and **Low**, which respectively correspond to 7 s, 9 s and 11 s.

14.6.7 Showing/Hiding PI

You can set whether to display PI in the SpO_2 parameter area. To do so, follow this procedure:

1. Select the SpO_2 numeric area or waveform area to enter the **SpO2** menu.
1. Select the **Setup** tab.
2. Switch on or off **Display PI.**

14.6.8 Monitoring SpO_2 and NIBP Simultaneously

When monitoring SpO_2 and NIBP on the same limb simultaneously, you can switch on **NIBP Simul** to lock the SpO_2 alarm status until the NIBP measurement ends. If you switch off **NIBP Simul**, low perfusion caused by NIBP measurement may lead to inaccurate SpO_2 readings and therefore cause false physiological alarms.

To set the **NIBP Simul**, follow this procedure:

1. Select the SpO_2 numeric area or waveform area to enter the **SpO2** menu.
2. Select the **Alarm** tab.
3. Select **SpO2** tab.
4. Set **NIBP Simul**.

14.6.9 Changing the Sweep Speed of the Pleth Wave

To set the sweep speed of Pleth waveforms, follow this procedure:

1. Select the SpO_2 numeric area or waveform area to enter the **SpO2** menu.
2. Select the **SpO2 Setup** tab.
3. Set **Speed**.

14.7 Changing the PR Settings

14.7.1 Changing the PR Alarm Settings

To change the PR alarm settings, follow this procedure:

1. Select the SpO_2 numeric area or waveform area to enter the **SpO2** menu.
2. Select the **PR Alarm** tab.
3. Enter the password if required. For more information, refer to *39.13 The Authorization Setup Settings*.
4. Set the alarm properties as desired.

14.7.2 Changing the QRS Volume

If the **Alarm Source** is set to **PR**, the QRS tone is derived from PR measurements. To set the QRS volume, follow this procedure:

1. Select the SpO_2 numeric area or waveform area to enter the **SpO2** menu.
2. Select the **PR** tab.
3. Select the **Setup** tab.
4. Set **QRS Volume**.

If the SpO_2 value is effective, the monitor also adjusts the QRS tone (pitch tone) according to the SpO_2 value.

14.7.3 Setting the PR Source

Current pulse source is displayed in the PR numeric area. The PR from current pulse source has the following characteristics:

- PR is monitored as system pulse and generates alarms when you select PR as the active alarm source.
- PR is stored in the monitor's database and reviewed in the graphic/tabular trends; in trend graphs, as the PR curve is in the same color with that of the PR source, it is unlikely to distinguish the PR source.
- PR is sent via the network to the CMS, if available.

To set which pulse rate as PR source, follow this procedure:

1. Select the SpO_2 numeric area or waveform area to enter the **SpO2** menu.
2. Select the **PR Setup** tab.
3. Set **PR Source**.

The **PR Source** menu displays the currently available PR sources from top to bottom by priority. When you select **Auto**, the system will automatically select the first option as the PR source. If the current PR source is unavailable, the system will automatically switch **PR Source** to **Auto**. When you select **IBP**, the system will automatically select the first pressure label as the PR source.

14.7.4 Showing/Hiding PR

You can set whether to display the PR value in the SpO_2 parameter area. To do so, follow this procedure:

1. Select the SpO_2 numeric area or waveform area to enter the **SpO2** menu.
2. Select the **PR** tab.
3. Select the **Setup** tab.

4. Switch on or off **Display PR.**

14.8 SpO_2 Troubleshooting

This section lists the problems that might occur. If you encounter the problems when using the equipment or accessories, check the table below before requesting for services. If the problem persists, contact your service personnel.

NOTE

- **For the physiological and technical alarm messages, see *D Alarm Messages*.**

Problem	Solution
Do not see SpO_2 numeric area or waveform area on the main screen	1. Check that the SpO_2 is set to display in the **Screen Setup** menu. For more information, see *39.12 The Other Settings*. 2. Check that if the SpO_2 parameter switch is enabled. If not, enable the SpO_2 measurement. For more information, see *3.11.1 Switching On or Off a Parameter*. 3. Check that the cable connections of SpO_2 sensor and the extension cable are tight. Replace the SpO_2 sensor or the extension cable if needed.
Dashes "- -" display in place of numerics.	1. Check that the cable connections of SpO_2 sensor and the extension cable are tight. Replace the SpO_2 sensor or the extension cable if needed. 2. Reconnect the SpO_2 sensor if the alarm **SpO2 Sensor Off** appears. 3. Check the PI value. If the PI value is too low, adjust the SpO_2 sensor, or apply the sensor to the site with better perfusion. 4. Move the sensor to the place with weaker light, or cover the sensor with shade cloth if the alarm **SpO2 Sensor Off** appears.
Low amplitude SpO_2 signal	1. The SpO_2 sensor and NIBP cuff are placed on the same limb. Change a monitoring site if necessary. 2. Check the PI value. If the PI value is too low. Adjust the SpO_2 sensor, or apply the sensor to the site with better perfusion. 3. Check the sensor and its application site.
SpO2 value is inaccurate	1. Check the patient's vital signs. 2. Check for conditions that may cause inaccurate SpO_2 readings. For more information, see *14.3 SpO_2 Measurement Limitations*. 3. Check the monitor, the SpO_2 module or the MPM for proper functioning.

14.9 Nellcor Information

■ Nellcor Patents

This device may be covered by one or more of the following US patents and foreign equivalents: 5,485,847, 5,676,141, 5,743,263, 6,035,223, 6,226,539, 6,411,833, 6,463,310, 6,591,123, 6,708,049, 7,016,715, 7,039,538, 7,120,479, 7,120,480, 7,142,142, 7,162,288, 7,190,985, 7,194,293, 7,209,774, 7,212,847, 7,400,919.

■ No Implied License

Possession or purchase of this device does not convey any express or implied license to use the device with unauthorized replacement parts which would, alone, or in combination with this device, fall within the scope of one or more of the patents relating to this device.

14.10 Masimo Information

Masimo Patents

This posting serves as notice under 35 U.S.C.§287(a) for Masimo patents: http://www.masimo.com/patents.htm.

No Implied License

Possession or purchase of this device does not convey any express or implied license to use the device with unauthorized sensors or cables which would, alone, or in combination with this device, fall within the scope of one or more of the patents relating to this device.

END-USER LICENSE AGREEMENT

THIS DOCUMENT IS A LEGAL AGREEMENT BETWEEN YOU ("PURCHASER") AND SHENZHEN MINDRAY. IF YOU DO NOT AGREE TO THE TERMS OF THIS AGREEMENT, PROMPTLY RETURN THE ENTIRE PACKAGE, INCLUDING ALL ACCESSORIES, IN THEIR ORIGINAL PACKAGE, WITH YOUR SALES RECEIPT TO SHENZHEN MINDRAY FOR A FULL REFUND.

1.Grant of License. In consideration of payment of the license fee, which is part of the price paid for this product, Shenzhen Mindray grants to Purchaser a nonexclusive, nontransferable license, without right to sublicense, to use the copy of the incorporated software/firmware, and documentation in connection with Purchaser's use of the Masimo Products for their labeled purpose. Shenzhen Mindray reserves all rights not expressly granted to Purchaser.

2.Ownership of Software/Firmware. Title to, ownership of, and all rights and interests in, any Masimo software and/or firmware and the documentation, and all copies thereof, remain at all times vested in Masimo Corporation, licensor to Shenzhen Mindray, and they do not pass to Purchaser.

3.Assignment. Purchaser shall not assign or transfer this License, in whole or in part, by operation of law or otherwise, without Shenzhen Mindray's prior written consent; any attempt without such consent, to assign any rights, duties or obligations arising hereunder shall be void.

4.Copy Restrictions. The software/firmware, mask works, circuit board layouts, and accompanying written materials are copyrighted. Unauthorized copying of the software, including software that has been modified, merged, or included with other software, or other written materials is expressly forbidden. You may be held legally responsible for any copyright infringement that is cause or incurred by your failure to abide by the terms of this license. Nothing in this license provides any rights beyond those provided by 17 U.S.C. §117.

5.Use Restriction. As the Purchaser, you may physically transfer the products from one location to another provided that the software/firmware is not copied. You may not electronically transfer the software/firmware from the products to any other device. You may not disclose, publish, translate, release distribute copies of, modify, adapt, translate, reverse engineer, decompile, disassemble, or create derivative works based on the Masimo Product, the software/firmware, or the written materials without the prior written consent of Masimo. Masimo Sensors that are designated for single use are licensed under Masimo patents for use on a single patient only, and are not sold. There is no license, implied or otherwise, that would allow use of single use Masimo Sensors beyond their intended single use. After use of single use Masimo Sensors, there is no further license granted by Masimo to use the sensors and they must be discarded.

6.Transfer Restrictions. The software/firmware is licensed to the Purchaser, and may not be transferred to anyone, except other end-users, without the prior written consent of Shenzhen Mindray. In no event may you transfer, assign, rent, lease, sell, or otherwise dispose of the software/firmware or the products on a temporary basis.

7.Beneficiary. Masimo Corporation is a Beneficiary of this Agreement and has the right to enforce its provisions.

U.S. Government Rights: If you are acquiring software (including the related documentation) on behalf of any part of the United States Government, the following provisions apply: the software is deemed to be "commercial software" and "commercial computer software documentation," respectively pursuant to DFAR Section 227.7202 FAR 12.212, as applicable. Any use, modification, reproduction, release, performance, display or disclosure of the software (including the related documentation) by the U.S. Government or any of its agencies shall be governed solely by the terms of this Agreement and shall be prohibited except to the extent expressly permitted by the terms of this agreement.

This page intentionally left blank.

15 Monitoring Temperature (Temp)

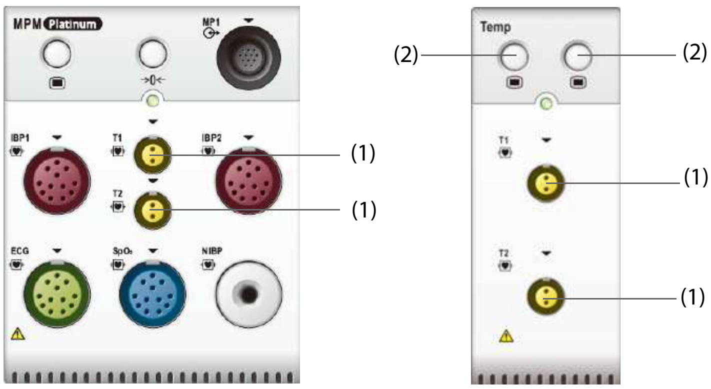
15.1 Temperature Introduction

You can continuously monitor the patient's skin temperature and core temperature by the MPM module and the Temp modules. Thermally sensitive resistors (thermistors) are used. They are based on the principle that electrical resistance of the thermistor changes as temperature changes. Thermistors measure the resistance change and use it to calculate the temperature.

You can connect an MPM module and up to three Temp modules. So you can simultaneously monitor up to eight temperature sites and calculate the difference between two measured sites.

You can also connect the Covidien Genius™ 2 tethered tympanic thermometer. The Genius™ 2 thermometer is an ear canal thermometer with measurement site equivalence modes including oral, core, and rectal equivalent temperatures.

Temperature monitoring is intended for adult, pediatric and neonatal patients.



(1) Temperature probe connector (2) Temp menu hard key

15.2 Displaying the Temp Numerics Area

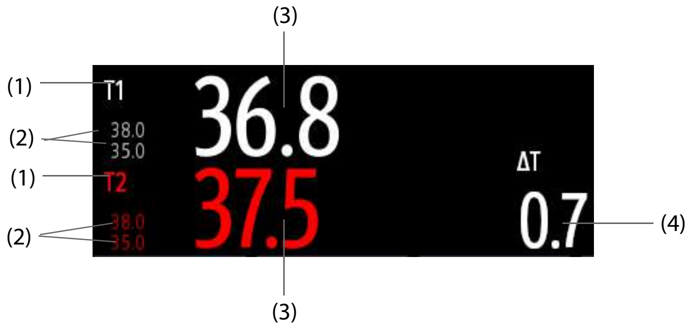
To display the Temp numerics area, follow this procedure:

1. Access **Tile Layout** in either of the following ways:
   - ◆ Select the **Screen Setup** quick key → select the **Tile Layout** tab.
   - ◆ Select the **Main Menu** quick key → from the **Display** column select **Tile Layout**.
2. Select a parameter numeric area or waveform area, and then from the popup list select **Any Temp**.

15.3 Temperature Display (for MPM and Temp Module)

The following figure shows the Temp numeric area for temperature monitoring with the MPM module or Temp module. Your display may be configured to look different.

The following figure shows the Temp numeric area for temperature monitoring with the monitor. Your display may be configured to look different.



(1) Temperature site (2) Alarm limits (3) Temperature value

(4) Temperature difference (ΔT): Difference between two temperature sites. It displays only when ΔT is switched on.

15.4 Preparing for Temperature Monitoring (for MPM and Temp Module)

To prepare temperature monitoring, follow this procedure:

1. Select an appropriate probe for your patient according to patient category and measured site.
2. Plug the probe or temperature cable to the temperature connector. If you are using a disposable probe, connect the probe to the temperature cable.
3. Follow the probe manufacturer's instructions to connect the probe to the patient.

15.5 Changing Temperature Settings (for MPM and Temp Module)

15.5.1 Setting the Temperature Alarm Properties (for MPM and Temp Module)

To set the temperature alarm properties, follow this procedure:

1. Select the temperature numeric area to enter the **Temp** menu.
2. Select the **Alarm** tab.
3. Enter the password if required.
4. Set the alarm properties。

15.5.2 Selecting the Temperature Label (for MPM and Temp Module)

Select the temperature label according to the measurement site. To do so, follow this procedure:

1. Select the temperature numeric area to enter the **Temp** menu.
2. Select the **Setup** tab.
3. Set the temperature label.

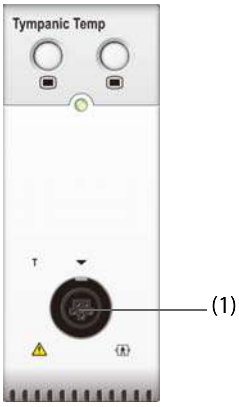
15.5.3 Displaying the Temperature Difference (for MPM and Temp Module)

To display the temperature difference between two measurement sites monitored by the same temperature module, switch on corresponding ΔT. To do so, follow this procedure:

1. Select the temperature numeric area to enter the **Temp** menu.
2. Select the **Setup** tab.
3. Switch on **ΔT**.

15.6 Monitoring Temperature with Genius^{TM} 2 Tethered Tympanic Thermometer

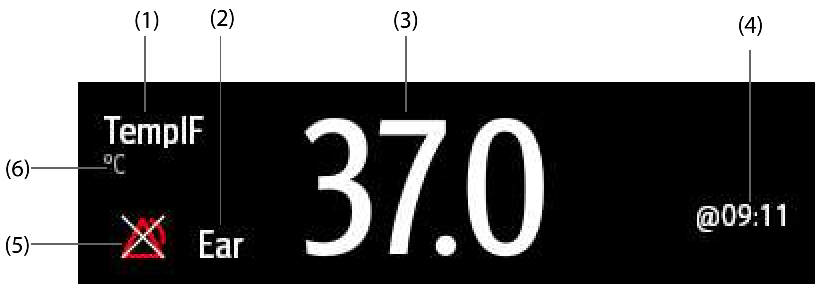
The Genius^{TM} 2 tethered tympanic thermometer is a fast, accurate, and convenient clinical instrument for measuring patient temperatures. It is connected to the monitor through the Temp adapting module. The thermometer is powered by the monitor.   Refer to the Genius^{TM} 2 Tethered Tympanic Thermometer Operator's Manual (P/N: 046-009467-00) for more information.



(1) Tympanic thermometer connector

15.6.1 Tympanic Temperature Display

The following figure shows the temperature measured by the tympanic thermometer.



(1) Temperature label	(2) Temperature site
(3) Temperature value	(4) Measurement time
(5) Temperature alarm limits. The alarm off symbol displays when the temperature alarm is switched off.	(6)Temperature unit

15.6.2 Measuring the Tympanic Temperature

To take the tympanic temperature, follow this procedure:

1. Visually inspect the patient's ear canal.
2. Remove the thermometer from the base.
3. Inspect the probe lens. If any debris is present, clean it with a lens wipe or lint free swab.
4. Press the scan button to verify functionality and mode selection on the LCD screen.
5. Install a probe cover by firmly inserting the probe tip into a probe cover. After the probe cover is installed, the thermometer will perform a system reset. The thermometer will then display dashes, the equivalence mode, and the thermometer icon.
6. Inspect the probe cover to make sure it is fully seated (no space between cover and tip base) and no holes, tears, or wrinkles are present in the plastic film.

7. Place the probe in the ear canal and seal the opening with the probe tip. For consistent results, ensure that the probe shaft is aligned with the ear canal.
8. Once positioned lightly in the ear canal, press and release the scan button. Wait for the triple beeps before removing the thermometer.
9. Remove the probe from the ear as soon as the beep is heard. The temperature and probe eject icon display on the LCD screen.
10. Press the eject button to eject the probe cover.

At the completion of measurement, always return the thermometer to the base for storage.

NOTE

- **Always wait for at least two minutes before taking another measurement in the same ear.**
- **Do not configure the thermometer or take an measurement during the startup of the monitor. Otherwise, the monitor may not obtain the thermometer data or the tympanic temperature displayed on the monitor may not be correct.**

15.7 Temperature Troubleshooting

This section lists the problems that might occur. If you encounter the problems when using the equipment or accessories, check the table below before requesting for services. If the problem persists, contact your service personnel.

NOTE

- **For the physiological and technical alarm messages, see *D Alarm Messages*.**

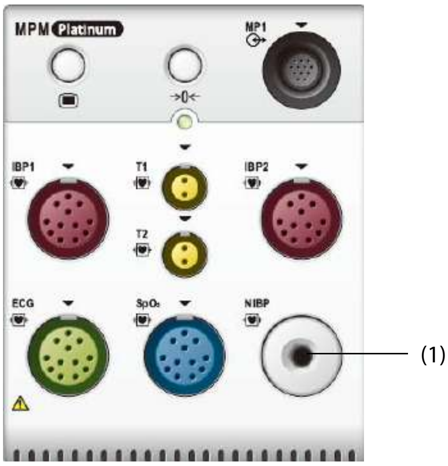
Problem	Solution
Do not see Temp numeric area on the main screen	1. Check that if the Temp parameter switch is enabled. If not, enable the Temp measurement. For more information, see *3.11.1 Switching On or Off a Parameter*. 2. Check that the connections of the temperature probe and the temperature cable are tight.
Measurement fails/'--' is displayed in the Temp numeric area	1. If you are using a disposable probe, check the connection between the probe and the temperature cable. 2. Try using a known good probe in case the sensor is damaged.
The tympanic thermometer display is frozen.	Install or remove the probe cover to activate the thermometer.

16 Monitoring Noninvasive Blood Pressure (NIBP)

16.1 NIBP Introduction

The monitor uses the oscillometric method for measuring the non-invasive blood pressure (NIBP). NIBP measurement is based on the principle that pulsatile blood flow through an artery creates oscillations of the arterial wall. The oscillometric device uses a blood pressure cuff to sense these oscillations that appear as tiny pulsations in cuff pressure. The Oscillometric devices measure the amplitude of pressure changes in the occluding cuff as the cuff deflates from above systolic pressure. The amplitude suddenly increases as the pulse breaks through the occlusion in the artery. As the cuff pressure decreases further, the pulsations increase in amplitude, reach a maximum (which approximates to the mean pressure), and then diminish. The oscillometric method measures the mean pressure and determines the systolic and diastolic pressures.

The NIBP module is integrated into the MPM module. NIBP monitoring is intended for adult, pediatric, and neonatal patients.



(1) NIBP cuff connector

NOTE

- **Blood pressure measurements determined with this device are equivalent to those obtained by a trained observer using the cuff/stethoscope auscultatory method or an intra-arterial blood pressure measurement device, within the limits prescribed by the American National Standard: manual, electronic, or automated sphygmomanometers.**
- **NIBP measurement can be performed during electro-surgery and discharge of defibrillator.**

16.2 NIBP Safety Information

WARNING

- **Be sure to select the correct patient category setting for your patient before NIBP measurement. Do not apply the higher adult settings for pediatric or neonatal patients. Otherwise, it may present a safety hazard.**
- **Do not measure NIBP on patients with sickle-cell disease or on the limb where skin damage has occurred or is expected.**
- **Use clinical judgment to determine whether to perform frequent unattended blood pressure measurements on patients with severe blood clotting disorders because of the risk of hematoma in the limb fitted with the cuff.**
- **Do not use the NIBP cuff on a limb with an intravenous infusion or arterial catheter in place. This could cause tissue damage around the catheter when the infusion is slowed or blocked during cuff inflation.**
- **Do not apply cuff on the arm on the side of a mastectomy.**
- **Continuous cuff pressure due to connection tubing kinking may cause blood flow interference, and resulting in harmful injury to the patient.**
- **NIBP reading can be affected by the measurement site, the position of the patient, exercise, or the patient's physiologic condition. If you doubt the NIBP measurements, determine the patient's vital signs by alternative means, and then verify that the monitor is working correctly.**
- **Devices that exert pressure on tissue have been associated with purpura, ischemia, and neuropathy. Inspect the application site regularly to ensure skin quality and inspect the extremity of the cuffed limb for normal color, warmth and sensitivity. If the skin quality changes, or if the extremity circulation is being affected, move the cuff to another site or stop the blood pressure measurements immediately. Check more frequently when making automatic or STAT measurements. Auto NIBP measurements with one and two minute intervals are not recommended for extended periods of time.**
- **NIBP diagnostic significance must be decided by the physician.**

CAUTION

- **Only use parts and accessories specified in this manual. Follow the instructions for use and adhere to all warnings and cautions.**
- **Accuracy of NIBP measurement depends on using a cuff of proper size. It is essential to measure limb circumference and choose a cuff with proper size.**

16.3 NIBP Measurement Limitations

Measurements are impossible with heart rate extremes of less than 30 bpm or greater than 300 bpm, or if the patient is on a heart-lung machine. The measurement may be inaccurate or impossible in the following situations:

- Regular arterial pressure pulses are hard to detect
- With excessive and continuous patient movement such as shivering or convulsions
- With cardiac arrhythmias
- With rapid blood pressure changes
- With severe shock or hypothermia that reduces blood flow to the peripheries
- On an edematous extremity.

NOTE

- **The effectiveness of this sphygmomanometer has not been established in pregnant, including pre-eclamptic patients.**

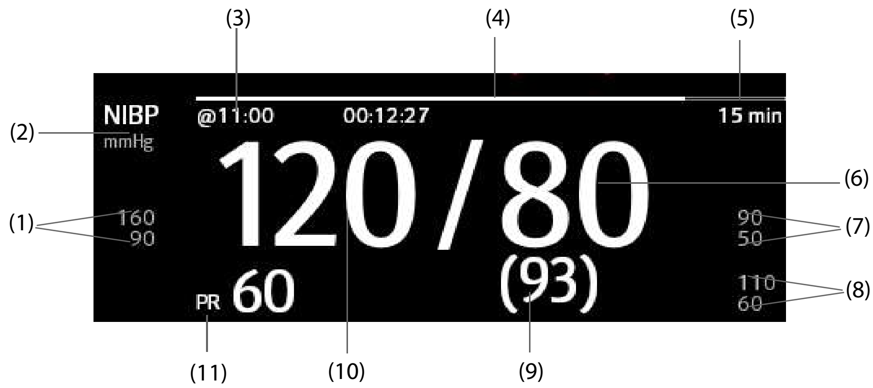
16.4 Measurement Modes

There are three NIBP measurement modes:

- Manual: measurement on demand.
- Auto: repeated measurements at set interval.
- STAT: continually rapid series of measurements over a five minute period.
- Sequence: continually automatic measurement at set durations and intervals.

16.5 NIBP Display

The NIBP display shows only numerics.



(1) Systolic pressure alarm limits

(2) NIBP unit: mmHg or kPa

(3)The last NIBP measurement time

(4) Time to the next measurement (for Auto mode and Sequence mode)

(5) Measurement mode: for Auto NIBP, interval is displayed; for Sequence mode, the current phase and interval are displayed

(6) Diastolic pressure

(7) Diastolic pressure alarm limit

(8) Mean pressure alarm limit

(9) Mean pressure (displayed after measurement completed) or cuff pressure (displayed during the measurement)

(10) Systolic pressure

(11) Pulse Rate

NOTE

- **If NIBP measurement fails, “XX” is displayed; if NIBP measurement is not taken, “--” is displayed.**
- **Outlined NIBP numerics indicate that the measurement is old and exceeds the set time. So these NIBP values are not recommended for reference.**

16.6 Preparing for NIBP Measurements

16.6.1 Preparing the Patient for NIBP Measurements

In normal use, perform NIBP measurement on a patient who is in the following position:

- Comfortably seated
- Legs uncrossed
- Feet flat on the floor
- Back, arm and feet supported

NOTE

- **It is recommended that the patient calms down and relaxes as much as possible before performing the measurement and that the patient do not talk during the measurement.**
- **It is recommended to have the patient sit quietly for several minutes before taking the measurement.**
- **Other factors that have been shown to result in an overestimation of blood pressure are labored breathing, full bladder, pain etc.**

16.6.2 Placing the NIBP Cuff

To place the NIBP cuff, follow this procedure:

1. Verify that the patient category setting is correct. If not, enter the **Patient Management** menu to change patient category. For more information, see *5.4.2 Editing Patient Information*.
2. Connect the air tubing to the NIBP connector on the MPM module.
3. Select an appropriately sized cuff for the patient, and then wrap it around the limb directly over the patient's skin as follows:
   a Determine the patient's limb circumference.
   b Select an appropriate cuff by referring to the limb circumference marked on the cuff. The width of the cuff should be 40% (50% for neonates) of the limb circumference, or 2/3 of the length of the upper arm or the thigh. The inflatable part of the cuff should be long enough to encircle at least 50% to 80% of the limb.
   c Apply the cuff to the patient's upper arm or leg and make sure the Φ marking on the cuff matches the artery location. The cuff should fit snugly, but with enough room for two fingers to be placed between the cuff and the patient's arm (on adults), and loosely on neonates with little or no air present within the cuff. Otherwise it may cause discoloration and ischemia of the extremities. Make sure that the cuff index line falls within the range markings on the cuff.
   d Middle of the cuff should be at the level of the right atrium of the heart. If it is not, you must use the measurement correction formula to correct the measurement. For more information, see *16.8.10 Correcting the NIBP Measurements*.
4. Connect the cuff to the air tubing. Avoid compression or restriction of pressure tubes. Air must pass unrestricted through the tubing.

CAUTION

- **A wrong cuff size and a folded or twisted bladder can cause inaccurate measurements.**
- **Do not touch or apply external pressure against the cuff and air tubing during NIBP measurement. This may cause inaccurate blood pressure values.**
- **Use care when placing the cuff on an extremity used for monitoring other patient parameters.**

16.7 Starting and Stopping NIBP Measurements

Start and stop NIBP measurement by selecting the NIBP quick keys or from the NIBP menu.

Task	By Quick Key	From NIBP menu
Start a manual measurement	**NIBP Start/Stop** quick key	**Start NIBP** button
Start auto NIBP series	**NIBP Start/Stop** quick key Make sure to set **Interval** before starting auto NIBP.	**Setup** tab → set **Interval** → **Start NIBP** button
	NIBP Measure quick key → select **interval**	
Start NIBP sequence measurement	**NIBP Measure** quick key → **Sequence**	**Sequence** tab → set NIBP sequence →**Start NIBP** button
Start STAT measurement	**NIBP STAT** quick key	**STAT** button
	NIBP Measure quick key → **STAT**	
Stop the current NIBP measurements	**NIBP Start/Stop** quick key	**Stop NIBP** button
End auto NIBP series or NIBP Sequence	**Stop All** quick key	**Stop All** button
Stop STAT measurement and end series	**NIBP Start/Stop** quick key	**Stop NIBP** or **Stop All** button
	NIBP STAT quick key	

16.8 Changing NIBP Settings

16.8.1 Setting the NIBP Alarm Properties

To set the NIBP alarm properties, follow this procedure:

1. Select the NIBP numeric area to enter the **NIBP** menu.
2. Select the **Alarm** tab.
3. Enter the password if required.
4. Set alarm properties as desired.

16.8.2 Setting the Initial Cuff Inflation Pressure

To set initial cuff inflation pressure, follow this procedure:

1. Select the NIBP numeric area to enter the **NIBP** menu.
2. Select **Initial Pressure**, and then select the appropriate setting.

NOTE

- **For known hypertensive patients, you need to set initial cuff pressure to a higher value to reduce the measurement time.**

16.8.3 Setting the NIBP Interval

For auto NIBP measurement, you need to set the interval between two NIBP measurements. To set the NIBP interval, follow this procedure:

1. Select the NIBP numeric area to enter the **NIBP** menu.

2. Set **Interval**. Selecting **Manual** switches to manual mode.

16.8.4 Selecting NIBP Start Mode

Start mode defines how NIBP auto mode works. To set the start mode, follow this procedure:

1. Select the NIBP numeric area to enter the **NIBP** menu.
2. Set **Start Mode**.

   - **Clock**: after the first measurement, the monitor automatically synchronizes NIBP automatic measurements with the real time clock. For example, if **Interval** is set to **20 min**, and you start NIBP auto measurement at 14: 03, the next measurement will be taken at 14: 20, and then at 14:40, 15:00, and so on.
   - **Interval**: after the first measurement, the monitor automatically repeats measurements at set interval. For example, if **Interval** is set to **20 min**, and you start NIBP auto measurement at 14:03, the next measurement will be taken at 14:23, and then at 14:43, 15:03, and so on.

16.8.5 Enabling the NIBP End Tone

The monitor can issue a reminder tone at the completion of NIBP measurement. The NIBP End Tone is off by default. To switch on the NIBP end tone, follow this procedure:

1. Select the NIBP numeric area to enter the **NIBP** menu.
2. Switch on **NIBP End Tone**.

16.8.6 Setting NIBP Sequence

NIBP sequence measurement can have up to five phases: A, B, C, D, and E. You can individually set the duration and interval of each phase.

To set NIBP sequence, follow this procedure:

1. Select the NIBP numeric area to enter the **NIBP** menu.
2. Select the **Sequence** tab.
3. Set **Duration** and **Interval** of each phase.

16.8.7 Setting the NIBP Display Format

To set the NIBP display format, follow this procedure:

1. Select the NIBP numeric area to enter the **NIBP** menu.
2. Select the **Setup** tab.
3. Set **Display Format**.

16.8.8 Setting the NIBP Alarm Limits Display Switch

To set whether to display the alarm limits of diastolic NIBP and mean NIBP, follow this procedure:

1. Select the NIBP numeric area to enter the **NIBP** menu.
2. Select the **Setup** tab.
3. Switch on or off **Display Alarm Limits.**

16.8.9 Showing/Hiding PR

You can set whether to display the PR value in the NIBP parameter area. To do so, follow this procedure:

1. Select the NIBP numeric area to enter the **NIBP** menu..
2. Select the **Setup** tab.
3. Switch on or off **Display PR.**

16.8.10 Correcting the NIBP Measurements

The middle of the cuff should be at the level of right atrium. If the limb is not at the heart level, you need to correct the measurement:

- Add 0.75 mmHg (0.10 kPa) to the displayed value for each centimetre higher.
- Deduct 0.75 mmHg (0.10 kPa) to the displayed value for each centimeter lower.

16.9 Assisting Venous Puncture

You can use the NIBP cuff to cause sub-diastolic pressure to block the venous blood vessel and therefore help venous puncture. To assist venous puncture, follow this procedure:

1. Select the **VeniPuncture** quick key or select the NIBP numeric area → **Setup** tab.
2. Set **Venipuncture pressure**.
3. Select **VeniPuncture** at the bottom of the menu.
4. Puncture vein and draw blood sample.
5. Select the **NIBP Start/Stop** quick key to deflate the cuff. If you do not deflate the cuff, the cuff automatically deflates after a period of time (170 seconds for adult and pediatric patient, 85 seconds for neonatal patient).

During venous puncture, pay attention to the cuff pressure and the remaining time displayd in the NIBP numerics area.

16.10 NIBP Maintenance

16.10.1 NIBP Leakage Test

The NIBP leakage test checks the integrity of the system and of the valve. The NIBP leakage test should be performed once every two years or when you doubt the NIBP measurements. The NIBP leakage test should be performed by Mindray-qualified service personnel only.

16.10.2 NIBP Accuracy Test

The NIBP accuracy test should be performed once every two years or when you doubt the NIBP measurements. The NIBP accuracy test should be performed by Mindray-qualified service personnel only.

16.11 NIBP Troubleshooting

For more information, see *D Alarm Messages*.

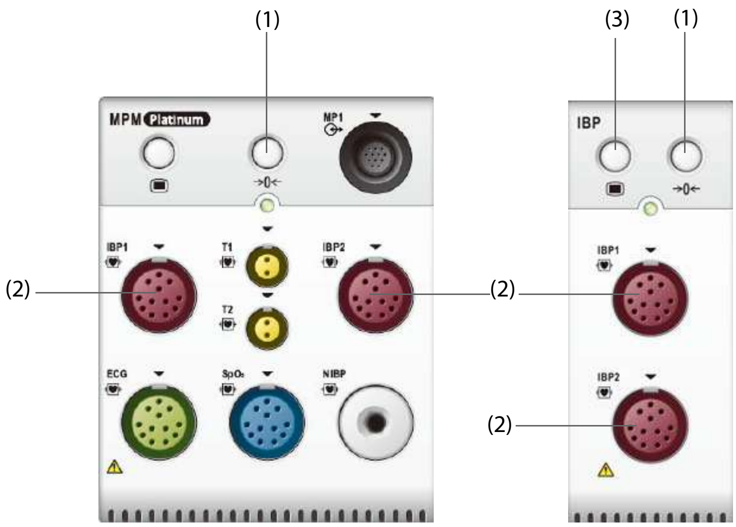
This page intentionally left blank.

17 Monitoring Invasive Blood Pressure (IBP)

17.1 IBP Introduction

You can measure invasive blood pressure (IBP) using the MPM, or the IBP module. This patient monitor can monitor up to 8 invasive blood pressures.

IBP monitoring is intended for adult, pediatric, and neonatal patients. PAWP monitoring is only intended for adult and pediatric patients.



(1) Zero IBP hard key (2) IBP cable connector (3) IBP menu hard key

NOTE

- **If your monitor configures the PiCCO module, you can also measure IBP with the PiCCO module. For more information, see *22 Monitoring Continuous Cardiac Output (from PiCCO Module)*.**

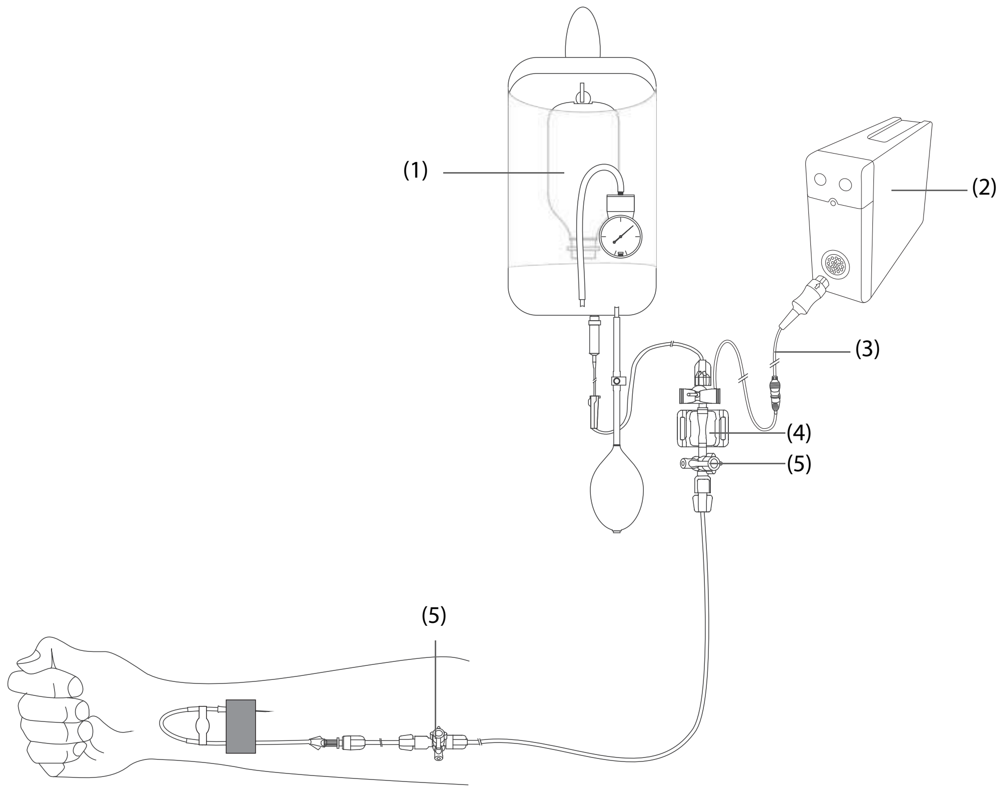
17.2 IBP Safety Information

WARNING

- **Use only pressure transducers specified in this manual. Never reuse disposable pressure transducers.**
- **Make sure that the applied parts never contact other conductive parts.**
- **To reduce the hazard of burns during high-frequency surgical procedure, ensure that the monitor's cables and transducers never come into contact with the high-frequency surgical units.**
- **When using accessories, their operating temperature should be taken into consideration. For more information, see instructions for use of accessories.**
- **All invasive procedures involve risks to the patient. Use aseptic technique. Follow catheter manufacturer's instructions.**
- **Mechanical shock to the invasive blood pressure transducer may cause severe shifts in zero balance and calibration, and cause erroneous readings.**

17.3 Preparing for IBP Monitoring

17.3.1 IBP Equipment to Patient Connection



(1) Pressure bag

(2) IBP module

(3) IBP cable

(4) IBP transducer

(5) Three-way valve

17.3.2 Measuring an Invasive Blood Pressure

To monitor IBP, follow this procedure:

1. Connect one end of the IBP cable to the IBP cable connector on the module, and the other end to the IBP transducer.
2. Flush the IBP transducer system to exhaust all air from the tubing according to the manufacturer's instructions. Ensure that the system is free of air bubbles.
3. Connect the IBP transducer to the patient, making sure that the transducer is at the same horizontal level as the heart.
4. Select the proper pressure label for currently measured pressure. For more information, see *17.6.2 Changing the Pressure Label*.
5. Zero the IBP transducer. For more information, see.*17.3.3 Zeroing the IBP transducer*. After a successful zeroing, turn off the stopcock to the air and turn on the stopcock to the patient.

CAUTION

- **Make sure that all the transducers are zeroed correctly before the IBP measure.**
- **Make sure that no air bubble exists in the IBP transducer system before the IBP measure.**
- **If measuring intracranial pressure (ICP) with a sitting patient, level the transducer with the top of the patient's ear. Incorrect leveling may give incorrect values (not applicable if measuring ICP with the Codman ICP transducer).**

17.3.3 Zeroing the IBP transducer

To avoid inaccurate pressure readings, the monitor requires a valid zero. Zero the transducer in accordance with your hospital policy. The IBP transducer should be zeroed in the following conditions:

- The IBP transducer, adapter cable or module is reconnected.
- The monitor restarts.
- You doubt the readings.
- The monitor displays the prompt message **Zero Required**.

To zero the transducer, follow this procedure:

1. Connect the IBP transducer, the IBP adapter cable and the module.
2. Turn off the three-way valve (the one near the transducer) to the patient, in order to vent the transducer to the atmospheric pressure.
3. Zero the transducer by one of the following methods:
   - Press the **Zero** hard key on the module.
   - Select the numeric area (such as the Art numeric area), and then select **Zero** button.
   - Select the **IBP Zero** quick key.
4. After the zero calibration is completed, close the stopcock to the air and open the stopcock to the patient.

Zero calibration may fail in case of pressure fluctuation or pressure exceeding the calibration range. If zero calibration fails, follow this procedure:

1. Check that the three-way valve (the one near the transducer) is open to the air.
2. Perform zero calibration again. Do not sway the IBP transducer and tubing during zero calibration.

17.4 Measuring ICP Using the Codman ICP Transducer

17.4.1 Zeroing the Codman ICP transducer

You shall zero the Codman ICP transducer (Model: 82-6653) before use. To zero the ICP transducer, follow this procedure:

1. Before unpacking the ICP transducer, check that the monitor supports the Codman ICP transducer.
   a Select the **Main Menu** quick key → turn to the second page → from the **Parameters** column select **Setup** → select **ICP** (If the **ICP** button is not in the **Setup** menu, select any IBP button to enter corresponding IBP menu, and then change the IBP label to **ICP**) → select the **Zero** tab.
   b Check that the following icon is displayed in the **Zero** page. The monitor supports the Codman ICP transducer if the following icon is displayed in the **Zero** page.

1. Connect the ICP transducer, the ICP adapter cable and the module.
2. Follow the manufacturer's instructions to prepare the ICP transducer.
3. Zero the ICP transducer: when you see the message **Zero Reference** in the ICP numeric area, select the ICP waveform area or numeric area to enter the **ICP** menu → select the **Zero** tab → select the **Zero** button.
4. Record the zero reference value on the blank area of the ICP transducer for further reference.

If the ICP transducer zero calibration failed or you doubt the zero reference value, perform a zero calibration again.

17.4.2 Measuring ICP

To perform the ICP measurement, follow this procedure:

1. Zero the Codman ICP transducer. For more information, see section *17.4.1 Zeroing the Codman ICP transducer*.
2. Disconnect the ICP transducer and ICP adapter cable. Follow the manufacturer's instructions to apply the ICP transducer to the patient.
3. Reconnect the ICP transducer and ICP adapter cable.
4. Check that the zero reference value displayed on the monitor is consistent with that recorded on the ICP transducer.
   - Consistent: select **Accept**.
   - Inconsistent: input the zero reference value recorded on the ICP transducer, and select **Accept**.

If you have to transfer the patient who is taking ICP measurement, check that the target monitor supports the Codman ICP transducer. For more information, see *17.4.1 Zeroing the Codman ICP transducer*. If the target monitor does not support the Codman ICP transducer, do not use it for ICP monitoring.

Follow this procedure to transfer the patient:

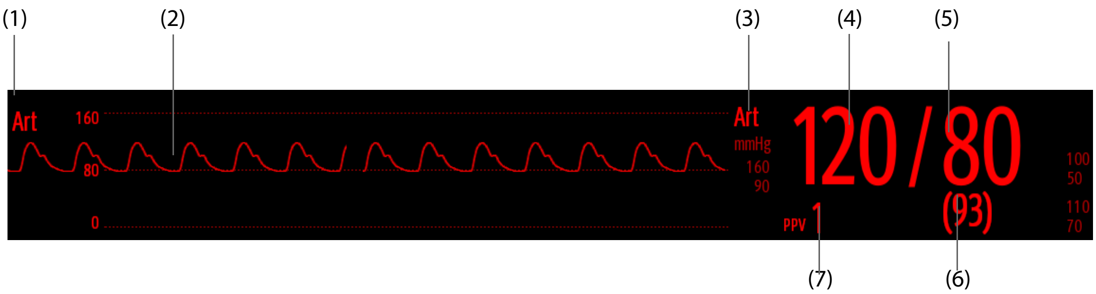
1. Disconnect the ICP adapter cable from the measurement module, or remove the module from the monitor.
2. Connect the ICP adapter cable, measurement module, and the target monitor, or insert the measurement module into the target monitor.
3. Check that the zero reference value displayed on the monitor is consistent with that recorded on the ICP transducer.
   - Consistent: select **Accept**.
   - Inconsistent: input the zero reference value recorded on the ICP transducer, and select **Accept**.

CAUTION

- **If monitors of different brands are used to zero the Codman ICP transducer, the zero reference values can be different. Use a Mindray monitor to Zero the Codman ICP transducer if you will take ICP measurement using a Mindray monitor. Otherwise the ICP measurement can be inaccurate.**

17.5 IBP Display

The IBP measurement is displayed on the monitor as a waveform and numeric pressures. For arterial pressure, the IBP numeric area displays systolic pressure, diastolic pressure and mean pressure. For venous pressure, the IBP numeric area displays only the mean pressure. The figure below shows the waveform and numerics for the Art pressure.



(1) Pressure label	(2) Waveform
(3) Pressure Unit	(4) Systolic pressure
(5) Diastolic pressure	(6) Mean pressure
(7) PPV measurement	

17.6 Changing IBP Settings

17.6.1 Changing the IBP Alarm Settings

To change the IBP alarm settings, follow this procedure:

1. Select the IBP numeric area or waveform area to enter the corresponding pressure menu.
2. Select the **Alarm** tab.
3. Enter the password if required.
4. Set the alarm properties.

17.6.2 Changing the Pressure Label

The pressure label is a unique identifier for each type of pressure. Therefore, you should select a proper pressure label for the source of the pressure you want to monitor.

To select the pressure label, follow this procedure:

1. Select the IBP numeric area or waveform area to enter the corresponding pressure menu.
2. Select the **Setup** tab.
3. Set **IBP1 Label** or **IBP2 Label**.

Label	Description	Label	Description
PA	Pulmonary artery pressure	CVP	Central venous pressure
Ao	Aortic pressure	LAP	Left atrial pressure
UAP	Umbilical arterial pressure	RAP	Right atrial pressure
BAP	Brachial arterial pressure	ICP	Intracranial pressure
FAP	Femoral arterial pressure	UVP	Umbilical venous pressure
Art	Arterial blood pressure	LV	Left ventricular pressure
CPP	Cerebral perfusion pressure	P1 to P4	Non-specific pressure label

NOTE

- **It is not allowed to select the same label for different pressures.**

17.6.3 Setting the Pressure Type for Display

For the non-specific pressure (P1, P2, P3 or P4), the displayed pressure type is configurable. To set the displayed pressure type, follow this procedure:

1. Select the numeric area or waveform area of the non-specific pressure to enter the corresponding pressure menu.
2. Select the **Setup** tab.
3. Set **Measure**:
   - ◆ If this non-specific pressure is artery pressure, set the **Measure** to **All**. In this case, its corresponding numeric area displays systolic pressure, diastolic pressure and mean pressure.
   - ◆ If this non-specific pressure is venous pressure, set the **Measure** to **Mean Only**. In this case, its corresponding numeric area displays only the mean pressure.

17.6.4 Changing the Sensitivity

The IBP value displayed on the monitor screen is the average of data collected within a specific time. The shorter the averaging time is, the quicker the monitor responds to changes in the patient's blood pressure, and the higher the sensitivity. Contrarily, the longer the averaging time is, the slower the monitor responds to changes in the patient's blood pressure, the lower the sensitivity, but the measurement accuracy will be improved. For critically ill patients, selecting higher sensitivity will help understanding the patient's state.

To set the sensitivity, follow this procedure:

1. Select the IBP numeric area or waveform area to enter the corresponding pressure menu.
2. Select the **Setup** tab.
3. Set **Sensitivity**.

17.6.5 Setting the IBP Waveform

To set the IBP waveform, follow this procedure:

1. Select the IBP numeric area or waveform area to enter the corresponding pressure menu.
2. Select the **Setup** tab.
3. Set the following properties of the IBP waveform:

- ◆ **Speed**
- ◆ **Scale**: if **Auto** is selected, the size of the pressure's waveform will be adjusted automatically.

17.6.6 Setting the Display Format of Artery Pressure

To set the display format of the artery pressure, follow this procedure:

1. Select the numeric area or waveform area of any arterial pressure to enter the corresponding menu.
2. Select the **Setup** tab.
3. Set **Display Format**.

17.6.7 Showing/Hiding the Alarm Limits of Artery Pressure

To set whether to display the alarm limits of the arterial pressure, follow this procedure:

1. Select the numeric area or waveform area of any arterial pressure to enter the corresponding menu.
2. Select the **Setup** tab.
3. Switch on or off **Display Alarm Limits.**

17.6.8 Setting the Use PA-D as PAWP Switch

You can set whether PA-D value is used to replace PAWP value for hemodynamic calculation. To do so, follow this procedure:

1. Select the PA numeric area or waveform area to enter the **PA** menu.
2. Select the **Setup** tab.
3. Switch on or off **Use PA-D as PAWP**.

For more information on hemodynamic calculation, see *35.4 Hemodynamic Calculations*.

17.6.9 Enabling PPV Measurement

PPV indicates pulse pressure variation. When measuring the arterial pressure (except PA), the PPV measurement is available. To enable the PPV measurement, follow this procedure:

1. Select the IBP numeric area or waveform area to enter the corresponding pressure menu.
2. Select the **PPV Setup** tab.
3. Switch on **PPV Measure**.

You can select PPV source after enabling the PPV measurement.

WARNING

- **This monitor can calculate PPV from beat-to-beat values of any arterial pulsatile pressure. The circumstances under which the calculation of a PPV value is clinically meaningful, appropriate and reliable must be determined by a physician.**
- **The clinical value of the derived PPV information must be determined by a physician. According to recent scientific literature, the clinical relevance of PPV information is restricted to sedated patients receiving controlled mechanical ventilation and mainly free from cardiac arrhythmia.**
- **PPV calculation may lead to inaccurate values in the following situations:**
  - ◆ **at respiration rates below 8 rpm**
  - ◆ **during ventilation with tidal volumes lower than 8 ml/kg**
  - ◆ **for patients with acute right ventricular dysfunction (“corpulmonale”).**
- **The PPV measurement has been validated only for adult patients.**

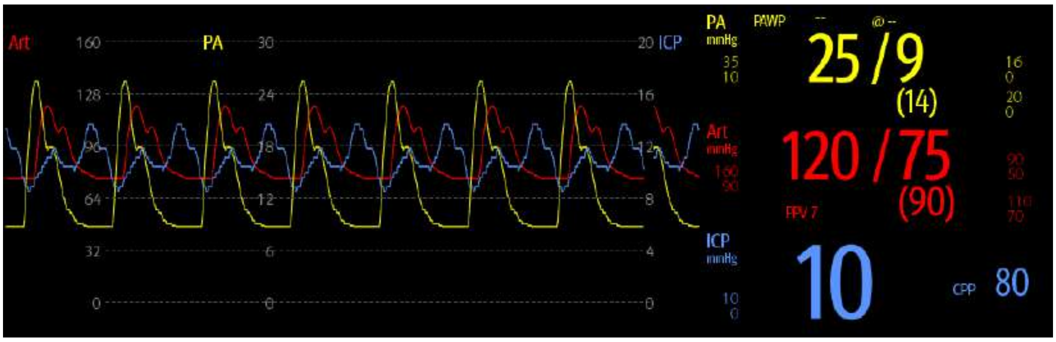
NOTE

- **The PPV measurement from IBP will automatically be switched off if PiCCO module is working. The monitor will measure PPV through PiCCO module.**

17.6.10 Overlapping IBP Waveforms

The IBP waveforms can be displayed together. To combine IBP waveforms, follow this procedure:

1. Access **Tile Layout** by either of the following ways:
   - ◆ Select the **Screen Setup** quick key → select the **Tile Layout** tab.
   - ◆ Select **Main Menu** quick key → from the **Display** column select **Tile Layout**.
2. Select the waveform area where you want to display the overlapped IBP waveforms, and then select the IBP waves to be overlapped on the left side of the same line.
3. Repeat step 2 in another waveform area if needed.
4. Select ☒ to save the setting and exit the window. The main screen will display the overlapped IBP waves.



Selecting the overlapped IBP waveforms on the main screen opens the **Overlapping Waveform Setup** menu, where you can make the following settings:

- ■ Scale
  - ◆ Set **Left Scale** for the arterial pressure.
  - ◆ Set **Right Scale** for the venous pressure.
  - ◆ Set **CVP Scale** individually if the CVP waveform is combined and CVP unit is different from IBP unit.
  - ◆ Set **ICP Scale** individually if the ICP waveform is combined and ICP unit is different from IBP unit.
  - ◆ Set **PA Scale** individually if the PA waveform is combined.
- ■ Switch on or off **Gridlines** to show or hide gridlines in the overlapped waveform area.
- ■ Set **Speed** for the overlapped waveforms.

NOTE

- **The unit of CVP scale is consistent with CVP parameter unit.**

17.7 Measuring PAWP

Pulmonary Artery Wedge Pressure (PAWP) values, used to assess cardiac function, are affected by fluid status, myocardial contractility, and valve and pulmonary circulation integrity.

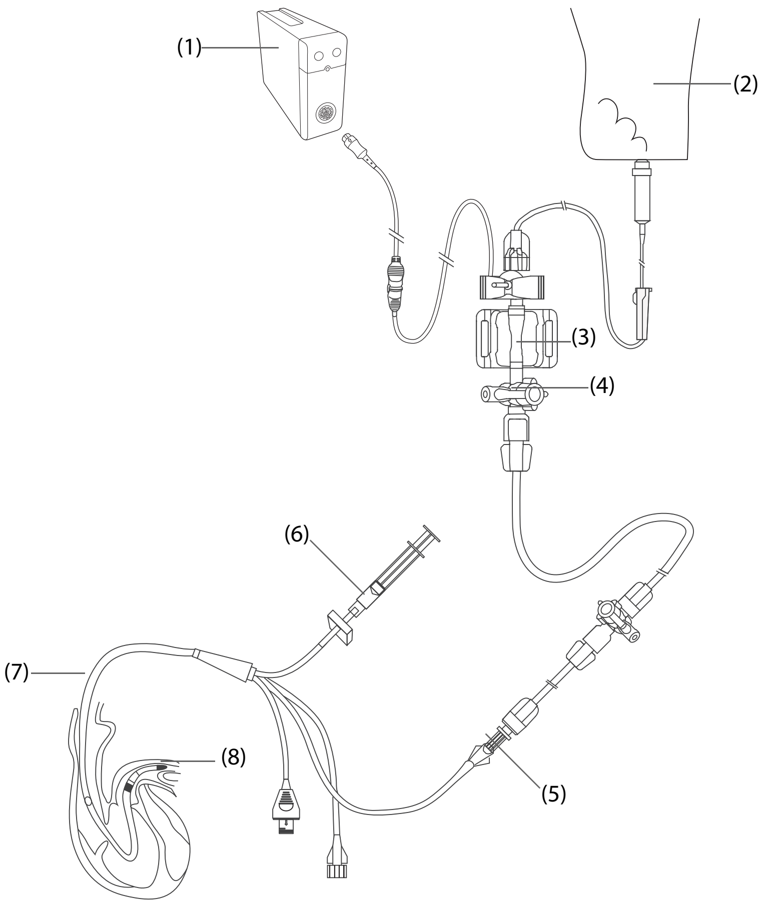
Obtain the measurement by introducing a balloon-tipped pulmonary artery flotation catheter into the pulmonary artery. When the catheter is in one of the smaller pulmonary arteries, the inflated balloon occludes the artery allowing the monitor to record changes in the intrathoracic pressures that occur throughout the respiration cycle.

The pulmonary wedge pressure is the left ventricular end diastolic pressure when the airway pressure and valve function are normal. The most accurate PAWP values are obtained at the end of the respiration cycle when the intrathoracic pressure is fairly constant and the artifact caused by respiration is minimal.

WARNING

- **PAWP monitoring is not intended for neonatal patients.**

17.7.1 PAWP Equipment to Patient Connection



(1) MPM/IBP module	(2) Flush bag
(3) IBP transducer	(4) Three-way valve
(5) PA distal port	(6) Balloon inflation valve
(7) Thermodilution catheter	(8) Balloon

17.7.2 Preparing to Measure PAWP

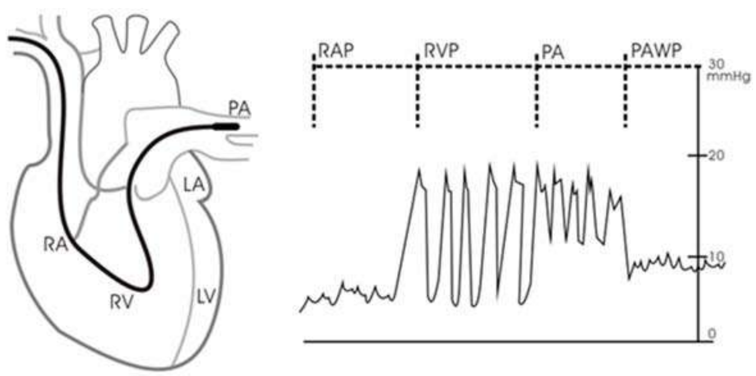
To prepare to monitor PAWP, follow this procedure:

1. Connect the IBP transducer, the IBP cable and the module. For more information, see *17.3.2 Measuring an Invasive Blood Pressure*.
2. Follow the manufacturer's instructions to connect the PA port of the thermodilution catheter and the patient end of the IBP transducer.
3. Zero the IBP transducer. For more information, see *17.3.3 Zeroing the IBP transducer*.
4. Set the IBP label to **PA** since the PAWP is measured on PA. For more information, see *17.6.2 Changing the Pressure Label*.

17.7.3 Measuring PAWP

To measure the PAWP, follow this procedure:

1. Select the PA numeric area or waveform area to enter the **PA** menu, and then select **PAWP**.
2. Wedge the flotation catheter into the pulmonary artery by observing the PA waveform changes on the screen, referring to the following figure.



3. Select **Start**.
4. Inflate the balloon and pay attention to PA waveform changes on the screen when the prompt message **Ready For Balloon Deflation** appears.
5. Deflate the balloon when the prompt message **Ready For Balloon Deflation** appears. If the PA waveform is stable yet the monitor still not show the prompt message **Ready For Balloon Deflation**, select the **Freeze** to freeze the waveform, and deflate the balloon.
6. Select **Accept** to save the PAWP value.
7. If you need to start a new measurement, repeat the step 3 to step 6.

If the measurement fails or you need to adjust the PAWP value, you can use the following buttons to adjust the PAWP waveform and measurement.

- Select the up or down arrow button to adjust the PAWP value.
- Select the left or right arrow button to view the frozen waveforms of 40 seconds.
- Select **Accept** to save the PAWP value.

WARNING

- **Prolonged inflation can cause pulmonary hemorrhage, infarction or both. Inflate the balloon for the minimum time necessary to get an accurate measurement.**
- **If the PAWP is greater than the PA (systolic), deflate the balloon and report the incident in accordance with hospital policy. Because the pulmonary artery could be accidentally ruptured, and the PAWP value derived will not reflect the patient's hemodynamic state, but will merely reflect the pressure in the catheter or balloon.**

- **If the flotation/thermodilution catheter drifts into the wedge position without inflation of the balloon, the PA waveform assumes a wedged appearance. Take appropriate action, in accord with standard procedures, to correct the situation.**

NOTE

- **The PA alarm is turned off automatically when the monitor enters the PAWP screen.**

17.7.4 Setting the Waveforms of the PAWP Screen

On the **PAWP** screen, select **Setup** to enter the **PAWP Setup** menu. In the **PAWP Setup** menu, you can make the following settings:

- Select **Reference Waveform 1** to set an ECG lead wave as the first reference wave.
- Select **Reference Waveform 2** to set a respiration wave as the second reference wave.
- Select **Speed** to set a sweep speed for the displayed waveforms on the **PAWP** screen.
- Select **Scale** to set the size of the PA waveform on the **PAWP** screen.

17.7.5 Performing Hemodynamic Calculation

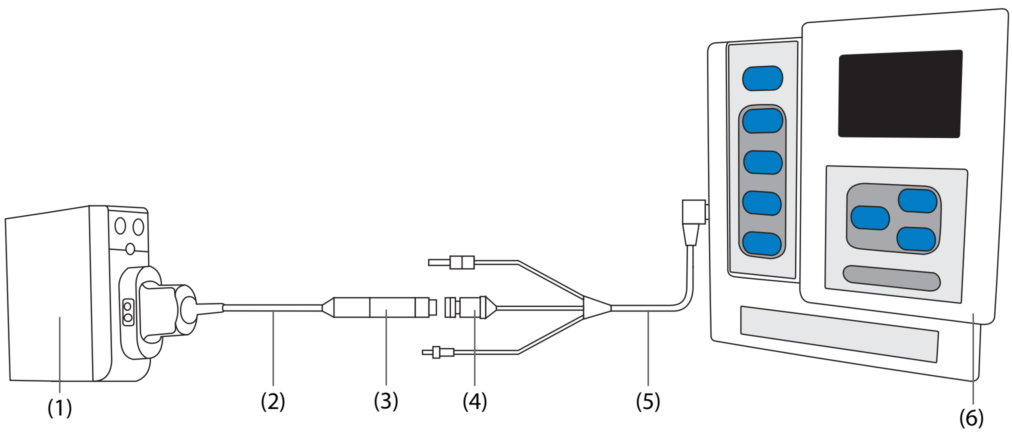
On the **PAWP** screen, select **Hemo Calcs** to enter the **Hemo Calcs** menu. For more information, see *35.4 Hemodynamic Calculations*.

17.8 Connecting a Camino Device

The IBP module can interface with the Camino multi-parameter monitor (Model: MPM1) to measure intracranial pressure (ICP).

To connect the Camino, follow this procedure:

1. Plug the IBP module into the module rack.
2. Connect the Camino ICP cable to the IBP module.
3. Connect the ICP connector to the ICP adapter.
4. Connect the Camino cable to the Camino monitor.



(1) IBP module	(2) Camino ICP cable
(3) ICP adapter	(4) ICP connector
(5) Camino cable	(6) Camino monitor

WARNING

- **Observe the Camino Operator's Manual to make settings and to connect the monitor with the patient.**
- **Because you can set the ICP alarm limits on this patient monitor, the ICP alarms settings on this patient monitor may be different from those on the Camino device. Please pay special attention to the alarms on the Camino.**

NOTE

- **Only IBP module can be used for connecting the Camino. IBP connectors on other modules, such as the MPM, PiCCO module, do not have this function.**

17.9 IBP Troubleshooting

This section lists the problems that might occur. If you encounter the problems when using the equipment or accessories, check the table below before requesting for services. If the problem persists, contact your service personnel.

NOTE

- **For the physiological and technical alarm messages, see *D Alarm Messages*.**

Problem	Solution
Cannot see IBP numeric area or waveform area on the main screen	1. Check that the IBP is set to display in the **Screen Setup** menu. For more information, see *39.13 The Authorization Setup Settings*. 2. Check that if the IBP parameter switch is enabled. If not, enable the IBP measurement. For more information, see *3.11.1 Switching On or Off a Parameter*. 3. Check the connection of IBP cable, IBP transducer and module. 4. Check that the stopcock is turned to the correct position. 5. Check that the IBP transducer has been zeroed. For more information, see *17.3.3 Zeroing the IBP transducer*.
Cannot see systolic pressure and diastolic pressure for P1/P2/P3/P4	Set **Measure** to **All** in the P1/P2/P3/P4 setup menu. For more information, see *17.6.3 Setting the Pressure Type for Display*.
IBP readings seem unstable	1. Make sure there are no air bubbles in the transducer systems. 2. Check that the transducer is properly fixed. 3. Zero the transducer again. 4. Replace a transducer.
Zeroing of IBP channel(s) fails.	1. Ensure that the channels are open to air. 2. Perform zero calibration again. Do not sway the IBP transducer and tubing during zero calibration. For more information, see *17.3.3 Zeroing the IBP transducer*. 3. If zero calibration still fails, replace the transducer.

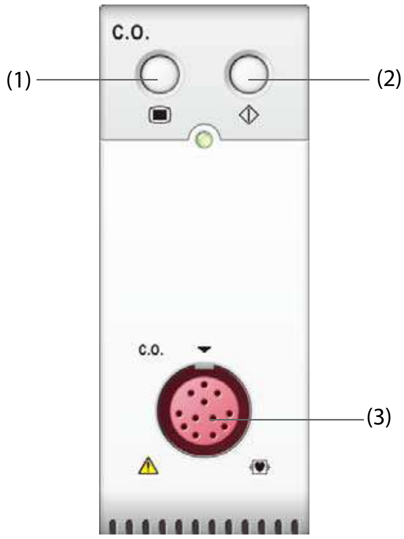
This page intentionally left blank.

18 Monitoring Cardiac Output (C.O.)

18.1 C.O. Introduction

The cardiac output (C.O.) measurement invasively measures cardiac output and other hemodynamic parameters using the right heart (atria) thermodilution method. A cold solution of known volume and temperature is injected into the right atrium through the proximal port of a pulmonary artery (PA) catheter. The cold solution mixes with the blood in the right ventricle and the change in blood temperature is measured with a thermistor at the distal end of the catheter in the pulmonary artery. The temperature change is displayed as a curve on the C.O. split screen, and the monitor calculates the C.O. value from this curve. The C.O. value is inversely proportional to the area under the curve. As cardiac output varies continuously, a series of measurements must be carried out to achieve a reliable C.O. average value. Always use the average of multiple thermodilution measurements for therapy decisions. The monitor is capable of storing 6 measurements.

C.O. monitoring is intended for adult patients only.



(1) C.O. menu hard key (2) C.O. measure menu hard key (3) C.O. cable connector

18.2 C.O. Safety Information

WARNING

- **The C.O. measurement results may be erroneous during electrosurgery.**
- **All invasive procedures involve risks to the patient. Use aseptic technique and follow catheter manufacturer's instructions.**
- **Use only accessories specified in this manual. Make sure that the accessories never come into contact with conductive parts.**
- **C.O. monitoring is not intended for pediatric and neonatal patients.**

18.3 C.O. Measurement Limitations

The following factors may influence the accuracy of C.O. measurement:

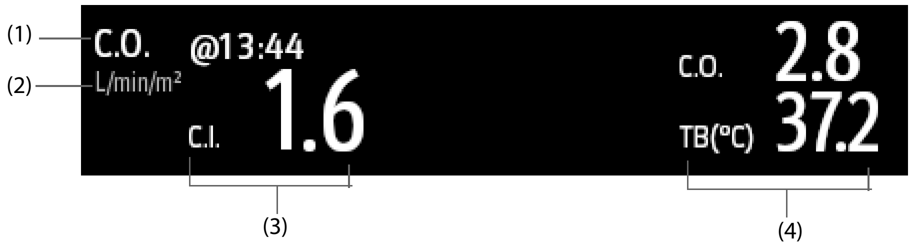
- temperature of injectate solution
- volume of injectate solution
- baseline of patient's blood temperature
- patient's inspiratory/expiratory cycle
- placement of catheter with relation to proximity of lung field
- the catheter itself
- patient's heart rate and hemodynamic status
- any solution infused with intravenous injection during the C.O. measurement

To obtain accurate C.O. measurements, follow these recommendations:

- Temperature of injectate solution must be at least 10 ºC cooler than that of the patient's blood.
- Inject solution at end of expiration.
- Inject solution rapidly and smoothly.
- Finish injection within four to five seconds.

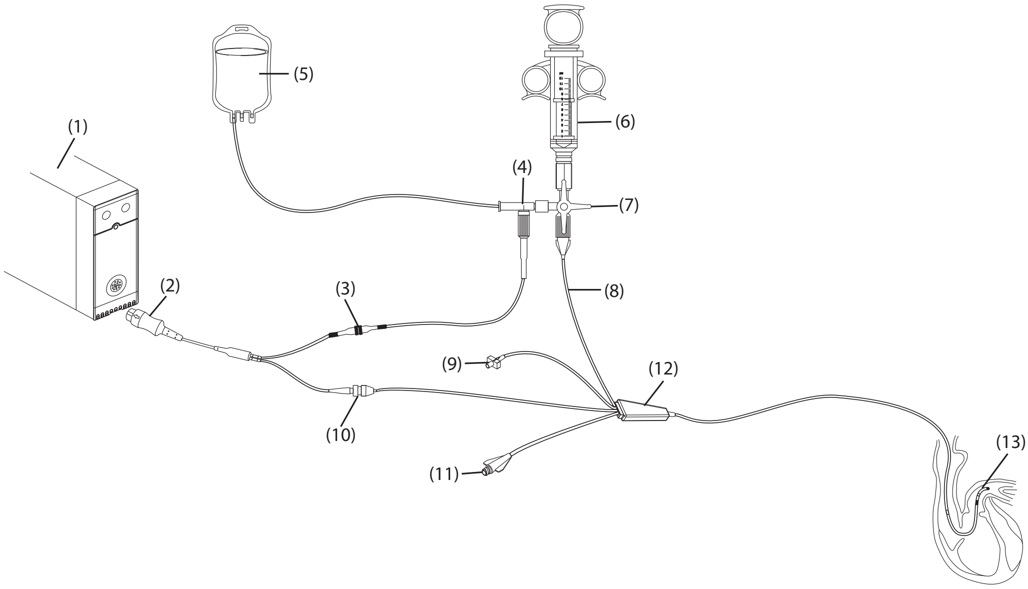
18.4 C.O. Display

The C.O. display shows only C.O., C.I (cardiac index), and TB (blood temperature) in the C.O. numeric area.



(1) C.O. label	(2) Primary parameter unit
(3) Labels and values for primary parameter	(4) Label and value for secondary parameters

18.5 C.O. Equipment to Patient Connection



(1) C.O. module	(2) 12-pin C.O. cable (Model: CO7702)	(3) TI cable connector
(4) In-line probe	(5) Injectate solution	(6) Injectate syringe
(7) Three-way valve	(8) Proximal injectate port	(9) Balloon inflation valve
(10) Thermistor connector	(11) PA distal port	(12) Thermodilution catheter
(13) Thermistor		

18.6 Performing C.O. Measurement

18.6.1 Preparing for C.O. Measurement

1. Connect the C.O. cable to the C.O. module and thermistor connector, making sure the C.O. numeric area is displayed on the monitor's main screen.
2. Follow the hospital's policy and procedures to prepare the patient for the C.O. measurement.
3. Follow the manufacturer's instructions to set up the catheter and other accessories.
4. Check that all the accessories are properly connected.

NOTE

- **For an in-line probe setup, make sure the in-line sensor is securely connected to the tubing. For the bath probe setup, make sure the bath probe is correctly sensing the injectate temperature.**

18.6.2 Setting C.O. Measurement

Before performing the C.O. measurement, follow this procedure:

1. Select the C.O. numeric area to enter the **C.O. Measure** menu.
2. Select the **Setup**.
3. Perform the following check or setup:
   - ◆ Check if the height and weight are appropriate for your patient. Change if necessary. The patient's height and weight values are required for determining cardiac index (C.I.).
   - ◆ Check that the correct computation constant is entered. The computation constant has a close relationship with the entered injectate volume, injectate probe type (in-line probe or bath probe) and

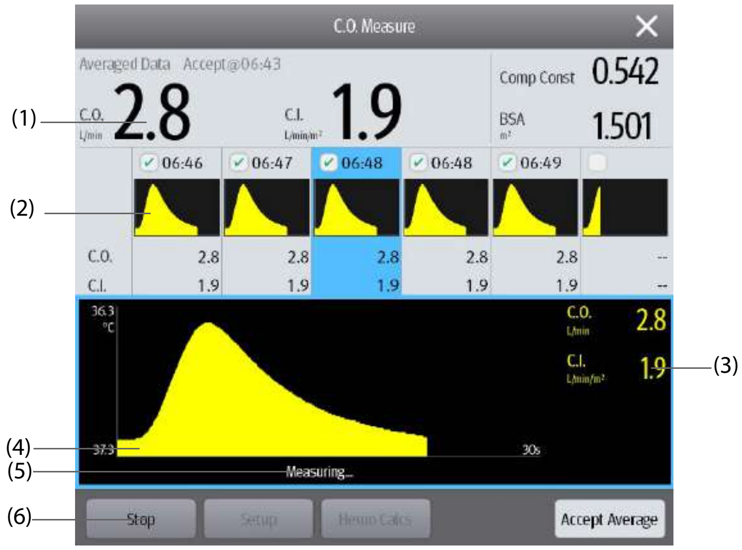
temperature. See the Instruction for Use of pulmonary artery catheter to determinate. To change the computation constant, select **Comp Const** and then input the correct value. When a new catheter is used, the computation constant should be adjusted in accordance with the manufacturer's instructions for use.

- Switch on or off **Auto TI**. If **Auto TI** is switched on, the system automatically detects the injectate temperature, and **TI** setting is disabled. If **Auto TI** is switched off, you need to input the injectate temperature at **TI**.
- Switch on or off **Auto Start**. If **Auto Start** is switched on, the monitor automatically takes the C.O. measurement after establishing a baseline of blood temperature. If **Auto Start** is switched off, you need to click the **Start** button in the **C.O. Measure** window for a new measurement.

18.6.3 Performing C.O. Measurement

To perform the C.O. measurement, follow this procedure:

1. Select the C.O. numeric area to enter the **C.O. Measure** menu.



(1) Average values	(2) Historical measurement windows
(3) Currently measurement values	(4) Current C.O. curve
(5) Prompt message area	(6) Buttons

2. Proceed as follows to perform the C.O. measure:
   - If **Auto Start** is switched off, select the **Start** button, and then inject the solution quickly when you see the message **Please Wait**. As shown in the figure above, during the measurement, the currently measured thermodilution curve is displayed. At the end of the measurement, the thermodilution curve is transferred to one of the 6 measurement windows and the monitor prompts you to wait for a certain period of time before starting a new measurement.
   - If **Auto Start** is switched on, inject the solution quickly when you see the message **Ready for new set of measurement**. The monitor consecutively takes C.O. measurements automatically without the need for pressing the **Start** button between two measurements. A new thermodilution measurement is possible as soon as the message **Inject now!** is displayed on the screen. The monitor automatically detects further thermodilution measurements.
3. Acquire the average value of C.O. and C.I. A maximum of 6 measurements can be stored. If you perform more than six measurements without rejecting any, the oldest will automatically be deleted when a seventh curve is stored. Select from the 6 measurement curves and the system will automatically calculate and display the averaged C.O. and C.I. values. Then select the **Accept Average** button to accept and store the averaged values.

When injecting, the stopcock to the thermodilution catheter is open and the stopcock to the injectate solution is closed. After completing the measurement, turn off the stopcock to the thermodilution catheter and turn on the stopcock to the injectate solution, and then draw the injectate solution into the injectate syringe.

The button area also provides you with the following functions:

- Select **Stop** to stop the current measurement.Select **Setup** to enter the **C.O.** menu.
- Select **Hemo Calcs** to enter the **Calculations** menu.

NOTE

- **Starting a measurement without blood temperature being stable may cause measurement failure.**
- **The TB alarms are inactivated during a C.O. measurement, and will be reactivated automatically after the completion of C.O. measurement.**
- **Please see the Instructions for Use of thermodilution catheter to determine the Comp Const and the volume of injectate solution.**

18.7 Changing C.O. Settings

18.7.1 Setting C.O. Alarm Properties

To set the C.O. alarm properties, follow this procedure:

1. Select the C.O. numeric area to enter the **C.O. Measure** menu.
2. Select **Setup** to enter the **C.O.** menu.
3. Select the **Alarm** tab.
4. Enter the password if required.
5. Set alarm properties as desired.

18.7.2 Selecting the Primary C.O. Parameter

You can select C.O. or C.I. as the main C.O. parameter. The measurement of the primary parameter displays in larger numerics. To do so, follow this procedure:

1. Select the C.O. parameter area to enter the **C.O. Measure** menu.
2. Select the **Setup** tab.
3. Set **Primary Parameter**.

18.8 C.O. Troubleshooting

This section lists the problems that might occur. If you encounter the problems when using the equipment or accessories, check the table below before requesting for services. If the problem persists, contact your service personnel.

NOTE

- **For the physiological and technical alarm messages, see *D Alarm Messages*.**

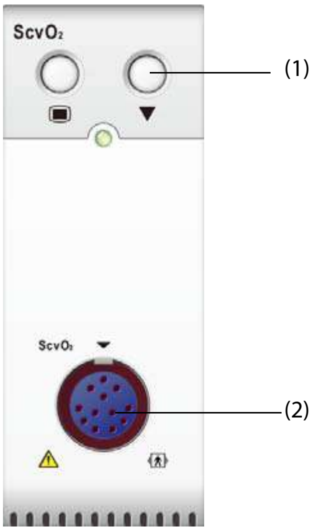
Problem	Solution
Do not see C.O. numeric area on the main screen	1. Check that the C.O. is set to display in the **Screen Setup** menu. For more information, see *39.9.5 The Other Tab*. 2. Check that if the C.O. parameter switch is enabled. If not, enable the C.O. measurement. For more information, see *3.11.1 Switching On or Off a Parameter*. 3.Check that the patient type is adult. 4. Check the connection of C.O. cable, thermodilution catheter and TI sensor.
C.O. value is inaccurate	1. Check that the thermodilution catheter is positioned properly. 2. Check that the computational constant is proper for current injectate temperature, injectate volume and injectate probe type. 3. Inject solution rapidly and smoothly. 4. Finish injection within four to five seconds. 5. Inject more volume, or inject colder solution. 6. Check that the height and weight of patient is properly configured. 7. If **Auto TI** is switched off, check that the entered temperature is correct.
C.O. measurement fails	1. Inject more volume, or inject colder solution. Make sure that the injectate temperature is at least 10°C colder than the patient blood temperature. 2. Finish injection within four to five seconds. 3. Check the connection of C.O. cable, thermodilution catheter and TI sensor.

19 Monitoring Central Venous Oxygen Saturation ($ScvO_2$)

19.1 $ScvO_2$ Introduction

Central venous oxygen saturation ($ScvO_2$) is measured across spectrophotometry. Spectrophotometry involves the use of light emitting diodes (LED) that produce light of various wavelengths in red and infrared spectra. The light is transmitted to the blood through a fiberoptic in the probe, reflected off the red blood cells and transmitted back through a separate fiberoptic to an optical module. The central venous oxygen saturation is calculated through the analysis of the reflected spectra.

$ScvO_2$ monitoring is intended for adult and pediatric patients.



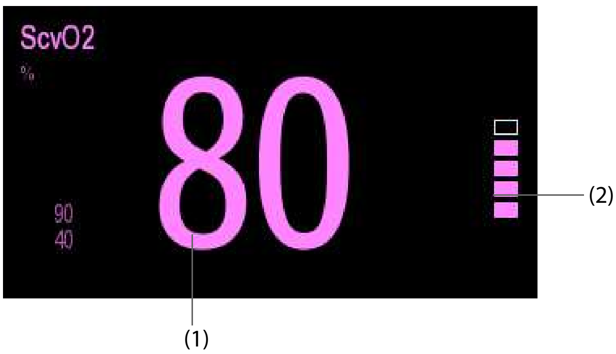
(1) Calibration hard key (2) CeVOX cable connector

19.2 $ScvO_2$ Safety Information

WARNING

- **$ScvO_2$ monitoring is not intended for neonatal patients.**

19.3 $ScvO_2$ Display



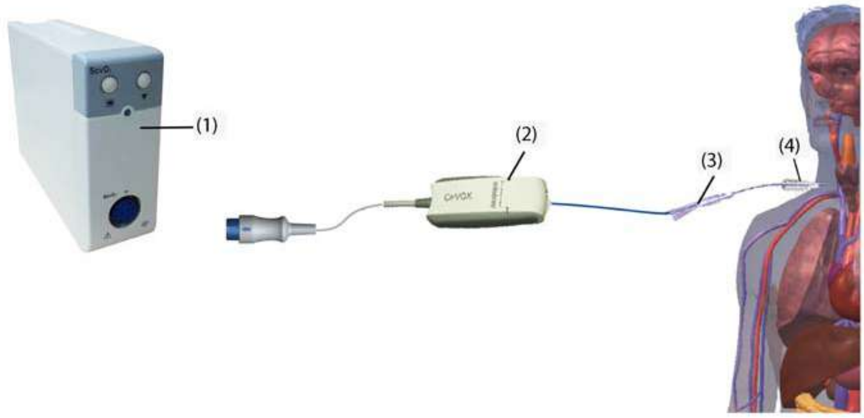
(1) $ScvO_2$ value (2) SQI bar graph

19.4 Accessing the On-screen $ScvO_2$ Guide

The monitor provides the on-screen $ScvO_2$ guide to help you understand $ScvO_2$ monitoring principles, functions, and operating procedure. To access the on-screen $ScvO_2$ guide, follow this procedure:

1. Select the $ScvO_2$ numeric area to enter the **ScvO2** menu.
2. Select the **Introduction** tab.
3. Select the desired tab of **Summary**, **Target Patients**, **Points To Note**, or **Operation Guides**.

19.5 $ScvO_2$ Equipment to Patient Connection



(1) $ScvO_2$ module	(2) CeVOX optical module
(3) CeVOX fiberoptic probe	(4) Central venous catheter

19.6 Measuring $ScvO_2$

To perform the $ScvO_2$ measurements, follow this procedure:

1. Apply the central venous catheter.
2. Place one end of the fiberoptic probe into the central venous catheter through the distal lumina, and connect the other end to the CeVOX optical module.
3. Plug the CeVOX cable into the $ScvO_2$ module.
4. If you see the message **Calibration Required**, calibrate the $ScvO_2$ before performing the measurements. For more information, see *19.7 $ScvO_2$ Calibration*.
5. Check the reading in the $ScvO_2$ numeric area.

WARNING

- **To avoid application failure, ensure that the proper fiberoptic probe is selected.**
- **The monitor may only be regarded as a device providing early warning. If there is an indication of a trend towards de-oxygenation of the patient, blood samples must be taken and tested on a laboratory oximeter in order to arrive at a decision concerning the condition of the patient.**
- **Incorrect placement of the fiberoptic probe can lead to vessel perforation. Therefore, check the correct position of the probe as indicated in the probe's instructions for use.**

19.7 $ScvO_2$ Calibration

Regular in vivo calibration is required using blood gas analysis of a central venous blood sample to ensure accurate measurement of continuous $ScvO_2$. For optimal accuracy, it is recommended that an in vivo calibration be performed at least every 24 hours or if hemoglobin is changing greatly.

To perform calibration, follow this procedure:

1. Check the central venous catheter and CeVOX probe for proper placement.
2. Check the quality of the signal. The Signal Quality Indicator (SQI) is used for assessing the quality of fiberoptical signals during probe placement, calibration and measurement. The signal quality is indicated by bars of different height levels. Generally, the higher the level, the better the signal.
3. Withdraw a sufficient amount of central venous blood from the side port of the CeVOX probe to avoid intermixture of infusion/injection with the withdrawn blood.
4. Slowly withdraw 2ml blood from the side port of the CeVOX probe. Do not pull too strongly in order to avoid a hemolysis.
5. Immediately confirm by selecting **Sample Drawn** in the **Calibration** page of the **ScvO2** menu.
6. Perform an analysis by a blood gas analysis device or a laboratory oximeter.
7. Input lab values for Hb/Hct and $ScvO_2$ and select **Calibrate** to confirm.

NOTE

- **The SQI signal can be affected by the presence of electrosurgical units. Keep electrocautery equipment and cables away from the monitor and use separate power socket if possible.**
- **To achieve optimal accuracy, it is recommended that the entered hemoglobin and hematocrit values are updated when there is a change of 6% or more in hematocrit, or of 1.8 g/dl (1.1 mmol/l) or more in hemoglobin. A change in hemoglobin may also affect SQI.**
- **Dye (e.g. Indocyanine Green) or other substances, containing dyes which usually modify the light absorption capacities, can lead to faulty measurement values of the oxygen saturation.**

19.8 Accessing the HemoSight Menu

To accessing the **HemoSight** menu, follow this procedure:

1. Select the $ScvO_2$ numeric area to enter the **ScvO2** menu.
2. Select the **HemoSight** button. For information on HemoSight, see*33 HemoSight^{TM}*.

19.9 Changing $ScvO_2$ Settings

19.9.1 Changing $ScvO_2$ Alarm Settings

To change the $ScvO_2$ alarm settings, follow this procedure:

1. Select the $ScvO_2$ numeric area to enter the **ScvO2** menu.
2. Select the **Alarm** tab.
3. Enter the password if required.
4. Set the alarm properties of $ScvO_2$.

19.9.2 Setting Hb/Hct

To set the Hb or Hct, follow this procedure:

1. Select the $ScvO_2$ numeric area to enter the **ScvO2** menu.
2. Select the **Calibration** tab.
3. Set **Hb/Hct**.

19.9.3 Inputting the SaO_2 Value

The monitor computes the DO_2 and VO_2 using the SaO_2 value. To input the SaO_2valule, follow this procedure:

1. Select the $ScvO_2$ numeric area to enter the **ScvO2** menu.
2. Select the **Setup** tab.
3. Input the **SaO2** value.

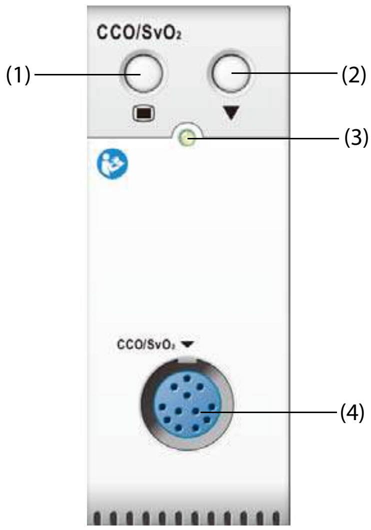
20 Monitoring CCO/SvO_2

20.1 CCO/SvO_2 Introduction

The Edwards Vigilance II, Vigileo, EV1000, and HemoSphere monitors measure continuous cardiac output (CCO), mixed venous oxygen saturation (SvO_2), central venous oxygen saturation ($ScvO_2$) etc. They also calculate hemodynamic and oxygenation parameters. This monitor can be connected to the Vigilance II/Vigileo/EV1000/HemoSphere monitor and can display, store, and review the measured and calculated parameter values from these monitors. This monitor can also give alarms of these measured parameters. You must set alarm on/off, alarm limits, alarm priority, and alarm record separately on this monitor. The alarm is On by default.

The Vigilance II, Vigileo, EV1000, and HemoSphere monitors are manufactured by Edwards Lifesciences. This company provides the technology of measuring and calculating the relevant parameters. We only provide the connection between this monitor and Vigilance II/Vigileo/EV1000/HemoSphere monitor. If you have any doubts about the operation and maintenance of theVigilance II/Vigileo/EV1000/HemoSphere monitor, read the operator's manuals of corresponding monitor, or contact Edwards Lifesciences (www.edwards.com) directly.

The CCO/SvO_2 module is only intended for adult and pediatric patients.



(1) CCO/SvO2 menu hard key

(2) Calibration key (for Vigilance II and Vigileo monitor)

(3) Module status indicator

(4) CCO/SvO_2 cable connector

20.2 CCO/SvO_2 Safety Information

WARNING

- **Because the alarm limits of the relevant measured parameters can be set on this monitor, the alarms of these parameters may be different from those on the Vigilance II/Vigileo/EV1000/HemoSphere monitor. Please pay special attention to the alarms on the Vigilance II/Vigileo monitor.**
- **The CCO/SvO_2 monitoring is not intended for neonatal patients.**

CAUTION

- **Observe the operator's manuals of Vigilance II/Vigileo/EV1000/HemoSphere monitor to configure settings and to connect the monitor to the patient.**
- **This patient monitor gives disconnection alarms when it is disconnected from the Vigilance II/ Vigileo/EV1000/HemoSphere monitor. These alarms may be delayed.**

20.3 CCO Display

The monitor displays CCO parameters from the Vigilance II monitor, Vigileo monitor, or EV1000 monitor. The CCO parameters area varies with different monitoring mode and monitors. You can select the desired parameters to be displayed. For the configuration of the parameters to be displayed, see *20.7.3 Setting Parameters for Display*.

20.4 SvO_2/$ScvO_2$ Display

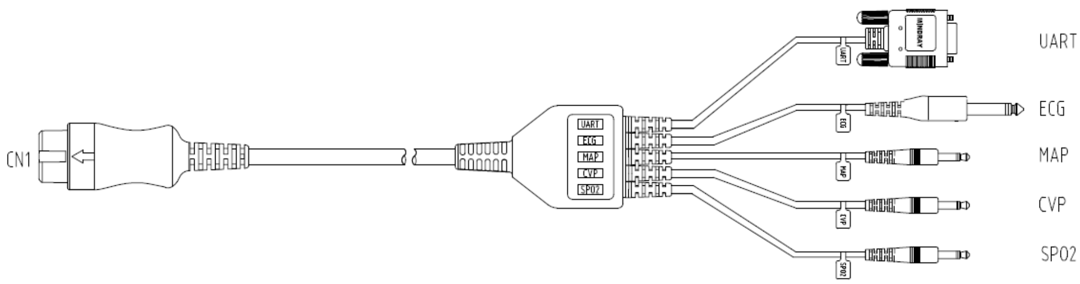
The monitor displays either SvO_2 or $ScvO_2$ parameters from the Vigilance II/Vigileo/EV1000/HemoSphere monitor. SvO_2 numeric area and $ScvO_2$ numeric area cannot display simultaneously. The display depends on the setting of the Vigilance II/Vigileo/EV1000/HemoSphere monitor.

20.5 Connecting the Device

The CCO/SvO_2 cable is used to connect this monitor to the Vigilance II/Vigileo/EV1000/HemoSphere monitor.

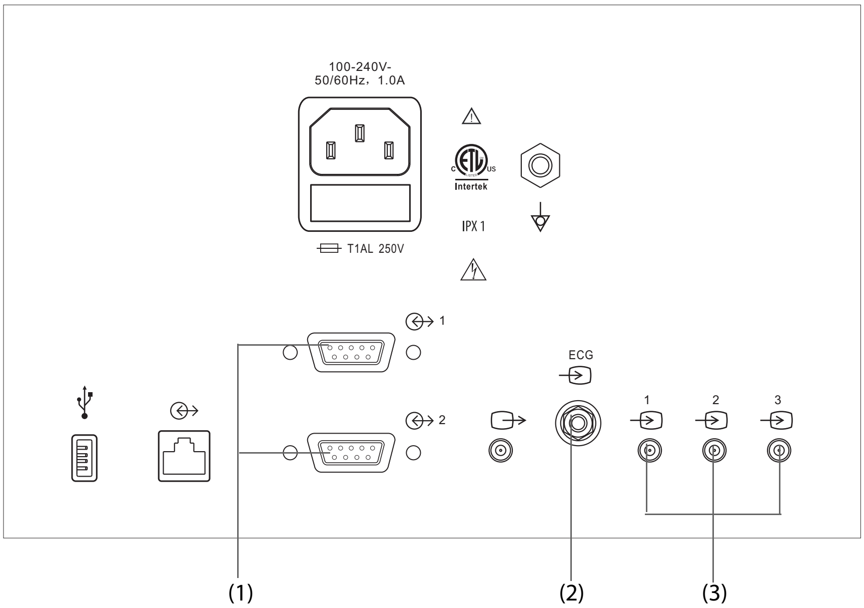
20.5.1 CCO/SvO2 Cable

The following figure shows the CCO/SvO_2 cable.



20.5.2 Connecting to the Vigilance II Monitor

The following figure shows the rear housing connectors of the Vigilance II monitor.



(1) Serial ports (2) ECG signal input port (3) Analog signal input ports

To connect the Vigilance II monitor, follow this procedure:

1. Connect the end of the CCO/SvO_2 cable marked CN1 to the CCO/SvO_2 module.
2. Insert the ECG signal end of the CCO/SvO_2 cable into the ECG signal input port marked ECG on the rear housing of the Vigilance II monitor.
3. Insert the MAP signal end of the CCO/SvO_2 cable into the analog signal input port 1 marked 1, the CVP signal end into port 2 marked 2, and SpO_2 signal end into port 3 marked 3 respectively on the rear housing of the Vigilance II monitor.
4. Insert UART end of the CCO/SvO_2 cable into either of the serial ports (marked 1 or 2) on the rear housing of the Vigilance II monitor.
5. Enter the **Serial Port Setup** menu of the Vigilance II monitor, and make the following settings:
   - **Device**: **IFMout**
   - **Baud Rate**: **19200**
   - **Parity**: **None**
   - **Stop Bits**: **1**
   - **Data Bits**: **8**
   - **Flow Control**: **2 seconds**
6. Enter the **Analog Input Setup** menu of the Vigilance II monitor, and set port 1, port 2 and port 3 as follows:

Setting	**Port 1**	**Port 2**	**Port 3**
Parameter	MAP	CVP	SaO_2
Voltage Range	0-5 v	0-5 v	0-10 v
Full Scale Range	500 mmHg (66.7 kPa)	100 mmHg (13.3 kPa)	100%
Simulated High Value	500 mmHg (66.7 kPa)	100 mmHg (13.3 kPa)	100%
Simulated Low Value	0 mmHg (0.0 kPa)	0 mmHg (0.0 kPa)	0%

For more information, see the Vigilance II operator's manual for the operation of the monitor.

WARNING

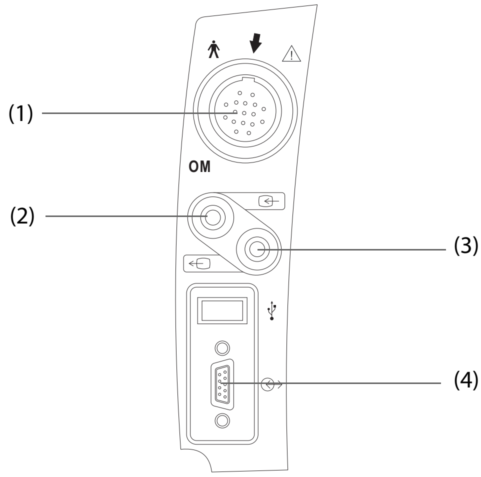
- **Calibrate the Vigilance II monitor before monitoring. For more information, see the Vigilance II operator's manual for the calibration instructions.**

NOTE

- **For the Vigilance II monitor, Flow Control must be set to 2 seconds.**

20.5.3 Connecting to the Vigileo Monitor

The following figure shows the rear housing connectors of the Vigileo monitor.



(1) Patient Optical Module (OM)	(2) Analog Input
(3) Analog input	(4) Serial Port

To connect the Vigileo monitor, follow this procedure:

1. Connect the end of the CCO/SvO_2 cable marked CN1 to the CCO/SvO_2 module.
2. Insert the CVP signal end of the CCO/SvO_2 cable into the analog signal input port on the rear housing of the Vigileo monitor.
3. Insert UART end of the CCO/SvO_2 cable into the serial port on the rear housing of the Vigileo monitor.
4. Enter the **Serial Port Setup** menu of the Vigileo monitor, and make the following settings:
   - **Device**: **IFMout**
   - **Baud Rate**: **19200**
   - **Parity**: **None**
   - **Stop Bits**: **1**
   - **Data Bits**: **8**
   - **Flow Control**: **2 seconds**
5. Enter the **Analog Input Port Setup** menu of the Vigileo monitor, and set the CVP as follows:
   - **Parameter**: **CVP**
   - **Voltage Range**: **0-5 v**
   - **Full Scale Range**: **100 mmHg** (13.3 kPa)
   - **Simulated High Value**:**100 mmHg** (13.3 kPa)
   - **Simulated Low Value**: **0 mmHg** (0.0 kPa)

For more information, see the Vigileo operator's manual for the operation of the monitor.

WARNING

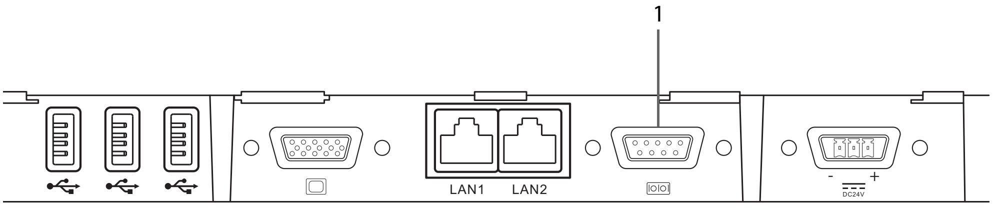
- **Calibrate the Vigileo monitor before monitoring. See the Vigileo operator's manual for the calibration instructions.**

NOTE

- **For the Vigileo monitor, Flow Control must be set to 2 seconds.**

20.5.4 Connecting the EV1000 Monitor

The following figure shows the rear housing of the EV1000 monitor.



(1) serial port

To connect the EV1000 monitor, follow this procedure:

1. Connect CN1 with the CCO/SvO2 cable connector of the CCO/SvO2 module.
2. Insert UART into the serial port on the rear housing of the EV1000 monitor.
3. Enter the **Serial Port Setup** menu of the EV1000 monitor, and make the following settings:
   - **Device**: **IFMout**
   - **Baud Rate**: **19200**
   - **Parity**: **None**
   - **Stop Bits**: **1**
   - **Data Bits**: **8**
   - **Flow Control**: **2 seconds**

For more information, see the EV1000 operator's manual for the operation of the monitor.

WARNING

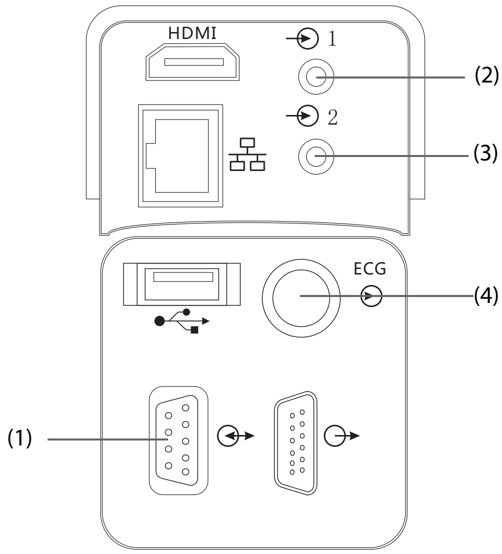
- **Calibrate the EV1000 monitor before monitoring. Refer to the EV1000 Operator's Manual for the calibration instructions.**

NOTE

- **For the EV1000 monitor, Flow Control must be set to 2 seconds.**

20.5.5 Connecting the HemoSphere Monitor

The following figure shows the rear housing of the HemoSphere monitor.



(1) COM1 Serial Port	(2) Analog Input
(3) Analog Input	(4) ECG Input

To connect the HemoSphere monitor, follow this procedure:

1. Connect CN1 with the CCO/SvO2 cable connector of the CCO/SvO2 module.
2. Insert the UART signal end of the CCO/SvO_2 cable into the COM1 serial port on the rear housing of the HemoSphere monitor.
3. Insert the CVP and MAP signal ends of the CCO/SvO_2 cable into the Analog Inputs on the rear housing of the HemoSphere monitor.
4. Insert ECG signal end of the CCO/SvO_2 cable into the ECG Input on the rear housing of the HemoSphere monitor.
5. Enter the **Serial Port Setup** menu of the HemoSphere monitor, and make the following settings:
   - **Device**: **IFMout**
   - **Baud Rate**: **19200**
   - **Parity**: **None**
   - **Stop Bits**: **1**
   - **Data Bits**: **8**
   - **Flow Control**: **2 seconds**
6. Enter the **Analog Input Setup** menu of the HemoSphere monitor, and set as follows:

Parameter	MAP	CVP
Voltage Range	0-5 v	0-5 v
Full Scale Range	500 mmHg (66.7 kPa)	100 mmHg (13.3 kPa)
Simulated High Value	500 mmHg (66.7 kPa)	100 mmHg (13.3 kPa)
Simulated Low Value	0 mmHg (0.0 kPa)	0 mmHg (0.0 kPa)

For more information, see the HemoSphere operator's manual for the operation of the monitor.

WARNING

- **Calibrate the HemoSphere monitor before monitoring. Refer to the HemoSphere Operator's Manual for the calibration instructions.**

NOTE

- **For the HemoSphere monitor, Flow Control must be set to 2 seconds.**

20.6 Accessing the HemoSight Menu

To accessing the **HemoSight** menu, follow this procedure:

1. Select the **CCO** numeric area to enter the **CCO** menu.
2. Select the **HemoSight** button. For more information, see *33 HemoSight^{TM}*.

20.7 Changing CCO Settings

20.7.1 Changing the CCO Alarm Settings

To change the CCO alarm settings, follow this procedure:

1. Select the CCO numeric area to enter the **CCO** menu.
2. Select the **Alarm** tab.
3. Set the alarm properties of CCO and CCI.

20.7.2 Changing the SVR Unit

To change the SVR unit, follow this procedure:

1. Select the CCO numeric area to enter the **CCO** menu.
2. Select the **Setup** tab.
3. Set **SVR Unit**.

NOTE

- **The SVRI unit changes accordingly after the SVR unit is changed.**

20.7.3 Setting Parameters for Display

To set the parameters for display, follow this procedure:

1. Select the CCO numeric area to enter the **CCO** menu.
2. Select the **Select Parameter** tab.
3. Select the primary and secondary parameters for display.

20.7.4 Setting the CCO Analog Output Signal

To set the CCO output signal, follow this procedure:

1. Select the CCO numeric area to enter the **CCO** menu.
2. Select the **Signal Output Setup** tab.
3. Set the output signal as follows:
   - ◆ This monitor can output the analog signals of ECG waveform, MAP value, SpO_2 value and CVP value to the Vigilance II monitor. If a signal has several sources, you can select a source.

- This monitor can output the CVP analog signal to the Vigileo monitor. If the CVP signal has several sources, you can select a source.
- This monitor can output ECG waveform, MAP value, and CVP value to the HemoSphere monitor. If a signal has several sources, you can select a source.
- Select **Simulated High Value** to output the simulated high value calibration signals to the Vigilance II, Vigileo, or HemoSphere monitor. To stop output the simulated high value signal, select **Simulated High Value** again.
- Select **Simulated Low Value** to output the simulated low value calibration signals to the Vigilance II, Vigileo, or HemoSphere monitor. To stop output the simulated low value signal, select **Simulated Low Value** again.

The following table shows values and voltages of the high and low value calibration signals.

Parameters	Parameter Values	Output Voltage
High Value Calibration Signals		
MAP	500 mmHg	5V
SpO_2	100%	10V
CVP	100mmHg	5V
Low Value Calibration Signals		
MAP	0 mmHg	0V
SpO_2	0%	0V
CVP	0mmHg	0V

CAUTION

- **The calibration voltage of Vigilance II, VigileoEV1000, and HemoSphere monitor should be the same as the output voltage of this monitor. Otherwise, some parameter values may be incorrectly calculated.**

NOTE

- **See the operator's manuals of Vigilance II, VigileoEV1000, and HemoSphere monitors for the calibration instructions.**

20.8 Changing SvO_2/$ScvO_2$ Settings

20.8.1 Changing the SvO_2/$ScvO_2$ Alarm Settings

To change the SvO_2/$ScvO_2$ alarm settings, follow this procedure:

1. Select the SvO_2/$ScvO_2$ numeric area to enter the **SvO2** or **ScvO2** menu.
2. Select the **Alarm** tab.
3. Set the alarm properties of SvO_2/$ScvO_2$.

20.8.2 Setting the SvO_2/$ScvO_2$ Analog Output Signal

This monitor can output the analog signals to the Vigilance II monitor. To set the SvO_2/$ScvO_2$ analog output signal, follow this procedure:

1. Select the SvO_2 numeric area to enter the **SvO2** menu; or select the $ScvO_2$ numeric area to enter the **ScvO2** menu.
2. Select the **Signal Output Setup** tab.
3. Set the output signal as follows:

- This monitor can output the analog signals of ECG waveform, MAP value, SpO_2 value and CVP value to the Vigilance II monitor. If a signal has several sources, you can select a source.
- This monitor can output the CVP analog signal to the Vigileo monitor. If the CVP signal has several sources, you can select a source.
- This monitor can output ECG waveform, MAP value, and CVP value to the HemoSphere monitor. If a signal has several sources, you can select a source.
- Select **Simulated High Value** to output the simulated high value calibration signals to the Vigilance II, Vigileo, or HemoSphere monitor. To stop output the simulated high value signal, select **Simulated High Value** again.
- Select **Simulated Low Value** to output the simulated low value calibration signals to the Vigilance II, Vigileo, or HemoSphere monitor. To stop output the simulated low value signal, select **Simulated Low Value** again.

The following table shows values and voltages of the high and low value calibration signals.

Parameters	**Parameter Values**	**Output Voltage**
High Value Calibration Signals		
MAP	500 mmHg	5V
SpO_2	100%	10V
CVP	100mmHg	5V
Low Value Calibration Signals		
MAP	0 mmHg	0V
SpO_2	0%	0V
CVP	0mmHg	0V

20.9 CCO/SvO_2 Troubleshooting

This section lists the problems that might occur. If you encounter the problems when using the equipment or accessories, check the table below before requesting for services. If the problem persists, contact your service personnel.

NOTE

- **For the physiological and technical alarm messages, see *D Alarm Messages*.**

Problem	**Solution**
The numeric area does not display CCO values when the Vigilance II, Vigileo, EV1000, or HemoSphere monitor is connected.	1. Check that the CCO is set to display in the **Screen Setup** menu. For more information, see *3.11.2 Displaying Parameter Numerics and Waveforms*. 2. Check that if the CCO parameter switch is enabled. If not, enable the CCO measurement. For more information, see *3.11.1 Switching On or Off a Parameter*. 3.Check that the Vigilance II, Vigileo, EV1000, or HemoSphere monitor is set properly as described in *20.5 Connecting the Device*. 4. Check the connection of CCO/SvO_2 cable. For more information, see *20.5 Connecting the Device*.

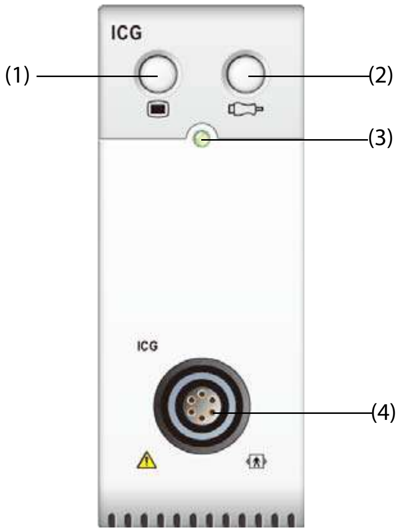
Problem	Solution
The numeric area does not display ScvO2 or SvO2 values when the Vigilance II, Vigileo, EV1000, or HemoSphere monitor is connected.	1. Check that the $ScvO_2$ or SvO_2 is set to display in the **Screen Setup** menu. For more information, see *3.11.2 Displaying Parameter Numerics and Waveforms*. 2. Check that if the $ScvO_2$ /SvO_2 parameter switch is enabled. If not, enable the $ScvO_2$ /SvO_2 measurement. For more information, see *3.11.1 Switching On or Off a Parameter*. 3.Check that the Vigilance II, Vigileo, EV1000, or HemoSphere monitor is set properly as described in *20.5 Connecting the Device*. 4. Check the connection of CCO/SvO_2 cable. For more information, see *20.5 Connecting the Device*.

21 Monitoring Impedance Cardiography (ICG)

21.1 ICG Introduction

Impedance cardiography (ICG) measures a patient's hemodynamic status using a safe, non-invasive method based on thoracic electrical bioimpedance (TEB) technology. ICG uses four pairs of sensors to transmit a small electrical signal through the thorax. As velocity and volume of blood in the aorta change, the ICG measures the changes in impedance from systole to diastole to calculate hemodynamic parameters.

Apply ICG monitoring only to patients above the age of 13 years, with weight greater than 34 kg, and taller than 130 cm..



(1) ICG menu hard key	(2) Check sensor hard key
(3) Module status indicator	(4) ICG patient cable connector

21.2 ICG Safety Information

WARNING

- **Before measuring patients with pacemakers, ensure that the function of the pacemaker cannot be influenced by the measuring current used for impedance cardiography. In the case of minute ventilation pacemakers the use of the ICG device is not allowed if the minute ventilation function of the pacemaker is activated.**
- **Do not perform ICG monitoring during operation on the opened thorax, since the current distribution can be distorted and can lead to inaccuracy.**
- **The ICG module is not intended to be used while exposing the patient to high frequency current.**
- **Simultaneous use of high frequency electrosurgical equipment (ESU) during ICG monitoring may result in burns at the stimulation site and can also adversely affect measurement accuracy. Make sure the ESU return electrode is properly applied to the patient.**

CAUTION

- **During ICG monitoring, make sure that the conductive paste on the ICG sensors never come into contact with other conductive parts.**

21.3 ICG Measurement Limitations

The measurement accuracy may be compromised when patients present with the following conditions or anomalies:

- Septic shock
- Aortic valve regurgitation and defect of septum
- Severe aortic sclerosis or aortic prosthesis
- Severe hypertension (MAP > 130 mmHg)
- Cardiac arrhythmia
- Tachycardia with a heart rate higher than 200 bpm
- Aortic balloon or aortic balloon pump
- Patient movement, talking, strain, shivering, or wrong examination position since they change the physiologic state of the patient
- Incorrect placement or position of the sensors or cuffs
- Signal interference from cable connections and/or power cords.
- During operations on the opened thorax the current distribution can be distorted and can lead to inaccuracies.
- Simultaneous use of electrical cautery systems during surgical procedures

NOTE

- **The ICG module allows the examination of adult patients in a resting position. The measured parameters can be used only if the ICG waveform has sufficient signal quality and is without artifact.**

21.4 ICG Display

The ICG monitoring provides a continuous display of the impedance waveform and four numerics. Of five numerics, one is the primary parameter C.I. and the other four are secondary parameters. You can select the parameter for display in the **Select Parameter** page of the **ICG** menu. For more information, see *21.7.4 Selecting ICG Parameters*.

(1) ICG waveform (2) Primary parameters (3) Secondary parameter

21.5 Accessing the On-screen ICG Guide

The monitor provides the on-screen ICG guide to help you understand ICG monitoring principles, functions, and operating procedure. To access the on-screen ICG guide, follow this procedure:

1. Select the ICG waveform are or numeric area to enter the **ICG** menu.
2. Select the **Introduction** tab.
3. Select the desired tab of **Summary**, **Target Patients**, **Points To Note**, or **Operation Guides**.

21.6 Preparing for ICG Monitoring

To prepare to monitor ICG, follow this procedure:

1. Prepare the patient's skin. For more information, see *21.6.1 Preparing the Skin*.
2. Place the ICG sensors on the patient. For more information, see *21.6.2 Placing the ICG Sensors*.
3. Connect one end of the patient cable to the ICG module.

4. Connect the electrode wires of the patient cable to the sensors on the patient by matching the right and left electrode wire colors and numbers. For more information, see *21.6.3 Connecting the ICG Patient Cable*.
5. Input the patient information. For more information, see *21.7.2 Changing Patient Information*.

WARNING

- **Before monitoring patients with pacemakers, ensure that the function of the pacemaker cannot be influenced by the measuring current used for impedance cardiography. In the case of minute ventilation pacemakers the use of the ICG module is not allowed if the minute ventilation function of the pacemaker is activated.**

21.6.1 Preparing the Skin

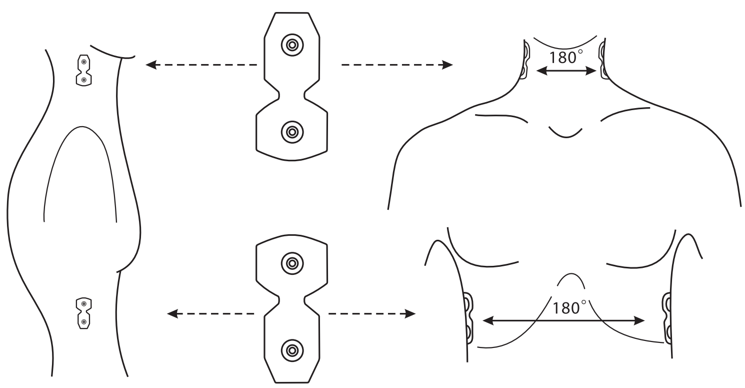
Good sensor-to-skin contact is important for good signal quality. Before applying the sensors, clean the application site of oil and dirt and avoid placing the sensors over excessive body hair or lesions. Insufficient cleaning of the skin can cause high skin impedance which could cause the stimulation to stop.

To properly prepare the skin, follow this procedure:

1. Select sites with intact skin, without lesion of any kind.
2. Shave hair from skin at chosen sites.
3. Gently rub skin surface at sites to remove dead skin cells.
4. Thoroughly cleanse the site with a mild soap and water solution.
5. Dry the skin completely before applying the sensors.

21.6.2 Placing the ICG Sensors

Appropriate sensor placement is important for good signal quality and accurate measurements. Attach ICG sensors to the patient as shown below:



To attach ICG sensors to the patient, follow this procedure:

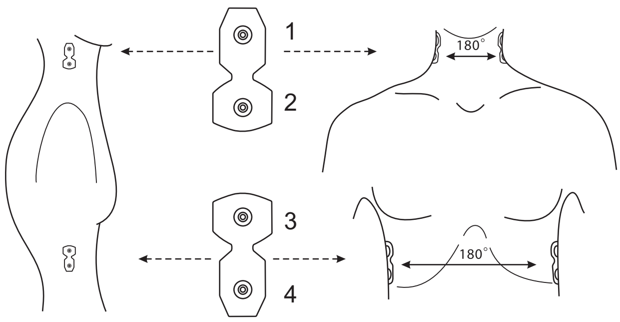
1. Place two sensors on each side of the neck: one is at the base (or root) of the neck and the other is directly superior and in line with the earlobe.
2. Place two sensors on each side of the thorax: one is at the level with the xyphoid process and the other is directly inferior and in line with the midaxillary line.

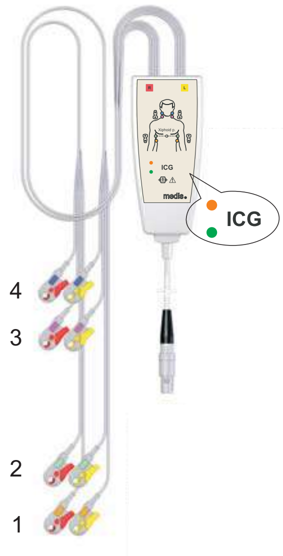
CAUTION

- **Each pair of sensors should be opposite directly to each other (180°) as shown in the figure above.**
- **The sensors must not have a direct contact to other electrically conductive materials.**
- **Only use disposable ICG sensors.**

21.6.3 Connecting the ICG Patient Cable

The ICG patient cable is used to connect the ICG module and the sensors on the patient. The left electrode wires (yellow-colored) and right electrode wires (red-colored) should be connected with the patient sensors by matching the numbers. For more information, see *21.6.2 Placing the ICG Sensors*.





The ICG patient cable contains a small box, which includes a cable splitter with integrated electronics. On the outside of the box two small LEDs (green and orange) display the current function of the patient cable, as indicated below:

Green	Orange	Description of function
●	○	Measurement is running; sensor contact is good
○	○	The electronic part of the patient cable is not connected with the power supply; cable is disconnected or the device is switched off (Power down mode)
☼	○	Patient cable is ready to use, but the measurement has not been started
○	☼	Patient cable has power but the software cannot access the cable; software has not been started or is not ready for measurement
●	●	Insufficient contact between sensors and patient: at least one lead wire is disconnected or not properly fixed; sensors are too dry (new sensors are necessary)

Legend: ○ LED off ☼ LED flashing ● LED on

21.7 Changing ICG Settings

21.7.1 Changing ICG Alarm Settings

To change the ICG alarm settings, follow this procedure:

1. Select the ICG numeric area or waveform area to enter the **ICG** menu.
2. Select the **Alarm** tab.
3. Enter the password if required.
4. Set the alarm properties as desired.

21.7.2 Changing Patient Information

To change the patient information, follow this procedure:

1. Select the ICG numeric area or waveform area to enter the **ICG** menu.
2. Select the **Setup** tab.
3. Set **Height**, **Weight**, **Gender**, **Age** and **Paced** of the patient.
4. Input the measurements of **Art-S**, **Art-D**, **Art-M**, **CVP**, **PAWP**, and **PA-M** if the system fails to automatically obtain these measurements. For example, measurements of CVP, PA-M and Art-M can be obtained from the IBP measurements. If measurement of Art-M is unavailable from the IBP module, it can also be obtained from the NIBP measurements (mean pressure). If it is unavailable from the NIBP module, you should input the Art-M manually.

21.7.3 Changing the ICG Wave Sweep Speed

To set the sweep speed of ICG waveform, follow this procedure:

1. Select the ICG numeric area or waveform area to enter the **ICG** menu.
2. Select the **Setup** tab.
3. Set **Speed**.

21.7.4 Selecting ICG Parameters

The ICG numeric area displays one primary parameter (C.I. by default) and four secondary parameters (SVRI, SVI, C.O. and TFC by default). You can also select your desired primary and secondary parameters for display.

1. Select the ICG numeric area or waveform area to enter the **ICG** menu.
2. Select the **Select Parameter** tab.
3. Select the parameters to be displayed.

21.8 ICG Troubleshooting

This section lists the problems that might occur. If you encounter the problems when using the equipment or accessories, check the table below before requesting for services. If the problem persists, contact your service personnel.

NOTE

- **For the physiological and technical alarm messages, see *D Alarm Messages*.**

Problem	**Solution**
Do not see ICG numeric area or waveform area on the main screen	1. Check that the ICG is set to display in the **Screen Setup** menu. For more information, see *39.12 The Other Settings*. 2. Check that if the ICG parameter switch is enabled. If not, enable the IBP measurement. For more information, see *3.11.1 Switching On or Off a Parameter*. 3.Check that the patient type is properly configured. 4. Check the connection of the ICG cable, ICG sensor and ICG module.

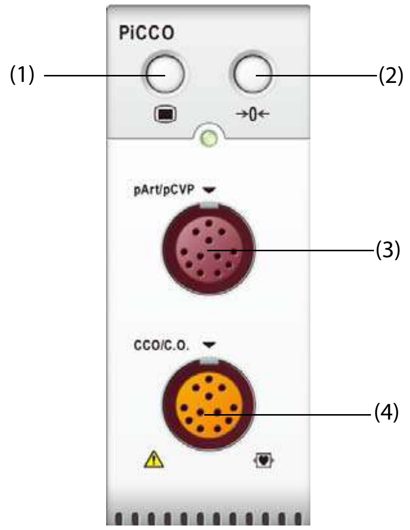
This page intentionally left blank.

22 Monitoring Continuous Cardiac Output (from PiCCO Module)

22.1 CCO Introduction

The PiCCO method combines transpulmonary thermodilution and pulse contour analysis on the blood pressure waveform. A cold bolus (e.g. normal saline 0.9%) with a known volume and temperature is injected into the right atrium through a central venous catheter. The cold bolus mixes with the blood in the heart and the change in blood temperature is measured with a thermistor at the distal end of the arterial thermodilution catheter placed in one of the bigger systemic arteries, for example, the femoral artery. The monitor uses the transpulmonary thermodilution method to measure C.O., Global End Diastolic Volume (GEDV) and Extra Vascular Lung Water (EVLW). With the C.O. value measured with the transpulmonary thermodilution method and the result of the pulse contour analysis, a patient-specific calibration factor is calculated. The monitor uses this value to compute CCO and the other continuous hemodynamic parameters.

PiCCO monitoring is intended for adult and pediatric patients.



(1) CCO menu hard key | (2) Zero IBP hard key

(3) IBP cable connector | (4) PiCCO cable connector

22.2 CCO Safety Information

WARNING

- **PiCCO monitoring is not intended for neonatal patients.**
- **Use only pressure transducers specified in this manual. Never reuse disposable pressure transducers.**
- **Make sure that the applied parts never contact other conductive parts.**
- **To reduce the hazard of burns during high-frequency surgical procedure, ensure that the monitor's cables and transducers never come into contact with the high-frequency surgical units.**
- **When using accessories, their operating temperature should be taken into consideration. For details, see instructions for use of accessories.**

22.3 Zeroing the IBP transducer

To avoid inaccurate pressure readings, the monitor requires a valid zero. Zero the transducer in accordance with your hospital policy. The IBP transducer should be zeroed in the following conditions:

- The IBP transducer, IBP cable or module is reconnected.
- The monitor restarts.
- You doubt the readings.
- The monitor displays the prompt message **Zero Required**.

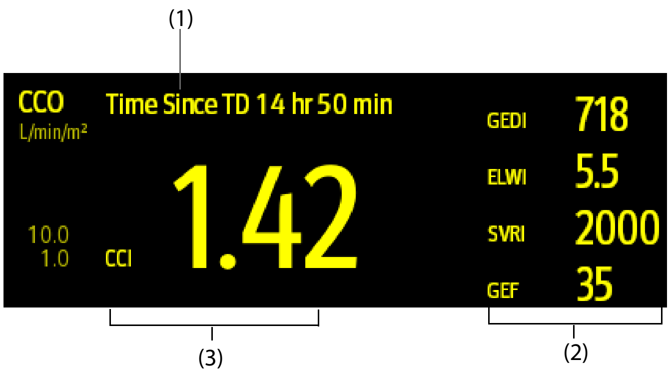
To zero the transducer, follow this procedure:

1. Connect the IBP transducer, the IBP cable and the module.
2. Turn off the three-way valve (the one close to the transducer) to the patient, in order to vent the transducer to the atmospheric pressure.
3. Zero the transducer by one of the following methods:
   - Press the **Zero** hard key on the module.
   - Select the numeric area (such as the Art numeric area), and then select **Zero**.
   - Select the **Zero IBP** quick key.
4. After the zero calibration is completed, close the stopcock to the air and open the stopcock to the patient.

22.4 PiCCO Display

22.4.1 CCO Display

CCO numeric area displays the CCO and other hemodynamic parameters. You can select the parameters for display on the **Parameter** page of the **CCO** menu. For more information, see *22.8.2 Setting Parameters for Display*.



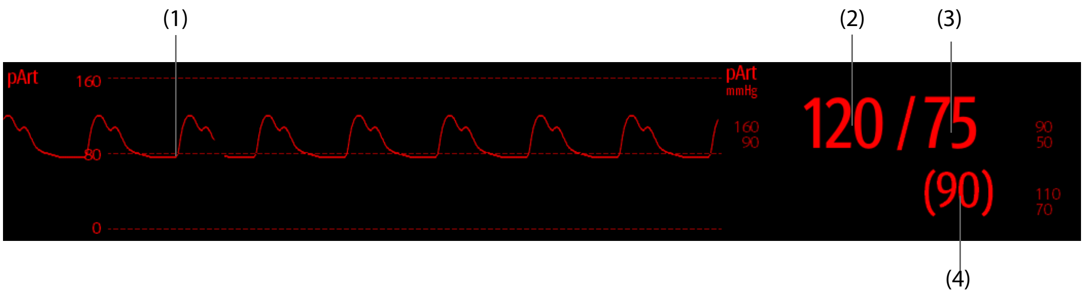
(1) Prompt message: the time since previous TD measurement

(2) Label and value for secondary parameters

(3) Labels and values for primary parameter

22.4.2 pArt Display

The artery pressure from the PiCCO module (pArt) is displayed on the monitor as a waveform and numeric pressures. The figure below shows the pArt waveform and numerics.

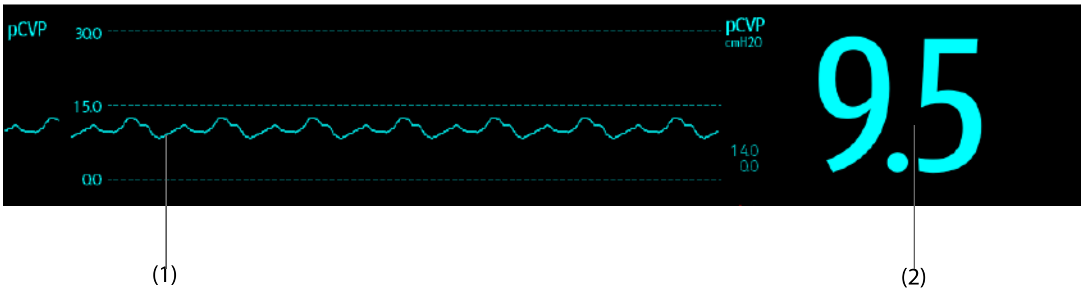


(1) Waveform (2) Systolic pressure

(3) Diastolic pressure (4) Mean pressure

22.4.3 pCVP Display

The central venous pressure is displayed on the monitor as a waveform and numeric pressures. The figure below shows the pCVP waveform and numerics.



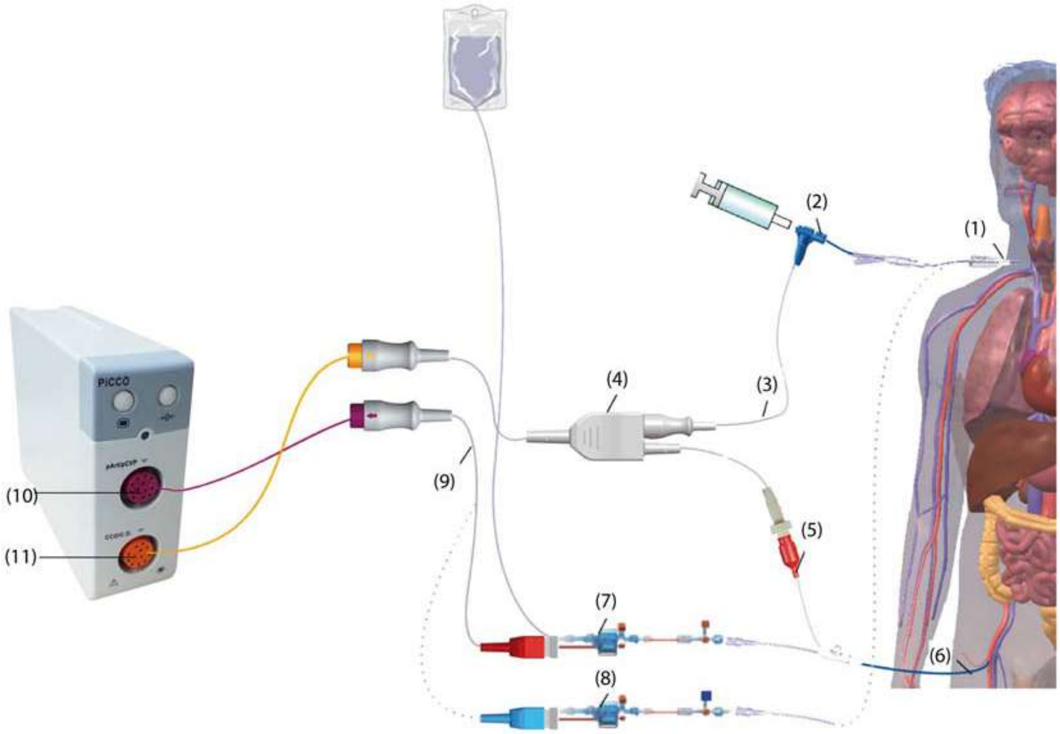
(1) Waveform (2) Central venous pressure

22.5 Accessing the On-screen CCO Guide

The monitor provides the on-screen CCO guide to help you understand CCO monitoring principles, functions, and operating procedure. To access the on-screen CCO guide, follow this procedure:

1. Select the CCO numeric area to enter the **C.O. Measure (CCO)** menu.
2. Select the **Introduction** tab.
3. Select the desired tab of **Summary**, **Target Patients**, **Points To Note**, or **Operation Guides**.

22.6 CCO Equipment to Patient Connection



(1) Central venous catheter	(2) Injectate temperature sensor
(3) Injectate temperature sensor cable	(4) PiCCO cable
(5) Blood temperature sensor	(6) Arterial thermodilution catheter
(7) Arterial pressure transducer	(8) CVP transducer
(9) IBP cable	(10) IBP cable connector
(11) PiCCO cable connector	

22.6.1 Preparing to Monitor C.O.

To prepare to monitor C.O., follow this procedure:

1. Place the arterial thermodilution catheter.

WARNING

- **The arterial thermodilution catheter must be placed in one of the bigger systemic arteries, for example, the femoral, the brachial or the auxiliary artery.**
- **Use the specified catheters and puncture locations.**

---

2. Place the central venous catheter.
3. Connect the blood temperature sensor to the arterial thermodilution catheter.
4. Connect the injectate temperature sensor to the central venous catheter.
5. Plug the PiCCO cable into the CCO/C.O. connector on the PiCCO module, and connect the following devices to the PiCCO cable:
   - Injectate temperature sensor probe
   - Blood temperature sensor connector.
6. Plug the IBP cable into the pArt/pCVP connector on the PiCCO module.
7. Connect one end of the arterial pressure transducer to the arterial thermodilution catheter and the other end to the IBP cable marked with pArt.

WARNING

- **Make sure there is no air bubbles in the IBP transducer systems. If air bubbles appear in the tubing system, flush the system with the infusion solution again. Air bubble may lead to wrong pressure reading.**

8. If you need to measure CVP, connect one end of the CVP transducer to the central venous catheter and the other end to the IBP cable marked with pCVP. Then plug the IBP cable to the pArt/pCVP connector on the PiCCO module.

22.6.2 Performing the CCO Settings

To perform the CCO settings, follow this procedure:

1. Select the CCO numeric area to enter the **C.O. Measure (CCO)** menu.
2. Select the **Setup** tab to enter the CCO Setup page.
3. Set the patient information.

   Correct input of height, weight, category and gender is mandatory for the accuracy of the displayed parameters as well as for the correct indexing of some parameters. The monitor automatically calculates predicted body weight (PBW), body surface area (BSA) and predicted body surface area (PBSA) according to the inputted height and weight.
4. Check that the correct arterial catheter type is displayed at **Catheter Type**.

   The monitor can recognize the arterial catheter automatically when the arterial thermodilution catheter, PiCCO cable, and PiCCO module are connected. If the catheter constant is not recognized, enter the correct value for the catheter in the **Catheter Type** edit box. The catheter constant is usually written either on the catheter or on the catheter packaging.
5. Set **Catheter Position**.

   Set the position site of the arterial thermodilution catheter according to the catheter type.
6. Set **Injectate Volume**.

   If the injectate volume is not selected, the monitor sets the volume by default during the first measurement, which is 15ml for adult and 10 ml for pediatric. Later the monitor adjusts the injectate volume according to previous measuring result. The following table displays the recommended injectate volume depending on body weight and Extravascular Lung Water Index (ELWI):

Patient Weight (kg)	ELWI < 10	ELWI > 10	ELWI < 10
	Iced Injectate	Iced Injectate	Room Temperature Injectate
<3	2ml	2ml	3ml
<10	2ml	3ml	3ml
<25	3ml	5ml	5ml
<50	5ml	10ml	10ml
<100	10ml	15ml	15ml
≥100	15ml	20ml	20ml

CAUTION

- **The selected volume should be strictly the same as actual injected volume. Otherwise, the measurement accuracy may be compromised or measurement may be failed.**

7. Set **Auto Start**.

   ◆ If **Auto Start** is disabled, you should start each measurement manually by selecting **Start** in **C.O. Measure (CCO)** window.

◆ If **Auto Start** is enabled, C.O. measurements can be performed consecutively after you start the first measurement, without the need for pressing **Start** between measurements.

8. Set the **Auto pCVP**.

◆ Enable **Auto pCVP** if the monitor is performing pCVP measurement. In this case, the monitor obtains the pCVP value automatically.

◆ Disable **Auto pCVP** if the monitor fails to obtain the pCVP value. In this case, the pCVP value should be input manually at **pCVP**.

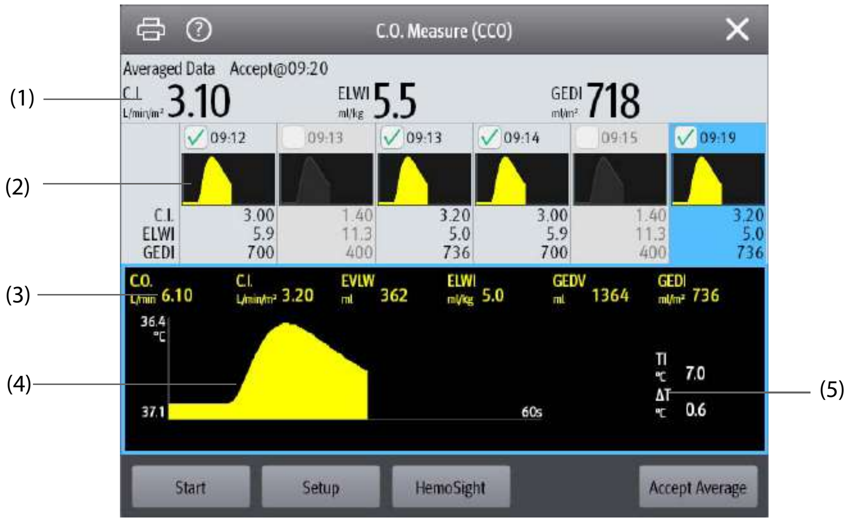
NOTE

- **Input a proper pCVP value if Auto pCVP is disabled. The system adopts 5mmHg by default if the pCVP value is not input manually.**

22.6.3 Performing C.O. Measurement

To perform the C.O. measurement, follow this procedure:

1. Select the CCO numeric area to enter the **C.O. Measure (CCO)** menu.



(1) Average values (2) History window

(3) Current measurements (4) Thermodilution curve

(5) Variation of blood temperature (ΔT)

2. Select **Start** and inject the bolus rapidly (<7sec) and smoothly as soon as the message **Inject xx ml!** displays and prompt tone sounds. As shown in the figure above, during the measurement, the currently measured thermodilution curve is displayed. At the end of the measurement, the measured values are displayed in the history window and the monitor prompts you to wait for a certain period of time before starting a new measurement. The ΔT value should be greater than 0.15°C to ensure high accuracy. A low ΔT can be caused by a very high ELWI or an extreme low CI. If ΔT is too low, you can try to increase it by the following method:

◆ Inject more volume (remember to reenter the injectate volume in the **Setup** page of the **CCO** menu before injecting).

◆ Inject colder bolus.

◆ Inject the bolus in a shorter time.

3. Perform three to five single measurements directly after each other within a maximum of 10 minutes as described in Step 2. A new measurement is available when you see the blood temperature is steady in the **C.O. Measure (CCO)** window.

◆ If **Auto Start** is disabled in the **Setup** page of the **CCO** menu, you should repeat step 2 manually.

◆ If **Auto Start** is enabled in the **Setup** page of the **CCO** menu, the C.O. measurements can be performed consecutively, without the need for pressing **Start** between measurements. A new thermodilution measurement is possible as soon as **Inject xx ml** is displayed on the screen. The patient monitor automatically detects further thermodilution measurements.

4. Select the thermodilution curves you desired in the history window, and select **Accept Average** to obtain the averaged value of parameters.

   A maximum of six C.O. measurements can be stored. The monitor automatically performs calibration and calculates the CCO and CCI values according to the C.O. measurements you select.

CAUTION

- **If the monitor can not get a reliable pArt value during a C.O. measurement, the corresponding C.O. value is invalid for CCO calibration.**
- **If the option of the auto pCVP measurement is not enabled, pCVP value should be manually updated as soon as a new value is obtained to accurately calculate SVR and CCO.**
- **If the displayed continuous parameters are not plausible, they should be checked by a thermodilution measurement. The PiCCO measurement will be recalibrated automatically.**
- **Faulty measurements can be caused by incorrectly placed catheters, interfering signal transmission e.g. of arterial pressure, defective connections or sensors, or by electromagnetic interference.**
- **Aortic aneurysms may cause the displayed blood volume (GEDV/ITBV) derived by thermodiution measurement to be erroneously high if the arterial thermodilution catheter is placed in the femoral artery.**
- **The use of injectate solution with a temperature that is not at least 10°C lower than the blood temperature may cause incorrect values for the thermodilution and CCO calibration.**

NOTE

- **Three to five single thermodilution measurements within 10 minutes are recommended. For a stable patient it is recommended to perform a thermodilution measurement every eight hours. For an unstable patient it may be necessary to perform thermodilution measurements more frequently in order to determine the patient's volume status and to recalibrate the continuous determination of C.O..**
- **As the pulse contour cardiac output of children has not been sufficiently validated thus far, the C.O. should be checked by thermodilution before therapeutic interventions.**
- **A new measurement is recommended with significant changes in hemodynamic conditions, such as volume shifts or changes to medication.**

22.7 Accessing the HemoSight Menu

To accessing the **HemoSight** menu, follow this procedure:

1. Select the CCO numeric area to enter the **C.O. Measure (CCO)** menu.
2. Select the **HemoSight** button. For more information, see *33 HemoSight™*.

22.8 Changing CCO Settings

22.8.1 Changing CCO and CCI Alarm Settings

To change the CCO and CCI alarm settings, follow this procedure:

1. Select the CCO numeric area to enter the **C.O. Measure (CCO)** menu.
2. Select the **Setup** tab to enter the **Setup** page of the **CCO** menu.
3. Select the **Alarm** tab.
4. Enter the password if required.
5. Set alarm properties as desired.

22.8.2 Setting Parameters for Display

To set the parameters for display, follow this procedure:

1. Select the CCO numeric area to enter the **C.O. Measure (CCO)** menu.

2. Select the **Setup** tab to enter the **Setup** page of the **CCO** menu.
3. Select the **Select Parameter** tab.
4. Select the primary and secondary parameters for display.

22.9 PiCCO Troubleshooting

This section lists the problems that might occur. If you encounter the problems when using the equipment or accessories, check the table below before requesting for services. If the problem persists, contact your service personnel.

NOTE

- **For the physiological and technical alarm messages, see *D Alarm Messages*.**

Problem	Solution
Do not see CCO numeric area on the main screen	1. Check that the CCO is set to display in the **Screen Setup** menu. For more information, see *39.12 The Other Settings*. 2. Check that if the CCO parameter switch is enabled. If not, enable the CCO measurement. For more information, see *3.11.1 Switching On or Off a Parameter*. 3.Check that the patient type is adult. 4. Check the connection of PiCCO cable, arterial thermodilution catheter and injectate temperature sensor.
CCO value is inaccurate	1. Check that the arterial thermodilution catheter is positioned properly. 2. Check that the catheter type is proper. 3. Inject solution rapidly and smoothly. 4. Finish injection within four to five seconds. 5. Inject more volume, or inject colder solution. 6. Check that the height and weight of patient is properly configured. 7. Check that the entered **Injectate Volume** is correct.
CCO measurement fails	1. Inject more volume, or inject colder solution. Make sure that the injectate temperature is at least 10°C colder than the patient blood temperature. 2. Finish injection within four to five seconds. 3. Check the connection of PiCCO cable, arterial thermodilution catheter and injectate temperature sensor.
Message "Unstable baseline. Please wait." constantly appears.	1. Check if the patient's temperature changes rapidly. Wait till the patient's temperature is stable. 2. Check if the patient is being transfused with large volume of fluid. Wait till transfusion stops. 3. IBP cable fails or incorrectly connected. Check the cable and its connection. Replace the cable if necessary. 3. The temperature sensor of the thermodilution catheter may fail. Flush the catheter and check if TB changes. If TB does not change, replace the catheter.

23 Monitoring Carbon Dioxide (CO_2)

23.1 CO_2 Introduction

CO_2 monitoring is a continuous, non-invasive technique for determining the concentration of CO_2 in the patient’s airway by measuring the absorption of infrared (IR) light of specific wavelengths. CO_2 has its own absorption characteristic and the amount of light passing the gas probe depends on the concentration of the measured CO_2. When a specific band of IR light passes through respiratory gas samples, some of IR light will be absorbed by the CO_2 molecules. The amount of IR light transmitted after it has been passed through the respiratory gas sample is measured with a photodetector. From the amount of IR light measured, the concentration of CO_2 is calculated.

CO_2 measurement are used to monitor the patient’s respiratory status. The following two methods are used for measuring CO_2:

- Mainstream CO_2 measurement

  Directly insert a CO_2 sensor into the patient's breathing system.

- Sidestream/Microstream CO_2 measurement

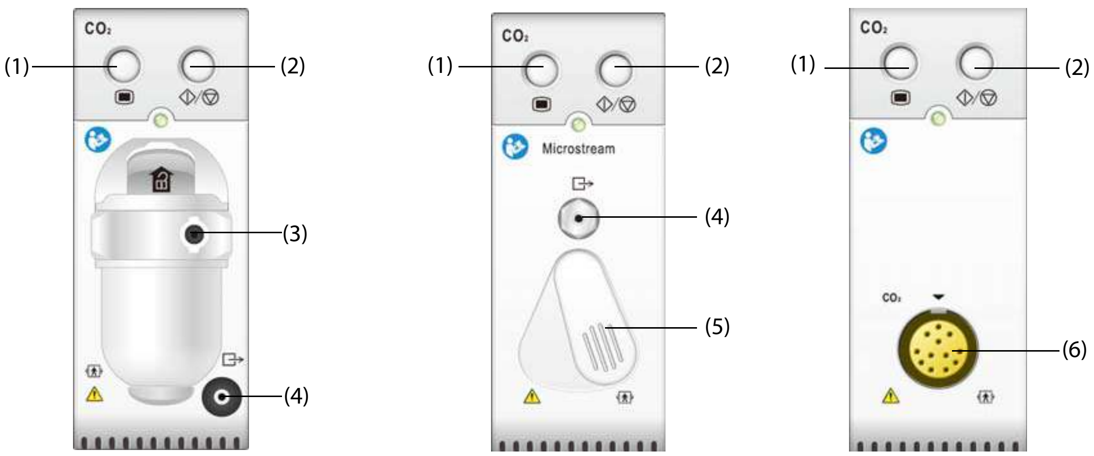
  Take a sample of the respiratory gas with a constant sample flow from the patient's airway and analyzes it with a remote CO_2 sensor built into the Sidestream or Microstream CO_2 module.

The sidestream CO_2 module can be configured with a paramagnetic oxygen sensor. The paramagnetic oxygen sensor measures oxygen relying on its paramagnetic properties.

The mainstream CO2 measurement can be used, with specified accessories, with intubated adult, pediatric and neonatal patients. The sidestream and microstream CO2 measurement can be used, with specified accessories, with intubated and non-intubated adult, pediatric, and neonatal patients. With intubated patients, a sample of the respiratory gas is drawn from the patient's breathing circuit through an airway adapter and a gas sampling line. With non-intubated patients, the gas sample is drawn through a nasal cannula.

CO_2 monitoring is intended for adult, pediatric and neonatal patients.

The following modules are sidestream CO_2 module, microstream CO_2 module and mainstream CO_2 module from left to right.



(1) CO_2 menu hard key	(2) CO_2 Measure/standby hard key
(3) CO_2 watertrap seat	(4) Gas outlet
(5) Sample line connector	(6) CO_2 sensor connector

If you measure CO_2 using the AG module, see *24 Monitoring Anesthetic Gas (AG)*.

23.2 CO_2 Safety Information

WARNING

- **Route all tubing away from the patient's throat to avoid strangulation.**

CAUTION

- **Remove the airway sample line from the patient's airway while nebulized medications are being delivered.**
- **$EtCO_2$ values measured from the CO_2 module may differ from those of from the blood gas analysis.**
- **Avoid mechanical shock to the sidestream CO_2 module configuring the paramagnetic oxygen sensor.**

NOTE

- **The CO_2 module automatic suppress physiological alarms until breathing waves have been detected. Make sure that a patient is properly connected when monitoring with the CO_2 module.**

23.3 CO_2 Measurement Limitations

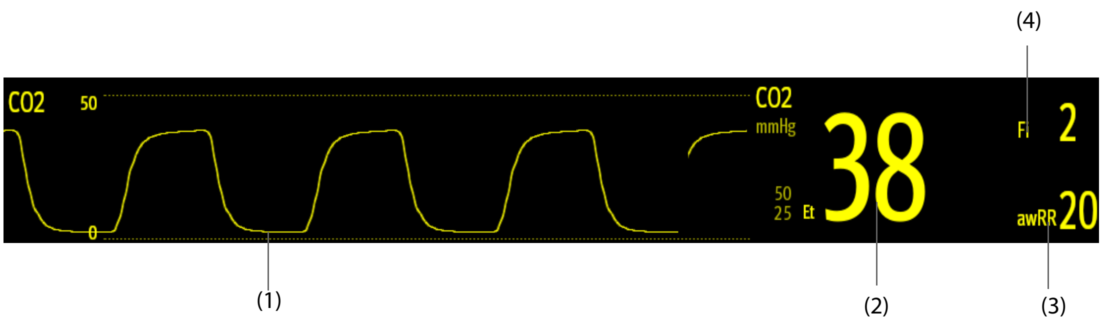
The following factors may influence the measurement accuracy:

- Leaks or internal venting of sampled gas
- Mechanical shock
- Cyclic pressure up to 10 kPa (100 cmH_2O)
- Other sources of interference, if any

Measurement accuracy of the sidestream CO_2 module may be affected by the breath rate and inspiration/ expiration (I/E) ratio. Measurement accuracy of the microstream CO2 module may be affected by the breath rate.For more information, refer to *A.15.13 CO_2 Specifications*.

23.4 CO_2 Display

The CO_2 numeric and waveform area provide $FiCO_2$ measurement, $EtCO_2$ measurement, awRR measurement, and a CO_2 waveform.



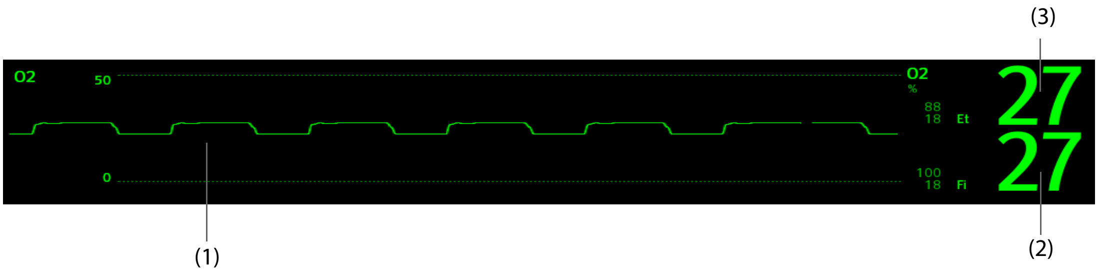
(1) CO_2 waveform

(2) End tidal CO_2 value ($EtCO_2$)

(3) Airway respiration rate (awRR)

(4) Fraction of inspired CO_2 ($FiCO_2$)

If your sidestream CO_2 module is configured with the oxygen sensor, O_2 waveform and parameters can be displayed as follows:



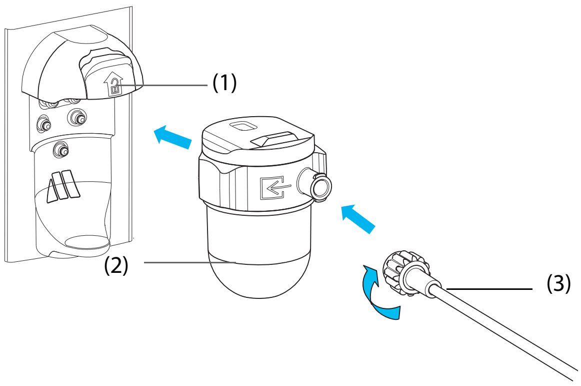
(1) O_2 waveform (2) FiO_2 measurement (3)EtO_2 measurement

23.5 Measuring CO_2 Using Sidestream/Microstream CO_2 Module

23.5.1 Preparing to Measure CO_2 Using Sidestream CO_2 Module

To prepare the CO_2 module for measurement, follow this procedure:

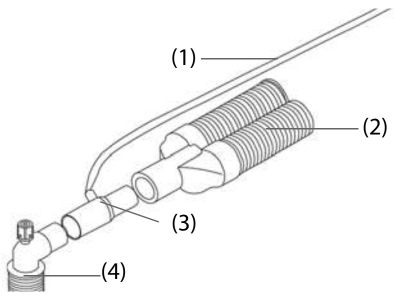
1. Select the appropriate gas sample line and watertrap according to the patient category.
2. Connect the watertrap to the CO_2 module, and connect the gas sample line to the watertrap.



(1) Watertrap receptacle (2) DRYLINE II watertrap

(3) Gas sample line

3. Connect the other end of the gas sample line to the patient.
   - For intubated patients requiring an airway adapter, install the airway adapter between the patient circuit and the ventilator Y-piece.



(1) Sample line (2) Connect to the ventilator

(3) Airway adapter (4) Connect to the patient

   - For non-intubated patients, place the nasal cannula onto the patient.

4. Connect the gas outlet to the scavenging system using an exhaust tube.

After the CO_2 module is connected, it enters measure mode by default and the monitor displays **CO2 Starting**. CO_2 can be measured after the start-up is complete.

WARNING

- **Do not apply adult or pediatric watertrap to the neonate patient. Otherwise, patient injury could result.**
- **Connect the gas outlet to the scavenging system when measuring CO_2 using the sidestream CO_2 module.**

CAUTION

- **Leakage in the breathing or sampling system may cause the displayed $EtCO_2$ values to be significantly low. Always make sure that all components are securely connected.**
- **Inspect the airway adapter for a tight connection and proper operation before attaching it to the patient.**
- **Squeezing or bending the sample line during the sidestream or microstream CO_2 measurement may cause inaccurate CO_2 reading or no reading.**
- **To avoid blocking the airway, empty the DRYLINE II watertrap container whenever half full. Dispose of accumulated fluids in accordance with hospital policy or your local regulations.**
- **The DRYLINE II watertrap has a filter preventing bacterium, water and secretions from entering the module. Extended use could destroy the filter in watertrap and fail to stop the bacterium, water and secretions entering the module, result in damaging the gas module and having infection risk. Replacing the DRYLINE II watertrap once a month is recommended.**

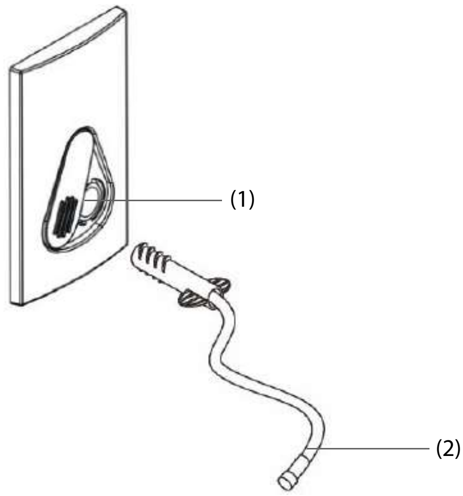
NOTE

- **To extend the lifetime of the watertrap and module, disconnect the watertrap from the module and set the operating mode to Standby mode when CO_2 monitoring is not required.**
- **The sample rates are different when different types of watertraps are used.**
- **The emptying interval of the DRYLINE II adult/pediatric watertrap is 26 hours @ 120 ml/min, sample gas of 37 °C, room temperature of 23 °C, and 100% RH.**
- **The emptying interval of the DRYLINE II neonatal watertrap is 35 hours @ 90 ml/min, sample gas of 37 °C, room temperature of 23 °C, and 100% RH.**

23.5.2 Preparing to Measure CO_2 Using Microstream CO_2 Module

To prepare the CO_2 module for measurement, follow this procedure:

1. Connect one end of the sample line to the microstream CO_2 module.



(1) Sample line connector (2) Sample line

2. Connect the other end of the sample line to the patient.
   - For intubated patient requiring an airway adapter, install the airway adapter between the patient circuit and the ventilator Y-piece.
   - For non-intubated patient, place the nasal cannula onto the patient.
   - For patient prone to mouth breathing, place the oral-nasal cannula onto the patient.
3. Connect the gas outlet to the a scavenging system using an exhaust tube.

After the CO_2 module is connected to the SMR, it enters measure mode by default and the monitor displays **CO2 Sensor Warmup**. CO_2 can be measured after the start-up is complete.

CAUTION

- **Connect the gas outlet to the scavenging system when measuring CO_2 using the microstream CO_2 module.**

NOTE

- **Disconnect the sample line from the module when CO_2 monitoring is not required.**

23.5.3 Zeroing the Sidestream/Microstream CO_2 Module

The sidestream or microstream CO_2 module performs zero calibration automatically when needed.

NOTE

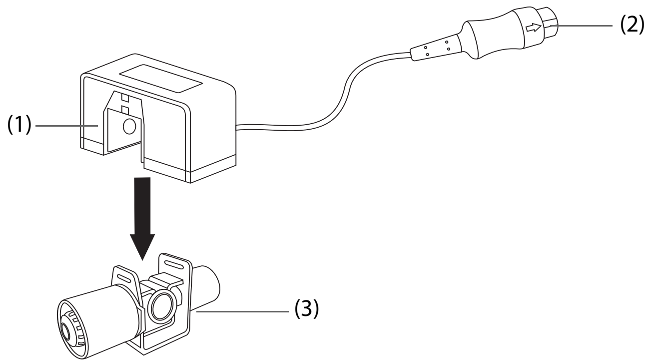
- **The CO_2 module temporally stops measuring during zeroing.**

23.6 Measuring CO_2 Using Mainstream CO_2 Module

23.6.1 Preparing to Measure CO_2 Using Mainstream CO_2 Module

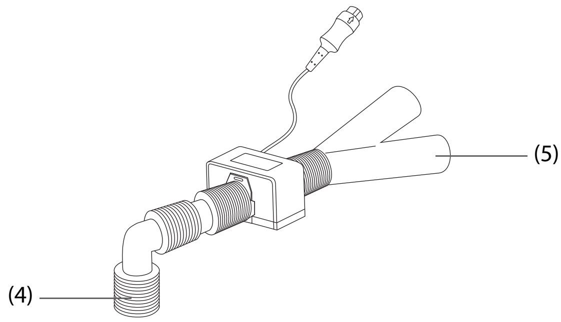
To prepare the CO_2 module for measurement, follow this procedure:

1. Connect the airway adapter to the sensor head.



(1) Sensor (2) Connect to module (3) Airway adapter

2. Attach the sensor connector to the CO_2 connector on the mainstream CO_2 module.
3. Zero the sensor after the warm-up is finished. For details, see *23.6.2 Zeroing the Mainstream CO_2 sensor*.
4. After the zero calibration is finished, connect the airway as shown below.



(4) Connect to patient (5) Connect to ventilator

5. Make sure that no leakages are in the airway and then start a measurement.

NOTE

- **Be sure to set the barometric pressure properly before using the mainstream CO_2 module. Improper settings will result in erroneous CO_2 reading.**
- **Always position the sensor with the adapter in an upright position to avoid collection of fluids in the windows of the adapter. Large concentrations of fluids at this point will obstruct gas analysis.**
- **To avoid dead space, place the sensor as close to the patient as possible.**

23.6.2 Zeroing the Mainstream CO_2 sensor

For mainstream CO_2 modules, the sensor should be zeroed in the following conditions:

- Before each measurement.
- A new adapter is used.
- Reconnect the sensor to the module.
- The message **CO2 Zero Required** displays. In this case, check the airway adapter for any blockage, e.g. mucus, etc. If a blockage is detected, clear or replace the adapter.

To zero the sensor, follow this procedure:

1. Connect the sensor to the module.
2. In the **CO2** menu, select **Setup** tab.
3. Set the **Operating Mode** to **Measure**. The message **CO2 Sensor Warmup** is displayed.
4. After warm-up is finished, connect the sensor to a clean, dry airway adapter. The adapter should be vented to the air and isolated from CO_2 sources, such as ventilator, the patient's breathing, your own breathing, etc.
5. Select **Zero** in the **CO2** menu. The message **Zeroing** is displayed.

It takes about 15 to 20 seconds. The message disappears when the zero calibration is completed.

WARNING

- **When perform a zero calibration during the measurement, disconnect the sensor from the patient's airway first.**
- **Please do not rely on the readings during zeroing.**

23.7 Changing Settings for All CO_2 Modules

23.7.1 Changing CO_2 Alarm Settings

To change the CO_2 alarm settings, follow this procedure:

1. Select the CO_2 numeric area or waveform area to enter the **CO2** menu.
2. Select the **Alarm** tab.
3. Enter the password if required.
4. Set alarm properties as desired.

23.7.2 Setting the CO_2 Waveform

To set the CO_2 waveform, follow this procedure:

1. Select the CO_2 numeric area or waveform area to enter the **CO2** menu.
2. Select the **Setup** tab.
3. Set **Waveform Type**, **Speed** and **CO2 Scale** of the CO_2 waveform.

23.7.3 Setting the RR Source

To set the respiration rate (RR) source, follow this procedure:

1. Select the CO_2 numeric area or waveform area to enter the **CO2** menu.
2. Select the **Setup** tab.
3. Set **RR Source**.

When the current RR source does not have valid measurement, the system will automatically switch **RR Source** to **Auto**.

23.7.4 Entering the Standby Mode

You can set the CO_2 module to one of the following modes according to the module status:

- Select **Measure** mode when you use the CO_2 modue for monitoring.
- Select **Standby** mode when you does not use the CO_2 module to prolong the serviec life of the CO_2 module.

The default operating mode is **Measure**. If you are not using the CO_2 module, you can proceed as follows to enter the Standby mode:

1. Select the CO_2 numeric area or waveform area to enter the **CO2** menu.
2. Select the **Setup** tab.
3. Set **Operating Mode** to **Standby**.

23.7.5 Entering the Intubation Mode

When performing intubation during general anesthesia, you can enter the intubation mode in order to reduce unnecessary alarms. To enter the intubation mode, follow this procedure:

1. Select the CO_2 numeric area or waveform area to enter the **CO2** menu.
2. Select **Intubation Mode**.

For the details of the intubation mode, see *10.13 Intubation Mode*.

23.8 Changing Settings for Sidestream and Microstream CO_2 Module

23.8.1 Setting the Auto Standby

The monitor enters standby mode automatically after the configured period of time if no breath is detected since the last detected breath. To set the auto standby, follow this procedure:

1. Select the CO_2 numeric area or waveform area to enter the **CO2** menu.
2. Select the **Setup** tab.
3. Set **Auto Standby**.

23.8.2 Setting Humidity Compensation

Sidestream and microstream CO_2 modules are configured to compensate CO_2 readings for either Body Temperature and Pressure, Saturated Gas (BTPS), to account for humidity in the patient's breath, or Ambient Temperature and Pressure, Dry Gas (ATPD).

- ATPD: $P_{CO2}(mmHg)=CO_2(vol\%) \times P_{amb}/100$
- BTPS (sidestream): $P_{CO2}(mmHg)=CO_2(vol\%) \times (P_{amb}- 47)/100$
- BTPS (microstream): $P_{CO2}(mmHg)=CO_2(vol\%) \times (1- 0.03) \times P_{amb}/100$

Where, $P_{CO2}(mmHg)$= *partial pressure, vol%=*CO_2 *concentration,* P_{amb}=*ambient pressure, and unit is mmHg.*

For the sidestream and microstream CO_2 module, you can set the humidity compensation on or off according to the actual condition.

To set the humidity compensation, follow this procedure:

1. Select the CO_2 numeric area or waveform area to enter the **CO2** menu.
2. Select the **Setup** tab.
3. Set **BTPS Compensation**.

   - Switch on for BTPS.
   - Switch off for ATPD.

23.9 Changing O_2 Settings (For Sidestream CO_2 Module Integrating O_2)

23.9.1 Changing O_2 Alarm Settings

To change the O_2 alarm settings, follow this procedure:

1. Select the CO_2 numeric area or waveform area to enter the **CO2** menu.
2. Select the **Alarm** tab.
3. Enter the password if required.
4. Set alarm properties as desired.

23.9.2 Setting the O_2 Waveform

To set the O_2 waveform, follow this procedure:

1. Select the CO_2 numeric area or waveform area to enter the **CO2** menu.
2. Select the **Setup** tab.
3. Set **Speed** and **O2 Scale** of the O_2 waveform.

23.10 Setting the Gas Compensation

The presence of interfering gas affects the CO_2 measurement. To get the best possible measuring result, it is needed to set the gas compensation. The configured concentration of the interfering gas should be in accordance with its actual proportion.

For the microstream CO_2 module, gas compensations are not required.

WARNING

- **Make sure to use the appropriate compensations. Inappropriate compensations may cause inaccurate measurement values and result in misdiagnosis.**

For the sidestream CO_2 module, follow this procedure to set the gas compensation:

1. Select the CO_2 numeric area or waveform area to enter the **CO2** menu.
2. Select the **Setup** tab.
3. Set the compensation according to the actual condition.

For the mainstream CO_2 module, follow this procedure to set the gas compensation:

1. Select the CO_2 numeric area or waveform area to enter the **CO2** menu.
2. Select the **Setup** tab.
3. Set the following compensation according to the actual condition.

- **Balance Gas**
  - Select **Room Air** when air predominates in the ventilation gas mixture.
  - Select **N2O** when N_2O predominates in the ventilation gas mixture.
  - Select **He** when He predominates in the ventilation gas mixture.
- **O2 Compensation**
  - Select **Off** when the amount of O_2 is less than 30%.
  - Select an appropriate setting according to the amount of O_2 in the ventilation gas mixture.
- **AG Compensation**: enters the concentration of anesthetic gas present in the ventilation gas mixture. This could compensate for the effect of AG on the readings.

23.11 Choosing a Time Interval for Peak-Picking

For microstream and mainstream CO_2 modules, you can select a time interval for picking the highest CO_2 as the $EtCO_2$ and the lowest as the $FiCO_2$.

To set the time interval, follow this procedure:

1. Select the CO_2 numeric area or waveform area to enter the **CO2** menu.
2. Select the **Setup** tab.
3. Set **Maximum Hold**.
4. Toggle between **Single Breath**, **10 s**, **20 s** and **30 s** if microstream CO_2 module is configured; toggle between **Single Breath**, **10 s** and **20 s** if mainstream CO_2 module is configured.

    - **Single Breath**: $EtCO_2$ and $FiCO_2$ are calculated for every breath.
    - **10 s**, **20 s**, or **30 s**: $EtCO_2$ and $FiCO_2$ are calculated using 10, 20 or 30 seconds of data.

23.12 Changing Barometric Pressure

Both sidestream and microstream CO_2 modules have the function of automatic barometric pressure compensation (the system automatically measures the barometric pressure to which the patient monitor is exposed). However, the mainstream CO_2 module does not have such function. For the mainstream CO_2 module, the default barometric pressure is 760 mmHg. You must modify the barometric pressure based on the actual situation.

This function is password protected. For more information, see *C.12 The Other Settings*.

WARNING

- **Be sure to set the barometric pressure properly before using the mainstream CO_2 module. Improper settings will result in erroneous CO_2 reading.**

23.13 Performing the Leakage Test

When the Sidestream CO_2 module needs maintenance, the monitor will prompt on the CO2 waveform area: **Maintenance Required. Enter CO2 menu.** Then, perform a leakage test by following this procedure:

1. Select the CO_2 numeric area or waveform area to enter the **CO2** menu.
2. Select the **Maintenance** tab.
3. Perform the leakage test according to the prompt.

23.14 CO_2 Calibration

For sidestream and microstream CO_2 modules, a calibration is needed every year or when the measured values have a great deviation. For maintream CO2 module, no calibration is needed.

To calibrate the CO_2 module, contact the service personnel.

CAUTION

- **Connect the gas outlet to the scavenging system when calibrating the CO_2 module.**

23.15 CO_2 Troubleshooting

This section lists the problems that might occur. If you encounter the problems when using the equipment or accessories, check the table below before requesting for services. If the problem persists, contact your service personnel.

NOTE

- **For the physiological and technical alarm messages, see *D Alarm Messages*.**

23.15.1 Troubleshooting the Sidestream/Microstream CO_2 Module

Problem	Solution
$EtCO_2$measurements too low	1. Ventilate the room if the environmental CO_2 concentration is too high. 2. Check the sample line and connectors for leakage. 3. Check the patient status.

23.15.2 Troubleshooting the Mainstream CO_2 Module

Problem	Solution
Elevated baseline	1. Check the patient status. 2. Check the sensor.

23.16 Oridion Information

Microstream

This trademark is registered in Israel, Japan, German and America.

Oridion Patents

The capnography component of this product is covered by one or more of the following US patents: 6,428,483; 6,997,880; 6,437,316; 7,488,229; 7,726,954 and their foreign equivalents. Additional patent applications pending.

No Implied License

Possession or purchase of this device does not convey any express or implied license to use the device with unauthorized CO_2 sampling consumables which would, alone, or in combination with this device, fall within the scope of one or more of the patents relating to this device and/or CO_2 sampling consumable.

This page intentionally left blank.

24 Monitoring Anesthetic Gas (AG)

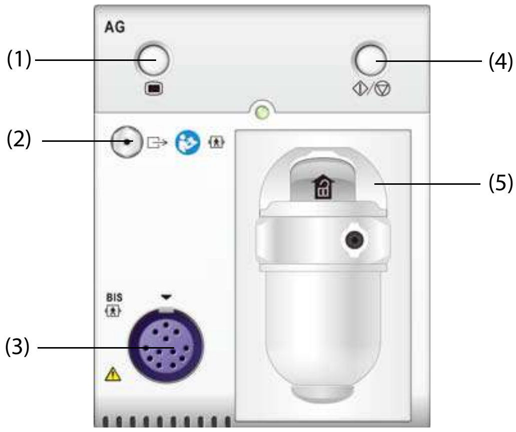
24.1 AG Introduction

The anesthetic gas (AG) module measures the patient's anesthetic and respiratory gases by connecting to the airway of intubated patients or collecting the gases with specified accessories. It also incorporates the features of the O_2 module and BIS module.

The AG module determines the concentration of certain gases using the infrared (IR) light absorption measurement. The gases that can be measured by the AG module absorbing IR light. Each gas has its own absorption characteristic. The gas is transported into a sample cell, and an optical IR filter selects a specific band of IR light to pass through the gas. For multiple gas measurements, there are multiple IR filters. The higher the concentration of gas in a given volume, the more IR light is absorbed. This means that higher concentration of IR absorbing gas causes a lower transmission of IR light. The amount of IR light transmitted after it has been passed through an IR absorbing gas is measured. From the amount of IR light measured, the concentration of gas present can be calculated.

Oxygen does not absorb IR light as other breathing gases and is therefore measured relying on its paramagnetic properties. Inside the O_2 sensor are two nitrogen-filled glass spheres mounted on a strong rare metal taut-band suspension. This assembly is suspended in a symmetrical non-uniform magnetic field. In the presence of paramagnetic oxygen, the glass spheres are pushed further away from the strongest part of the magnetic field. The strength of the torque acting on the suspension is proportional to the oxygen concentration. From the strength of the torque, the concentration of oxygen is calculated.

AG monitoring is intended for adult, pediatric and neonatal patients.



(1) AG menu hard key

(2) Gas outlet

(3) BIS sensor connector

(4) AG Measure/standby hard key

(5) Watertrap seat

NOTE

- **The AG module is configured with automatic barometric pressure compensation function.**
- **For the detailed information of BIS monitoring, see *28 Monitoring Bispectral Index (BIS)*.**

24.2 AG Safety Information

WARNING

- **To avoid explosion hazard, do not use flammable anesthetic agent such as ether and cyclopropane for this equipment.**
- **Using high-frequency electrosurgical units may increase the risk of skin burn. In this case, do not use antistatic or conductive respiratory tubing.**
- **Route all tubing away from the patient's throat to avoid strangulation.**

CAUTION

- **Perform the measurement in a well-ventilated environment.**
- **$EtCO_2$ values measured from the AG module may differ from that of from the blood gas analysis.**

NOTE

- **The AG module automatic suppress physiological alarms until breathing waves have been detected. Make sure that a patient is properly connected when monitoring with the AG module.**

24.3 AG Measurement Limitations

The following factors may influence the measurement accuracy:

- Leaks or internal venting of sampled gas
- Mechanical shock
- Cyclic pressure up to 10 kPa (100 cmH_2O)
- Other sources of interference, if any

24.4 AG Display

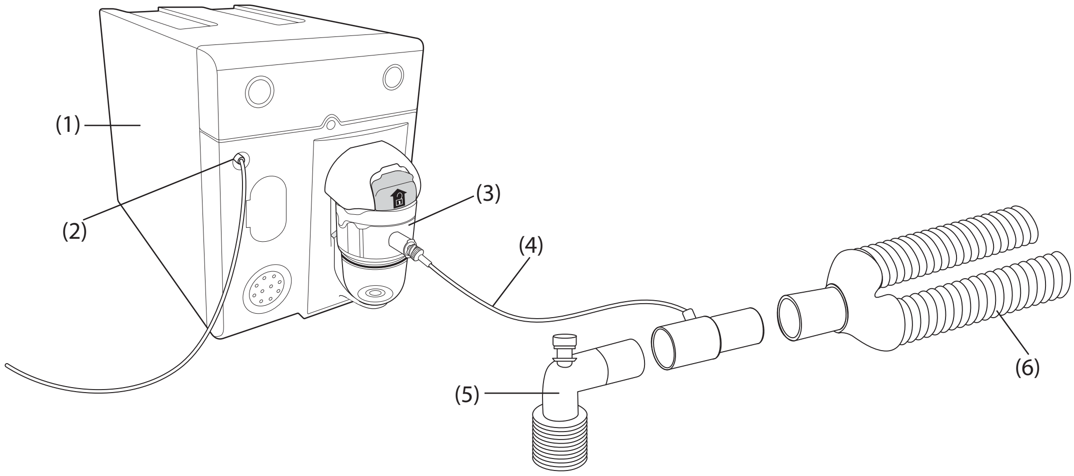
The AG module can send waves and numerics for all measured anesthetic gases for display on the monitor, including:

- CO_2, O_2, N_2O and AA waves
- awRR: airway respiratory rate
- MAC: minimum alveolar concentration
- End tidal (Et) and fraction of inspired (Fi) numerics for CO_2, O_2, N_2O and AA

AA represents one of the following agents: Des (desflurane), Iso (isoflurane), Enf (enflurane), Sev (sevoflurane), or Hal (halothane).

If only one anesthetic agent is used, the AA waveform area displays the waveform of this anesthetic agent. If several anesthetic agents are used, the AA waveform area displays the waveform of the primary anesthetic agent.

24.5 AG Equipment to Patient Connection



(1) AG module	(2) Gas outlet
(3) Watertrap	(4) Gas sample line
(5) Airway adapter (connected to patient)	(6) Y-piece (connected to the anesthesia machine)

24.6 Preparing for AG Monitoring

To prepare to monitor AG, follow this procedure:

1. Select the appropriate gas sample line and watertrap according to the patient category.
2. Connect the watertrap to the AG module, and connect the gas sample line to the watertrap.
3. Connect the other end of the gas sample line to the patient via the airway adapter.
4. Connect the gas outlet to a scavenging system using an exhaust tube.
5. Check that the connections are tight.

After the AG module is connected to the SMR, the AG module enters the measurement mode by default and the monitor prompts **AG Starting**. AG measurement is available after the start-up is completed.

WARNING

- **Connect the gas outlet to the scavenging system when using the AG module.**
- **Make sure that the connections are tight. Any leak in the system can result in erroneous readings due to ambient air mixing with patient gases.**
- **Always inspect the airway adapter for a tight connection and proper operation before attaching it to the patient.**
- **Squeezing or bending the gas sample line during AG measurement may cause erroneous readings or no readings.**

CAUTION

- **Position the airway adapter so that the part connecting to the gas sample line is pointing upwards. This prevents condensed water from passing into the gas sample line and causing an occlusion.**

- **The watertrap collects water drops condensed in the sample line and therefore prevents them from entering the module. To avoid blocking the airway, empty the watertrap container whenever half full. Dispose of accumulated fluids in accordance with hospital policy or your local regulations.**
- **The watertrap has a filter preventing bacterium, water and secretions from entering the module. After long-term use, dust or other substances may compromise the performance of the filter or even block the airway. In this case, replace the watertrap. Replacing the watertrap once a month is recommended.**

NOTE

- **Do not apply adult watertrap to the neonatal patient. Otherwise, patient injury could result.**
- **To extend the lifetime of the watertrap and module, disconnect the watertrap from the module and set the operating mode to Standby when AG monitoring is not required.**

24.7 MAC Values

Minimum alveolar concentration (MAC) is the minimum concentration of the agent in the alveoli. It is a basic index to indicate the depth of anesthesia. The standard ISO 80601-2-55 defines MAC as this: alveolar concentration of an inhaled anesthetic agent that, in the absence of other anesthetic agents and at equilibrium, prevents 50% of patients from moving in response to a standard surgical stimulus.

MAC values are listed below:

Agent	Des	Iso	Enf	Sev	Hal	N_2O
1 MAC	6%	1.15%	1.7%	2.1%	0.77%	105%*

* indicates 1 MAC nitrous oxide can only be reached in hyperbaric chamber.

NOTE

- **The MAC values shown in the table above are those published by the U.S. Food and Drug Administration for a healthy 40-year-old adult male patient.**
- **In actual applications, the MAC value may be affected by age, weight and other factors.**

The formula to calculate the MAC value is as follows:

$$MAC = \sum_{i=0}^{N-1} \frac{EtAgent}{AgentVol_{age}i}$$

Where N is the number of all agents (including N_2O) that the AG module can measure, $EtAgent_i$ is the concentration of each agent, and $AgentVol_{age}i$ is the concentration of each agent at 1 MAC with age correction.

The formula for calculating age correction of 1 MAC is:

$$MAC_{age} = MAC_{40} \times 10^{(-0.00269 \times (age - 40))}$$

For example, the Des concentration at 1 MAC of a 60-year old patient is.

$$6\% \times 10^{(-0.00269 \times (60 - 40))} = 6\% \times 0.88$$

The AG module measures 4% of Des, 0.5% of Hal and 50% of N_2O in the patient's end-tidal gas:

$$MAC = \frac{4.0\%}{6\% \times 0.88} + \frac{0.5\%}{0.77\% \times 0.88} + \frac{50\%}{105\% \times 0.88} = 2.04$$

NOTE

- **The formula above is only suitable for patients who are older than one year. If the patient is less than one year, the system uses one year old to do age correction.**

24.8 Changing AG Settings

24.8.1 Changing AG Alarm Settings

To change the AG alarm settings, follow this procedure:

1. Select the AG numeric area or waveform area to enter the **Gas** menu.
2. Select the desired gas tab.
3. Select the **Alarm** tab.
4. Enter the password if required.
5. Set the alarm properties of the desired gas.

24.8.2 Setting the O_2 Compensation

If the AG module does not incorporate the O_2 module, you need to set the amount of O_2 in the ventilation gas mixture. To set the O_2 compensation, follow this procedure:

1. Select the AG numeric area or waveform area to enter the **Gas** menu.
2. Select the **Setup** tab.
3. Set **O2 Compensation**:

   - Select **Off** when the amount of O_2 is less than 30%.
   - Select the other options in accordance with the O_2 concentration in the gas mixture.

If the AG module incorporates the O_2 module, the system directly uses the O_2 concentration detected by the O_2 module to make compensation. In this case, **O_2 Compensation** is fixed to **Off**.

24.8.3 Entering the Standby Mode

You can set the AG module to one of the following modes according to the module status:

- Select **Measure** mode when you use the AG module for monitoring.
- Select **Standby** mode when you are not using the AG module.

The default operating mode is **Measure**. If you are not using the AG module, follow this procedure to enter the Standby mode:

1. Select the AG numeric area or waveform area to enter the **Gas** menu.
2. Select the desired gas tab.
3. Select the **Setup** tab.
4. Set **Operating Mode** to **Standby**.

24.8.4 Setting Auto Standby

The monitor enters the standby mode automatically after the configured period of time if no breath is detected since the last detected breath. To set the auto standby, follow this procedure:

1. Select the AG numeric area or waveform area to enter the **Gas** menu.
2. Select the desired gas tab.
3. Select the **Setup** tab.
4. Set **Auto Standby**.

24.8.5 Setting the Gas Waveform

To set the gas waveform, follow this procedure:

1. Select the AG numeric area or waveform area to enter the **Gas** menu.
2. Select the desired gas tab.
3. Select the **Setup** tab.

4. Set the speed and scale of gas waveforms. For CO_2, you can also set **Waveform Type**.

24.8.6 Setting the RR Source

To set the RR (respiration rate) source, follow this procedure:

1. Select the AG numeric area or waveform area to enter the **Gas** menu.
2. Select the desired gas tab.
3. Select the **Setup** tab.
4. Set **RR Source**.

When the current RR source does not have valid measurement, the system will automatically switch **RR Source** to **Auto**.

24.8.7 Entering the Intubation Mode

When performing intubation during general anesthesia, you can enter the intubation mode in order to reduce unnecessary alarms. To enter the intubation mode, follow this procedure:

1. Select the AG numeric area or waveform area to enter the **Gas** menu.
2. Select **Intubation Mode** from the bottom of the menu.

For the details of the intubation mode, see ***10.13 Intubation Mode***.

24.8.8 Enabling or Disabling MAC Display

You can set whether MAC value is displayed in the AG numberic area. To do so, follow this procedure:

1. Select the AG numeric area or waveform area to enter the **Gas** menu.
2. Select the desired anesthetic agent tab.
3. Switch on or off **MAC**.

24.9 Changing the Anesthetic Agent

When the anesthetic agent used on the patient is changed, the AG module detects the mixed anesthetic gas during the transition of two anesthetic agents. The time required for completing the replacement of anesthetic agent depends on anesthesia type (low flow or high flow) and the characteristics of anesthetic agents (pharmacokinetics). During the transition of two anesthetic agents, the monitor gives no prompt messages and the MAC value displayed may be inaccurate.

The AG module can identify two anesthetic agents automatically. When the proportion of primary and secondary anesthetic agents in the mixture changes, the AG module can distinguish between them according to their contributions to the MAC value. Then primary and secondary anesthetic agents will be exchanged for display.

24.10 Performing AG Leakage Test

The AG leakage test is required every time before the AG measurement. To perform the AG leakage test, follow this procedure:

1. Plug the AG module into the module rack.
2. Wait for about one minute until the AG module warms up. Completely block the gas inlet of the AG module. Then the alarm message “**AG Airway Occluded**” will appear on the screen.
3. Block the gas inlet for another one minute.
4. Select the **Main Menu** quick key → turn to the third page → from the **System** column select **Maintenance** → input the required password → select .
5. Select the **Module** tab → **AG** tab.
6. Check that the current flow rate is less than 10ml/min, and the alarm message “**AG Airway Occluded**” does not disappear.

   This indicates that the module does not leak. If the alarm message disappears, or the flow rate is equal to 10ml/min or greater, it indicates that the module leaks. Perform the leakage test again. If the problem remains, contact your service personnel for help.

24.11 Calibrating the AG Module

Calibrate the AG module every year or when the measured value is outside the specification. To calibrate the AG module, contact the service personnel.

CAUTION

- **Connect the gas outlet to the scavenging system when calibrating the AG module.**

24.12 AG Troubleshooting

If the AG airway is occluded, the message **AG Airway Occluded** appears. In this case, check for the follows until the message disappears:

1. Check the airway adapter for occlusion and replace if necessary.
2. Check the sample line for occlusion or kinking and replace if necessary.
3. Check the watertrap for water or occlusion. Empty the watertrap, or replace the watertrap if necessary.
4. Check the gas outlet and the exhaust tube for any occlusion.

If the message does not disappear, it is probably the module fault. Contact the service personnel in this case.

NOTE

- **For the physiological and technical alarm messages, see *D Alarm Messages*.**

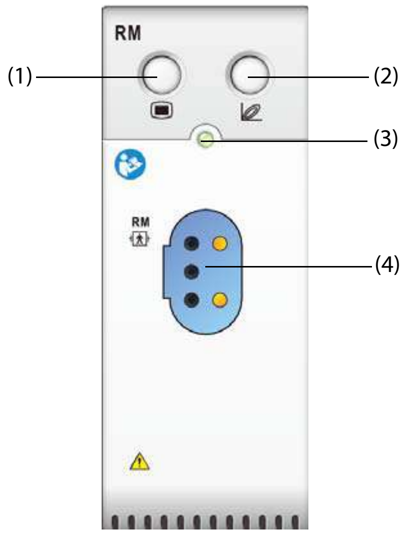
This page intentionally left blank.

25 Monitoring Respiratory Mechanics (RM)

25.1 RM Introduction

The RM monitoring enables clinicians to understand the ventilator/anesthesia machine operation and patient respiratory status. In the respiratory mechanics (RM) monitoring, the airway pressures are measured, from the part between the patient circuit and intubation tube, using a flow sensor between the Y-piece of patient circuit and the patient connection. The pressure is transferred to the monitor through the tube and measured by a pressure transducer in the RM module. The pressure difference together with the gas concentration information is used to calculate flow. The volume information is obtained by integrating the flow signal. From these three parameters, other parameters such as RR, I:E, Compl, etc. are derived.

RM monitoring is intended for adult, pediatric, and neonatal patients.



(1) RM menu hard key

(2) Enter/Exit the respiratory Loops

(3) Module status indicator

(4) Flow sensor connector

25.2 RM Safety Information

WARNING

- **RM monitoring is for mechanically ventilated patients only.**
- **The RM module is not intended to be used with high frequency ventilators.**

25.3 RM Parameters

RM monitoring displays the following waveforms and loops:

- Flow waveform
- Paw waveform
- Vol waveform
- FV (flow-volume) loop
- PV (paw-volume) loop
- PF (paw-flow) loop

RM monitoring provides values for 18 parameters. The 18 parameters can be classified into 4 categories:

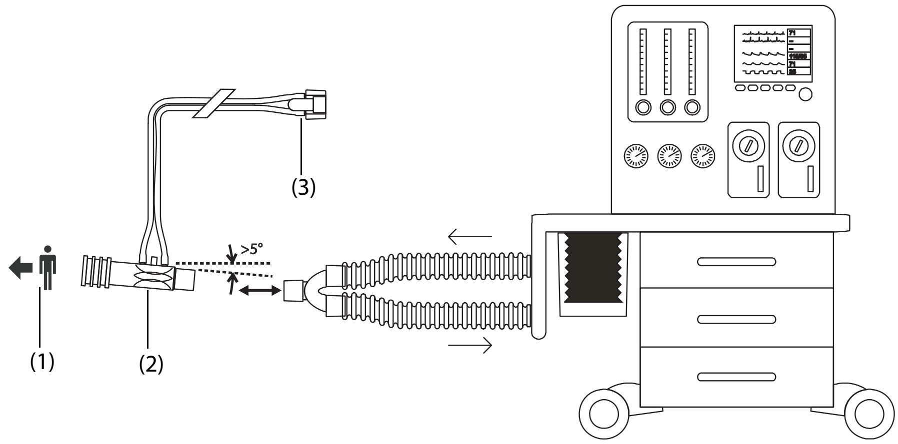
Parameter Label	Description	Unit
Paw parameters		
PIP	peak inspiratory pressure	cmH_2O
Pplat	pressure	cmH_2O
PEEP	positive end expiratory pressure	cmH_2O
Pmean	mean pressure	cmH_2O
Flow parameters		
PIF	peak inspiratory flow	L/min
PEF	peak expiratory flow	L/min
Vol parameters		
TVi	inspiratory tidal volume	ml
TVe	expiratory tidal volume	ml
MVi	inspiratory minute volume	L/min
MVe	expiratory minute volume	L/min
Other parameters		
RR	respiratory rate	rpm
I : E	ratio of the inspiratory and expiratory time	/
Compl	compliance	ml/cmH_2O
FEV1.0	first second forced expiratory volume ratio	%
RSBI	rapid shallow breathing index	rpm/L
WOB	work of breathing	J/L
NIF	negative inspiratory force	cmH_2O
RAW	airway resistance	$cmH_2O/L/s$

25.4 RM Display

You can select the parameter for display in the **Select Parameter** page of the **RM** menu. For more information, see *25.8.8 Setting Parameters for Display*.

(1) Flow waveform
(2) Paw waveform
(3) Volume waveform
(4) Flow numeric area
(5) Paw numeric area
(6) Vol numeric area

25.5 RM Equipment to Patient Connection



(1) Connects to the patient (2) Flow sensor (3) Connect to the RM module

25.6 Preparing for RM Monitoring

To prepare to monitor RM, follow this procedure:

1. Select an appropriate flow sensor in accordance with the patient category.
2. Connect the thin tubes of the flow sensor to the flow sensor connector of the RM module.
3. Connect the end of the flow sensor marked to the patient tracheal tube.
4. Connect the other end of the flow sensor to the Y-tube of a ventilator or anesthesia machine.
5. Check that the connections are tight.

CAUTION

- **Be sure to set the barometric pressure properly before using the RM module. Improper settings will result in erroneous RM reading.**
- **A system leak may significantly affect readings of flow, volume, pressure and other respiratory mechanics parameters.**
- **Match the airway adapter you select to the appropriate patient category. Improper sensor selection may produce excessive ventilation resistance or introduce excessive airway dead space.**
- **To prevent stress on the endotracheal tube, support the sensor and airway adapter.**
- **Position sensor tubing carefully to avoid entanglement or potential strangulation.**

NOTE

- **To avoid the effect of excessive moisture in the measurement circuit, insert the flow sensor in the breathing circuit with the tubes upright, and make sure that the flow sensor is always positioned a few degrees off the horizontal level towards the ventilator side.**
- **Do not place the flow sensor between the endotracheal tube and an elbow as this may allow patient secretions to block the flow sensor window.**
- **Measurement values provided by a ventilator or an anesthesia machine may differ significantly from the values provided by the RM module, due to different locations of the flow sensor.**
- **For best measurement performance, a heat moisture exchanger (HME) should always be put between the tracheal tube and the flow sensor. Periodically check the flow sensor and tubing for excessive moisture or secretion build-up and purge if necessary.**
- **During RM monitoring, the RM module automatically performs zero calibration periodically or when the temperature changes. Zero calibration affects RM waveforms.**
- **Keep the respiration loop away from condensing equipment.**

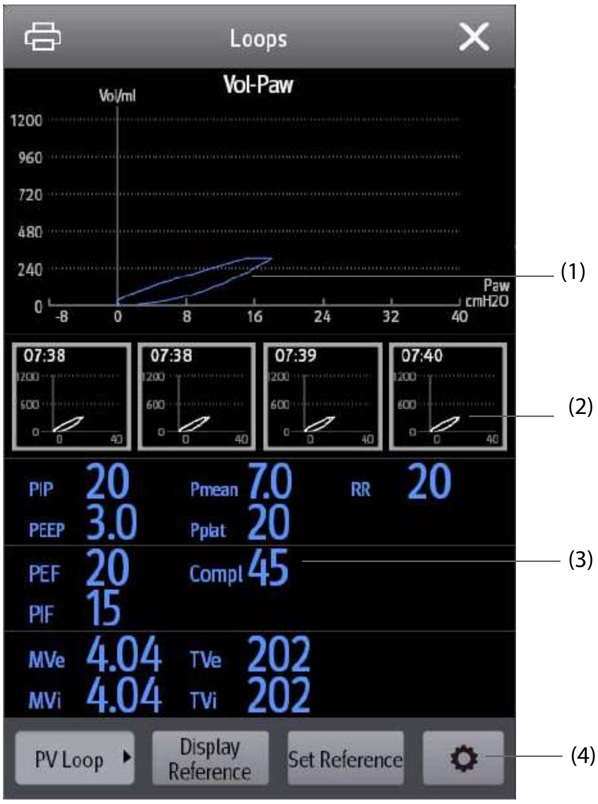
25.7 Respiratory Loops

Respiratory loops reflect patient lungs function and ventilation condition, such as the lung's compliance, over-inflation, breathing system leakage and airway blockage.

The monitor provides three types of respiratory loops: PV (pressure-volume) loop, FV (flow-volume) loop, and PF (flow-pressure) loop. The three types of loops come from pressure, flow, and volume waveforms data.

To view the respiration loops, choose any of the following ways:

- Select the **Loops** quick key.
- Select the **Screen Setup** quick key → the **Select Quick Keys** tab.
- Select the **Main Menu** quick key → from the **Display** column select **Choose Screen**→ select **Respiration Loops**.



(1) Respiratory loop

(2) Reference loop

(3) RM parameters

(4) Button area

25.7.1 Changing the Loop Type

The monitor displays only one type of respiratory loops at the same time. To change the type of the respiratory loops, follow this procedure:

1. Select the numeric area or waveform area of Paw, Flow or Vol to enter the **RM** menu.
2. Select **Loops** from the bottom of the menu to enter the **Loops** window.
3. Select the desired loop type at the lower left corner of the window.

NOTE

- **If the RM module is used together with the mainstream CO_2 module, you can also select the VCO_2 curve from the Loops screen.**

25.7.2 Saving the Loop as Reference

You can save the real time loops as reference loops. To save the loops, follow this procedure:

1. Select the numeric area or waveform area of Paw, Flow or Vol to enter the **RM** menu.
2. Select **Loops** from the bottom of the menu to enter the **Loops** window.
3. Select **Set Reference**.

The reference loops and the time at which the reference loops are saved display in the **Loops** window simultaneously. Up to four groups of loops can be saved as reference loops. If the fifth group of loops needs to be saved as reference, the monitor will prompt that an older group of reference loops should be replaced by the fifth group.

25.7.3 Displaying the Reference Loop

The reference loop and real time loop can overlap and be displayed in the same area of the **Loops** window. In this case, the reference loop is drawn in white. To display the reference loop, follow this procedure:

1. Select the numeric area or waveform area of Paw, Flow or Vol to enter the **RM** menu.
2. Select **Loops** from the bottom of the menu to enter the **Loops** window.
3. Select the reference loop to be displayed.
4. Select **Display Reference**.

To hide the reference loop, select **Hide Reference** button in the **Loops** window.

25.7.4 Adjusting the Loop Scale

The scales of the loops are the same as the scale of the corresponding waveforms. For more information, see *25.8.5 Changing the Wave Scale*.

25.7.5 Selecting the Parameters for Display

The parameters displayed in the **Loops** window are the same as those displayed in the Paw, Flow and Vol numeric areas. For more information, see*25.8.8 Setting Parameters for Display*.

25.8 Changing RM Settings

25.8.1 Changing RM Alarm Settings

To change the RM alarm settings, follow this procedure:

1. Select the numeric area or waveform area of Paw, Flow or Vol to enter the **RM** menu.
2. Select the **Alarm** tab.
3. Set the alarm properties of PEEP, PIP and MVe:

25.8.2 Setting the Apnea Alarm Delay

The monitor will alarm if the patient has stopped breathing for longer than the previously set apnea time. To change the delay time of the apnea alarm, follow this procedure:

1. Select the numeric area or waveform area of Paw, Flow or Vol to enter the **RM** menu.
2. Select the **Alarm** tab.
3. Enter the password if required.
4. Set **Apnea Delay**.

WARNING

- **The respiration monitoring does not recognize the cause of apneas. It only indicates an alarm if no breath is detected when a preadjusted time has elapsed since the last detected breath. Therefore, it cannot be used for diagnostic purposes.**

25.8.3 Setting RR Source

To set the RR (respiration rate) source, follow this procedure:

1. Select the numeric area or waveform area of Paw, Flow or Vol to enter the **RM** menu.
2. Select the **Setup** tab.
3. Set **RR Source**.

When the current RR source does not have valid measurement, the system will automatically switch **RR Source** to **Auto**.

25.8.4 Changing the Wave Sweep Speed

To set the sweep speed of Paw, Flow, and Vol waveforms, follow this procedure:

1. Select the numeric area or waveform area of Paw, Flow or Vol to enter the **RM** menu.
2. Select the **Setup** tab.
3. Set **Speed**.

25.8.5 Changing the Wave Scale

To set the scale of Paw, Flow, and Vol waveforms, follow this procedure:

1. Select the numeric area or waveform area of Paw, Flow or Vol to enter the **RM** menu.
2. Select the **Setup** tab.
3. Set **Paw Scale**, **Flow Scale**, or **Vol Scale**

25.8.6 Setting the Ambient Temperature

To set the ambient temperature, follow this procedure:

1. Select the numeric area or waveform area of Paw, Flow or Vol to enter the **RM** menu.
2. Select the **Setup** tab.
3. Set **Atmosphere Temp**.

25.8.7 Setting the Ambient Humidity

To set the ambient humidity, follow this procedure:

1. Select the numeric area or waveform area of Paw, Flow or Vol to enter the **RM** menu.
2. Select the**Setup** tab.
3. Set **Relative Humidity**.

25.8.8 Setting Parameters for Display

Each numeric areas of Paw, Flow or Vol can display up to 6 parameters. To set the parameters for display, follow this procedure:

1. Select the numeric area or waveform area of Paw, Flow or Vol to enter the **RM** menu.
2. Select the **Select Parameter** tab.
3. Select the parameters for display on pages of **Paw**, **Flow** and **Vol**.

25.8.9 Entering the Intubation Mode

When performing intubation during general anesthesia, you can enter the intubation mode in order to reduce unnecessary alarms. To enter the intubation mode, follow this procedure:

1. Select the numeric area or waveform area of Paw, Flow or Vol to enter the **RM** menu.
2. Select **Intubation Mode** from the bottom of the menu.

For more information of the intubation mode, see *10.13 Intubation Mode*.

25.9 VCO_2 and Metabolic Monitoring

When the RM module is used together with the mainstream CO_2 module, the following parameters can be monitored:

- Volume CO_2 parameters (VCO_2, $MVCO_2$, $FeCO_2$, $SlopeCO_2$),
- Ventilation parameters (Vtalv, MValv)
- Dead space parameters (Vdaw, Vdaw/Vt, Vdalv, Vdalv/Vt, Vdphy, Vd/Vt).

When the RM module is used together with the sidestream CO_2 module or AG module configured with the paramagnetic oxygen sensor, the following parameters can be monitored:

- Volume CO_2 parameters (VCO_2, $MVCO_2$)
- Oxygen consumption parameters (VO_2, MVO_2)
- Respiratory Quotien (RQ) and Energy Expenditure (EE)

Monitoring above parameters is intended for adult and pediatric patients.

25.9.1 VCO_2 and Metabolic Parameters

The following table lists VCO_2 and metabolic parameters.

Parameter label	Description	Unit	Required modules
VCO_2	CO_2 Production for one breath	ml	RM + mainstream CO_2 RM + sidestream CO_2/AG
$MVCO_2$	CO_2 Minute Production	ml/min	

Parameter label	Description	Unit	Required modules
$FeCO_2$	Mixed Expired CO_2 Concentration	%	RM + mainstream CO_2
$SlopeCO_2$	Slope of the alveolar plateau	%/L	
Vtalv	Alveolar Tidal Volume	ml	
MValv	Alveolar Minute Volume	L/min	
Vdaw	Airway Deadspace	ml	
Vdaw/Vt	Airway deadspace to tidal volume ratio	%	
Vdalv	Alveolar Deadspace	ml	
Vdalv/Vt	Alveolar deadspace to tidal volume ratio	%	
Vdphy	Physiologic Deadspace	ml	
Vd/Vt	Deadspace to tidal volume ratio	%	
VO_2	O_2 Consumption for one breath	ml	RM + sidestream CO_2/AG
MVO_2	O_2 Minute Consumption	ml/min	
EE	Energy Expenditure	kCal/day	
RQ	Respiratory Quotient	/	

25.9.2 Safety Information When RM Module in Use with CO_2 or AG Module

WARNING

- **Measurement using RM module and CO2 or AG Module is for intubated patients only.**

CAUTION

- **When using the RM module together with the CO2 or AG Module, the gas sampling positions should be between the patient and the Y-piece, adjacent to the Y-piece end. The two sampling positions should be close to each other. Otherwise, measurement error can result.**
- **Strong scavenging suction may change the operating pressure of the modules and cause inaccurate readings or excessive sample gas flow.**
- **When monitoring with the RM module and the CO2 or AG Module, keep the patient still. Do not disturb the patient or adjust the ventilation device.**
- **RQ has no reference significance if beyond the range of 0.6 and 1.3. Verify that the measurement is correct and the patient is stable.**

25.9.3 Measurement Limitations When RM Module in Use with CO_2 or AG Module

When the RM module is used together with the CO_2 module or AG module, measurements have reference significance only when the patient is in stable ventilation status. Stable ventilation status refers to the following situations:

■ Patient is at rest for at least 30 minutes.

■ Mechanical ventilation parameters (RR, TV, and etc) remain unchanged.

■ No operations that may affect the patient's gas exchange or metabolism.

The measurement may be inaccurate in the following situations:

■ The airway of sampling lines are abnormal or sampling lines leak or are blocked.

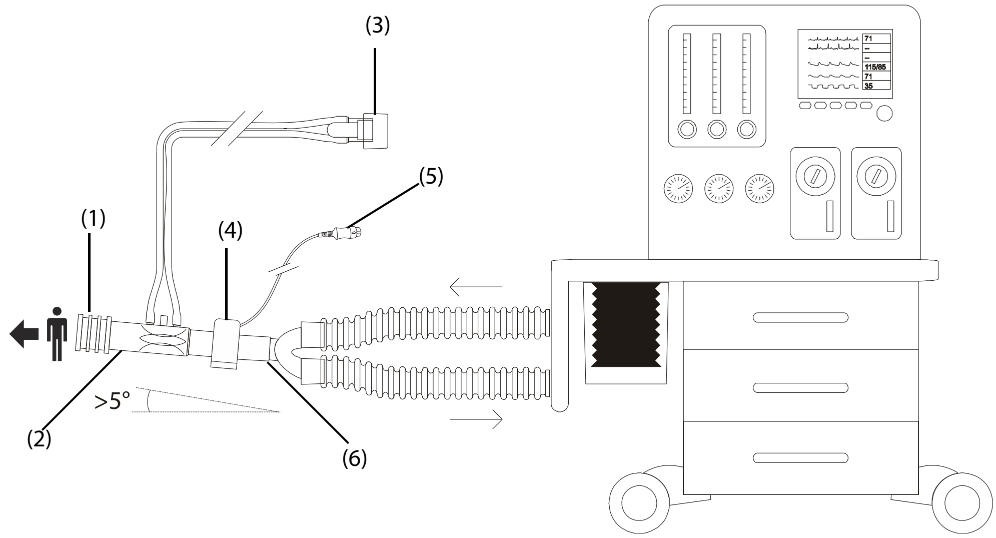
- Unsteady FiO_2 values
- Other circumstance causing wrong CO_2, O_2, and Flow measurements

Measurement cannot be taken in the following situations due to inadequate time for accurate sampling:

- High frequency ventilation (HFV) or bi-level positive airway pressure (BiPAP)
- Respiration rate is above 35 rpm.

25.9.4 Equipment to Patient Connection When RM Module in Use with CO_2 or AG Module

When the RM module is used together with the mainstream CO_2 module, equipment to patient connection is as follows:

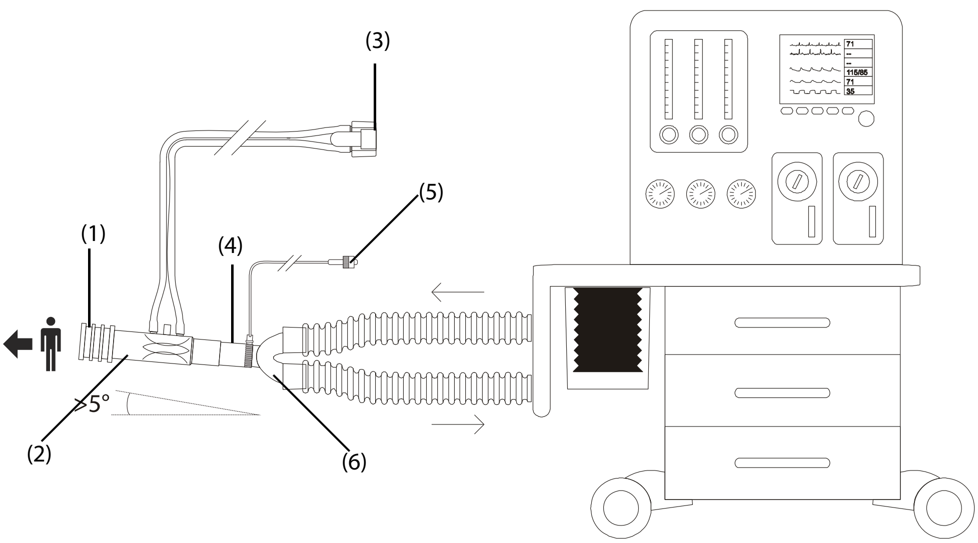


(1) Connects to the patient (2) RM flow sensor (3) Connects to the RM module

(4) Airway adapter (5) Connects to the mainstream CO_2 module

(6) Y-piece (connects to the ventilator or anesthesia machine)

When the RM module is used together with the sidestream CO_2 module or AG module, equipment to patient connection is as follows:



(1) Connects to the patient (2) RM flow sensor (3) Connects to the RM module

(4) Airway adapter (5) Connects to the sidestream CO_2 module or AG module

(6)Y-piece (connects to the ventilator or anesthesia machine)

25.9.5 Displaying the VCO2 and EE Numerics Areas

When the RM module is used together with the mainstream CO_2 module, parameter display is as follows:

- In the VCO_2 parameter area, up to 6 parameters can be displayed. You can choose the parameters you want to display. For more information, see *25.9.8 Selecting the Displayed VCO_2 Parameters*.
- In the Vol, Flow or Paw numerics area, choose Vtalv and MValv.

When the RM module is used together with the sidestream CO_2 module or AG module configured with the paramagnetic oxygen sensor, parameter display is as follows:

- In the VCO_2 parameter area, VCO_2, $MVCO_2$, VO_2, MVO_2 are displayed.
- In EE parameter area, RQ and EE are displayed.

25.9.6 Preparing for VCO2 and Metabolic Monitoring

For more information, see *23.5.1 Preparing to Measure CO_2 Using Sidestream CO2 Module*, *24.6 Preparing for AG Monitoring*, and *25.6 Preparing for RM Monitoring*.

NOTE

- **When monitoring dead space parameters (Vdalv, Vdalv/Vt, Vdphy, Vd/Vt) with the RM module and the mainstream CO_2 Module, you need to enter the $PaCO_2$ value.**
- **When the RM module is used together with the sidestream CO_2 module or AG module configured with the paramagnetic oxygen sensor, CO_2 waveform and Flow waveform needs aligning by self learning. So you have to wait for about two minutes to get valid measurement.**

25.9.7 Viewing V-CO_2 Curve

When the RM module is used together with the mainstream CO_2 module, you can view the V-CO_2 curve from the **Loops** screen. For more information, see *25.7 Respiratory Loops*, *25.7.1 Changing the Loop Type* for details.

The V-CO_2 curve displays the following items:

- V-CO_2 curve
- $MVCO_2$/MValv trend
- parameter values

25.9.8 Selecting the Displayed VCO_2 Parameters

When the RM module is used together with the mainstream CO_2 module, to select the parameters you want to display in the VCO_2 parameter area, follow this procedure:

1. Select the **VCO_2** parameter area to enter the **VCO_2** menu.
2. From the **VCO_2** Tile area, select a parameter block, and then select a parameter from the **Parameters** area.

25.10 RM Troubleshooting

This section lists the problems that might occur. If you encounter the problems when using the equipment or accessories, check the table below before requesting for services. If the problem persists, contact your service personnel.

NOTE

- **For the physiological and technical alarm messages, see *D Alarm Messages*.**

Problem	Solution
Do not see RM numeric area or waveform area on the main screen	1. Check that the Paw, Flow or Vol is set to be displayed in the **Screen Setup** menu. For more information, see *39.12 The Other Settings*. 2. Check that if the RM parameter switch is enabled. If not, enable the RM measurement. For more information, see *3.11.1 Switching On or Off a Parameter*. 3. Check the connection of flow sensor.
Erroneous values	1. Check that the tube connectors and their connections are tight and not leaking. 2. Check that the sensor type is appropriate. 3. Disconnect the flow sensor, and remove the water or secretions from the flow sensor.
Values seems unstable	
Strong vibrations in the loop	1. Check the patient status. 2. Check the breathing system for water or secretions.
The respiratory loops are not whole. (gap between the starting and ending points may indicate a leak)	Check the breathing system for leakage.

This page intentionally left blank.

26 Monitoring Transcutaneous Blood Gas (tcGas)

26.1 tcGas Introduction

This patient monitor can connect the external device for continuous transcutaneous blood gas monitoring.

This patient monitor can display, store and review measurements from the external device, as well as present related alarms. On this patient monitor, you can separately set the level of tcGas related alarms and switch on or off alarm recording; you can also view external device settings of alarm limits and alarm switch.

This patient monitor can integrate the following external devices:

- Radiometer TCM4
- Radiometer TCM5
- Radiometer TCM40
- Radiometer TCM CombiM
- Radiometer TCM TOSCA
- SenTec Digital Monitor (SDM)

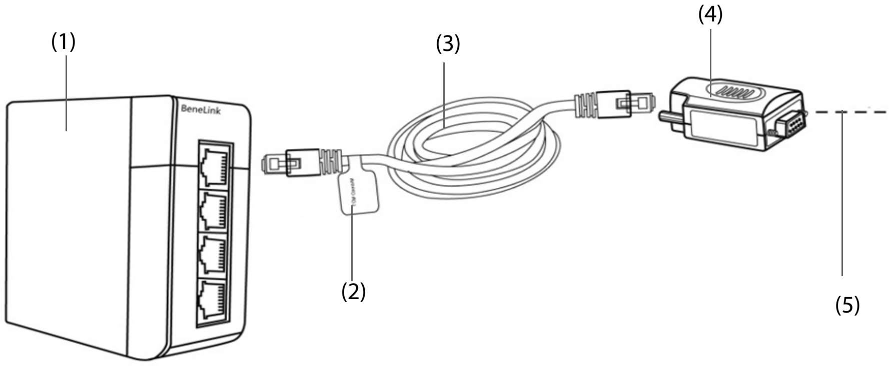
26.2 tcGas Safety Information

WARNING

- **TCM monitors are manufacutred by Radiometer Medical ApS. This company provides the technology for measuring tcGas parameters. We only provide the connection between this patient monitor and TCM monitors.**
- **The SenTec Digital Monitor (SDM) is manufacutred by SenTec AG. This company provides the technology for measuring tcGas parameters. We only provide the connection between this patient monitor and the SenTec Digital Monitor.**
- **If you have any doubts about the operation and maintenance of the external device, please refer to the operator's manual of the external device or directly contact its manufacturer.**
- **Fully observe the operator's manual of the external device to make settings and to connect the external device with a patient.**
- **For the intended use and contraindication of the external devices, refer to their operator's manuals.**

26.3 Connecting an External Device

The external device connects with BeneLink module through an ID adapter, see the picture below.



(1) BeneLink Module (2) Label (3) RJ45 connecting cable

(4) ID Adapter (5) Type C serial port adapting cable

To connect the external device, follow this procedure:

1. Insert a BeneLink module into the SMR.
2. Connect the ID adapter that matches the external device to the BeneLink module with an RJ45 connecting cable.
3. Connect the ID adapter to the external device:
   - ◆ For the TCM monitor, connect the ID adapter to the serial port (COM port) of the TCM monitor with Mindray type C serial port adapting cable (PN: 009-001769-00) and an interface cable provided with the TCM monitor.
   - ◆ For the SenTec Digital Monitor, connect the ID adapter to the serial port (COM port) of the SenTec Digital Monitor with Mindray type C serial port adapting cable (PN: 009-001769-00).
4. Put a label indicating device name to the RJ45 connecting cable at the end near the BeneLink module. When the BeneLink module is connected to several external devices, you can easily recognize the devices with these labels.
5. Turn on both monitors.

26.4 tcGas Parameters

The following table lists tcGas parameters provided by different monitors:

TCM CombiM/TCM4/TCM5 monitor		**TCM TOSCA monitor**		**TCM40 monitor**		**SenTec Digital Monitor**	
Primary parameters	**Secondary parameters**	**Primary parameters**	**Secondary parameters**	**Primary parameters**	**Secondary parameters**	**Primary parameters**	**Secondary parameters**
tcpCO2, tcpO2	Power, Tsensor	tcpCO2	SpO_2, PR, Power, Tsensor	tcpCO2, tcpO2	SpO_2, PR, Power, Tsensor	tcpCO2, tcpO2	SpO_2, PR, Power, Tsensor

NOTE

- **On the SenTec Digital Monitor it is possible to disable/enable the parameters to be monitored. For $tcpO_2$ monitoring an OxiVenT™ Sensor and activated PO_2-option are required. If the SenTec Digital Monitor is operated in neonatal mode, SpO_2 and PR are not supported.**

26.5 Activating the tcGas Alarm Sound

To activate the tcGas alarm sound, follow this procedure:

1. Select the tcGas numeric area to enter the **+tcGas** menu.
2. Set **Alarm Sound** to **On**.

After the tcGas alarm sound is activated, the patient monitor gives sound prompts for the alarms of the tcGas monitor.

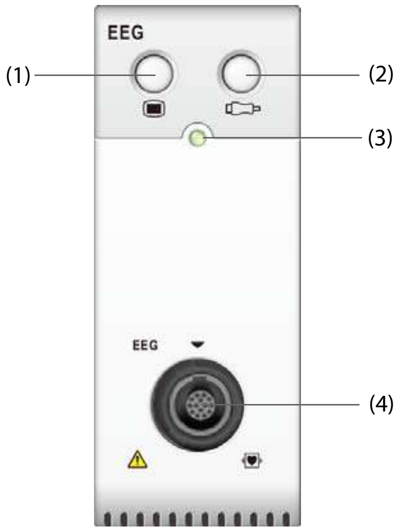
27 Monitoring Electroencephalogram (EEG)

27.1 EEG Introduction

The Electroencephalograph (EEG) module measures the spontaneous , rhythmic electrical activity of the cortex. Continuous EEG is routinely used in critical care and during anesthesia applications.

The EEG module can continuously monitor EEG signal from up to four channels. It can also display Density Spectral Arrays (DSA) and Compressed Spectral Arrays (CSA).

EEG monitoring is intended for adult, pediatric, and neonatal patients.



(1) EEG menu hard key	(2) Sensor check hard key
(3) Module status indicator	(4) EEG cable connector

27.2 EEG Safety Information

WARNING

- **The conductive parts of electrodes and connectors should not contact other conductive parts, including earth.**
- **To reduce the hazard of burns in the high-frequency surgical neutral electrode connection, the EEG sensor should not be located between the surgical site and the electrosurgical unit return electrode.**
- **The EEG electrode must not be located between defibrillator pads when a defibrillator is used on a patient under monitoring.**
- **To ensure proper defibrillator protection, use only recommended cables and leadwires.**
- **EEG is a complex monitoring technology intended for use only as an adjunct to clinical judgment and training.**

CAUTION

- **Only use parts and accessories specified in this manual. Follow the instructions for use and adhere to all warnings and cautions.**
- **Implanted devices (for example cardiac pacemakers), other patient connected equipment, and other equipment near the patient (for example high-frequency surgical units) can cause interference on the waveform, numerics, and the CSA presentation.**

- **External radiating devices may disturb the measurement. It is recommended to avoid the use of electrical radiating equipment in close proximity to the monitor.**
- **Interference from ECG can be eliminated by adjusting the filter settings.**

NOTE

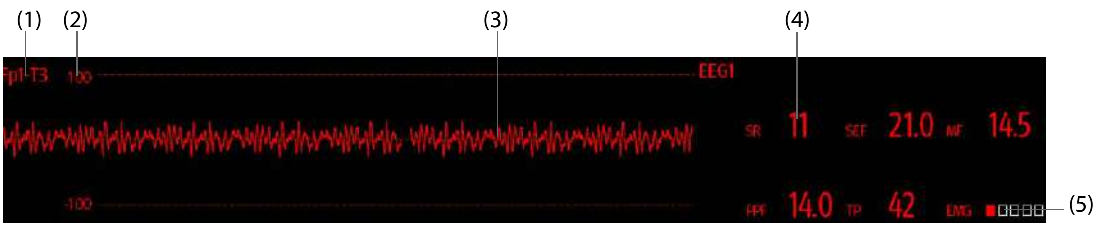
- **The EEG accessories are purchased from EB Neuro S.p.A. Please contact EB Neuro or visit its website (www.ebneuro.com) for more information.**
- **In case of electrode off, the monitor provides the error indication only when it performs auto sensor check according to the interval time (which is set by user). Therefore, immediately start manual sensor check if abnormal waveform and/or high noise is found.**

27.3 EEG Parameters

EEG monitoring provides ten parameters: SEF, MF, PPF, TP, SR, EMG, Delta, Theta, Alpha, and Beta. The numerics area of each EEG channel can display up to six parameters.

Label	Description
SEF (Spectrum Edge Frequency)	The frequency at which 95% of the total power lies below it and 5% lies above it. Its range is from 0.5 to 30.0Hz.
MF (Median Frequency)	The frequency at which 50% of the total power lies below it and 50% lies above it. Its range is from 0.5 to 30.0Hz.
PPF (Peak Power Frequency)	The PPF is the frequency with the highest measured amplitude range from 0.5 to 30 Hz.
TP (Total Power)	TP numeric is a measure of the absolute total power in the frequency range from 0.5 to 30.0 Hz. The useful range is from 40 to 100 db.
SR (Suppression Ratio)	SR numeric is the percentage of time in the past 60 seconds in which the EEG signal is considered suppressed.
EMG (Electromyography)	EMG bar graph reflects the electrical power of muscle activity and high frequency artifacts. Low EMG indicates that EMG activity is low.
Delta%, Theta%, Alpha%, Beta% (Frequency band ratio)	EEG is traditionally divided into four frequency bands: delta, theta, alpha and beta. Frequency band ratio is the percentage of total power falling in corresponding band. For example, Delta % = Power in delta band/Total power. Alpha waves: 8 to 13 Hz Beta waves: 13 to 30 Hz Theta waves: 4 to 8 Hz Delta waves: 0.5 to 4 Hz

27.4 EEG Display



(1) Lead label

(2) EEG waveform scale. For more information, see *27.8.1 Changing the EEG Scale*.

(3) EEG waveform
You can configure the displayed EEG waveforms. A maximum of four EEG waveforms can be displayed.

(4) EEG parameters

You can configure the displayed EEG parameters. A maximum of six EEG parameters can be displayed. For more information, see *27.8.5 Changing Displayed EEG Parameters*.

(5) EMG indicator

- ◆ Empty: EMG < 30 dB. EEG monitoring conditions are optimal.
- ◆ 1 to 4 bars: EMG 30 to 55 dB. EEG monitoring conditions are acceptable.
- ◆ 5 bars: EMG > 55 dB. EEG monitoring conditions are unacceptable.

27.5 Accessing the On-screen EEG Guide

The monitor provides the on-screen EEG guide to help you understand EEG monitoring functions and operating procedure.

To access the on-screen EEG guide, follow this procedure:

1. Select the EEG numerics area or waveform area to enter the **EEG** menu.
2. Select the **Introduction** tab.
3. Select a tab as required.

- ◆ Select the **Summary** tab to view the EEG monitoring principles, intended use, and work modes.
- ◆ Select the **Target Patient** tab to view the applicable patients for EEG monitoring.
- ◆ Select the **Operation Guide** tab to view the EEG monitoring procedure.
- ◆ Select the **CSA and DSA** tab to understand the CSA and DSA expand views.

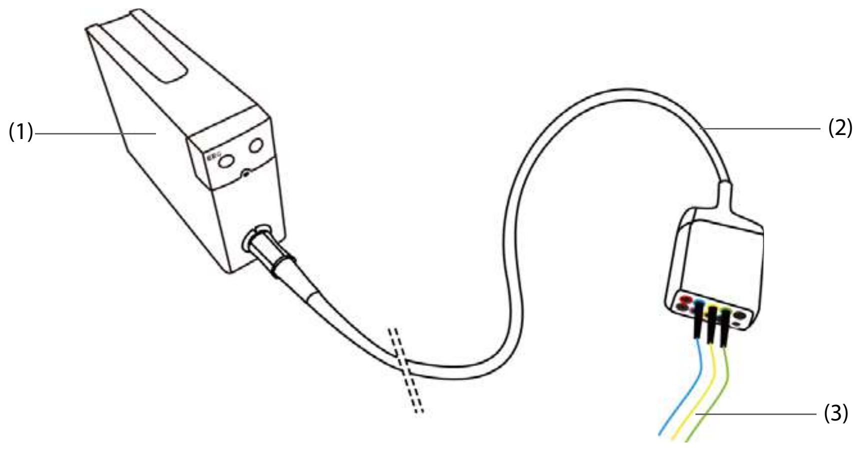
27.6 Prepare for EEG Monitoring

To monitor EEG, follow this procedure:

1. Connect EEG module, patient cable and lead wires. For more information, see *27.6.1 EEG Equipment to Patient Connection*.
2. Select Montage. You can select a predefined montage and you can also customize a montage. See *27.6.2.3 Customizing an Electrode Montage*.
3. Mark the electrode sites on the patient's head according to the montage you have chosen.
4. Prepare the skin of the electrode application sites.
5. Apply the electrodes. For more information, see *27.6.3 Attaching EEG Electrodes*.
6. Perform sensor check and observe the results.

27.6.1 EEG Equipment to Patient Connection

The following picture illustrates the connection between the EEG module and accessories.

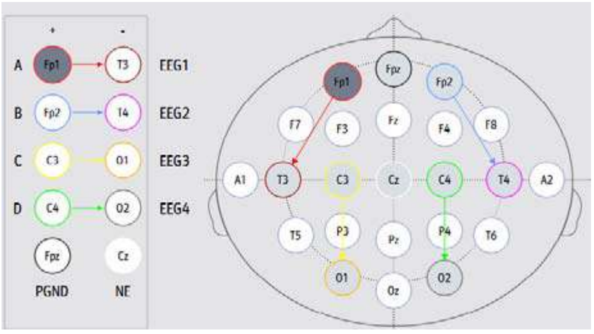


(1) EEG module (2) EEG patient cable (3) Lead wires

27.6.2 Choosing an EEG Electrode Montage

To choose a montage, follow this procedure:

1. Select the EEG numerics area or waveform area to enter the **EEG** menu.
2. Select the **Montage Setup** tab.
3. Select **Montage**.



For each montage, the **Montage Setup** menu shows the lead connection and electrode locations of each channel.

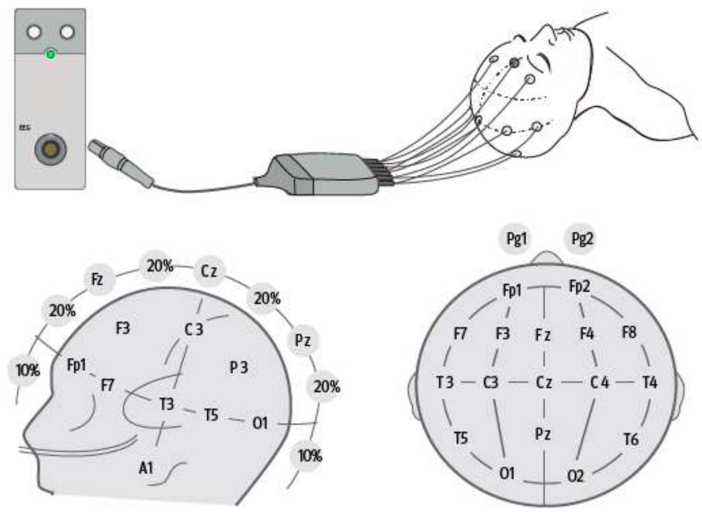
There are four predefined montages available. The following table shows electrode locations of each predefined montage.

Electrode		**Montage1**	**Montage2**	**Montage3**	**Montage4**
EEG1 (A)	**Positive (+)**	Fp1	F3	F3	Fp1
	Negtive (-)	T3	C3	Cz	Cz
	Label	Fp1-T3	F3-C3	F3-Cz	Fp1-Cz
EEG2 (B)	**Positive (+)**	Fp2	C3	F4	Fp2
	Negtive (-)	T4	P3	Cz	Cz
	Label	Fp2-T4	C3-P3	F4-Cz	Fp2-Cz
EEG3 (C)	**Positive (+)**	C3	F4	P3	O1
	Negtive (-)	O1	C4	Cz	Cz
	Label	C3-O1	F4-C4	P3-Cz	O1-Cz
EEG4 (D)	**Positive (+)**	C4	C4	P4	O2
	Negtive (-)	O2	P4	Cz	Cz
	Label	C4-O2	C4-P4	P4-Cz	O2-Cz

You can modify the predefined montage and rename it as customized montage. For more information, see *27.6.2.3 Customizing an Electrode Montage*.

27.6.2.1 EEG Electrode Locations

The following pictures shows the electrode locations. The electrode locations are labeled according to the international 10-20 electrode placement system. The numbers and letters refer to electrode locations:



- Odd numbered electrodes: placed on the left
- Even numbered electrodes: placed on the right
- Letters: F = frontal, T = temporal, C = central, P = parietal, O = occipital, Z = midline electrodes

27.6.2.2 Bipolar Mode and Referential Mode

Measurement can be referential or bipolar.

- In bipolar mode, each channel (EEG1, EEG2, EEG3 and EE4) uses two electrodes, a positive and a negative, to measure the potential difference between each pair.
- In referential mode, all channels use the same referential electrode (negative), and only use one electrode (positive) to measure the potential difference.

Montage 1 and Montage 2 are bipolar, while Montage 3 and Montage 4 are referential.

27.6.2.3 Customizing an Electrode Montage

To modify a predefined montage and save it as customized montage, follow this procedure:

1. Select the EEG numerics area or waveform area to enter the **EEG** menu.
2. Select the **Montage Setup** tab.
3. Select a montage (for example **Montage 1**).
4. Modify the electrode locations and montage type: select a electrode from the channel area on the left, and then select the electrode position from the electrode map on the right. Repeat this operation until you have defined all the electrodes as desired.
5. Select **Save As** and input a new name for this montage, and then select t **Confirm** to confirm the changes.

You can have up to three customized montages. Selecting Delete can delete a customized montage.

27.6.3 Attaching EEG Electrodes

WARNING

- **Use one type of electrodes in the whole montage.**

NOTE

- **Make sure that you have attached the ground electrode.**
- **The neutral electrode is usually more prone to artifact.**
- **For best results, use Ag/AgCl electrodes for the EEG measurement.**

27.6.3.1 Attaching Cup Electrodes

1. Mark the spots on the patient's head according to the montage you have chosen.
2. Comb or cut the hair away from the spots and rub the skin with the abrasive paste to remove oil and grease.
3. Apply the conductive paste on the inside of each electrode and then press the electrodes on the spots.

NOTE

- **Preferably use cup electrodes if montage includes placements within hair area.**

27.6.3.2 Attaching Needle Electrodes

1. Clean the skin with alcohol.
2. Insert the needle into the subcutaneous area.
3. Fix the needles to prevent getting out from the head. You may also use a small amount of paste to attach the cable to the patient's hair. This prevents the cables from pulling the needles out of the skin.

WARNING

- **Check that the package of needle electrodes is intact before use. Do not use the electrodes if the package is damaged.**
- **Do not open the electrode package until immediately before use.**
- **Needle electrode is disposable. Never reuse it.**
- **Replace the needle electrode whenever it is found bended. Do not manually straighten it and then reuse it.**

27.7 Performing EEG Sensor Check

The monitor has an EEG sensor check function. The **Sensor Check** menu displays the status of each electrode and the result of sensor check.

27.7.1 Setting the Interval of Auto Sensor Check

The sensor check is automatically initiated in the following situations:

- The EEG module is connected.
- The patient cable is connected.
- The Electrode montage is changed.
- The **Sensor Check** menu is entered.

You can set the interval of performing the auto sensor check. To do so, follow this procedure:

1. Select the EEG numerics area or waveform area to enter the **EEG** menu.
2. Select the **Sensor Check** tab.
3. Select an appropriate setting from **Interval** list. Selecting **Off** switch off auto sensor check.

27.7.2 Displaying/Hiding Impedance Value

You can display the impedance value on the electrode map of **Sensor Check** menu by clicking **Display Imped. Values (KΩ)** key, or hide the value by clicking **Hide Imped. Values (KΩ)** key.

27.7.3 Manually Starting a Sensor Check

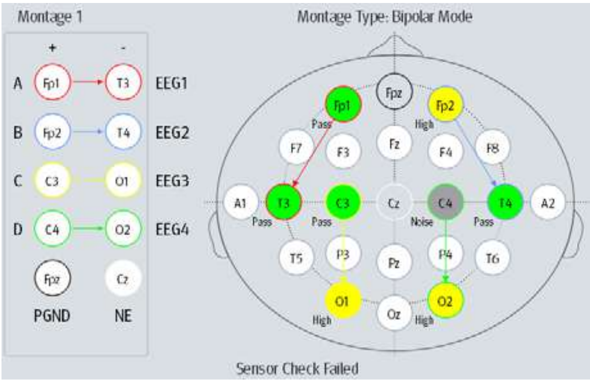
To manually start sensor check, choose either of the following way:

- Press the sensor check the hardkey on the EEG module.
- Select **Start Sensor Check** from the **Sensor Check** window.

At the completion of sensor check, the electrode status are shown. For more information, see*27.7.4 EEG Electrode Status*.

27.7.4 EEG Electrode Status

EEG electrode status is color coded. The following table lists all electrode status and actions to be taken.



Color	Status	Description	Action
Red	**Off**	Electrode falls off and has no skin contact.	Reconnect electrodes: In the Bipolar mode, reconnect the electrode indicated as red, and PGND electrode. In the Referential mode, reconnect the electrode indicated as red, NE and PGND electrodes.
Grey	**Noise**	The EEG signal is too noisy. Impedance cannot be measured.	Check the sensor-to-skin contact. If necessary, reconnect the electrodes.
Yellow	**High**	The impedance is above the limit	Check the sensor-to-skin contact. If necessary, reconnect the electrodes.
Green	**Pass**	The impedance is within valid range	No action is necessary.

For each EEG channel, to get reliable results all electrodes for this channel should be in **Pass** status (green).

27.7.5 Stopping Sensor Check

Sensor check automatically stops if all the electrodes pass the impedance check. You can also manually stop the sensor check.

To stop sensor check, choose either of the following ways:

- Press the sensor check key on the EEG module.
- Select **Stop Sensor Check** from the **Sensor Check** menu.

27.8 Changing EEG Settings

27.8.1 Changing the EEG Scale

To set EEG waveform scale, follow this procedure:

1. Select the EEG numerics area or waveform area to enter the **EEG** menu.
2. Select the **Setup** tab.
3. Select an appropriate setting from the **Scale** list.

27.8.2 Changing the EEG Sweep Speed

To set EEG sweep speed, follow this procedure:

1. Select the EEG numerics area or waveform area to enter the **EEG** menu.
2. Select the **Setup** tab.
3. Select an appropriate setting from the **Speed** list.

27.8.3 Changing the High/Low Filter

The low and high filters can screen out undesirable interference which may come from respiration, movement, etc. The current EEG high and low filter settings are shown at the top of DSA and CSA view.

To change the filter settings, follow this procedure:

1. Select the EEG numerics area or waveform area to enter the **EEG** menu.
2. Select the **Select Parameter** tab.
3. Select an appropriate setting from the **Low Freq Cut-off** and **High Freq Cut-off** list.

27.8.4 Switching Off the Notch Filter

The notch filter can screen out 50Hz/60Hz power line noise. The notch filter is enabled by default. To disable the notch filter, follow this procedure:

1. Select the EEG numerics area or waveform area to enter the **EEG** menu.
2. Select the **Setup** tab.
3. Set **Notch Filter** to **Off** .

27.8.5 Changing Displayed EEG Parameters

You can choose the displayed parameters. To do so , follow this procedure:

1. Select the EEG numerics area or waveform area to enter the **EEG** menu.
2. Select the **Parameter Display** tab.
3. Select the parameters you want to display.

You can select at most six parameters. The selected parameters are applied to all EEG channels.

27.9 Displaying the EEG Expand View

To display the EEG expand view, follow this procedure:

1. Select the EEG numerics area or waveform area to enter the **EEG** menu.
2. From the bottom of the **EEG** menu, select **EEG Expand**.
3. Select the desired tab to enter corresponding view:
   - Select the **EEG** tab, and then select **EEG Channels**, **Scale**, and **Speed** to view corresponding EEG waveforms.
   - Select the **Parameters** tab to view parameter values of each EEG channel.
   - Select the **Trends** tab, and then select **EEG Channels**, **Parameters**, and **Trend length** to view the trends of corresponding EEG channels and parameters.
   - Select the **CSA** tab to enter the CSA view. For more information, see *27.9.1 CSA View*.
   - Select the **DSA** tab to enter the DSA view. For more information, see *27.9.2 DSA View*.

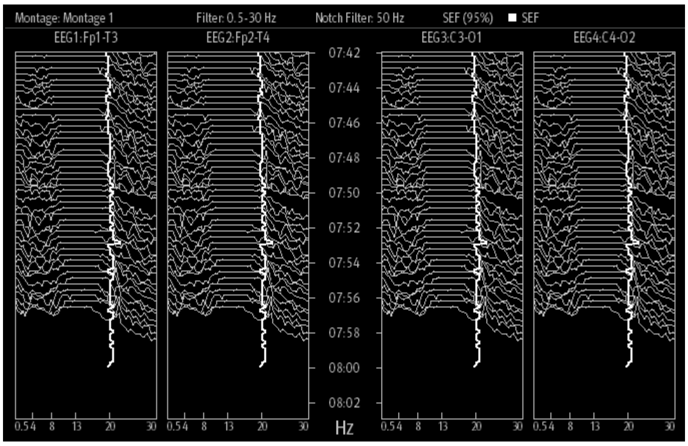
27.9.1 CSA View

The continuous EEG signal is sampled periodically and this value is stored in a frame. Each frame is processed using Fast Fourier Transformation (FFT) to provide a frequency spectrum displayed as a compressed spectral array (CSA).

The CSA View provides an overview of the patient's EEG values over time.

To display the CSA View, follow this procedure:

1. Select the EEG numerics area or waveform area to enter the **EEG** menu.
2. From the bottom of the **EEG** menu, select **EEG Expand**.
3. Select the **CSA** tab.



The CSA View provides up to CSA of four EEG channels. It provides the following information:

Displayed item	Description
Status bar	The first line displays the current montage, filter setting, notch frequency, SEF percentage (95%), and trendline labels and color codes. The second line displays the EEC channel labels and lead labels.
Frequency scale	It is the horizontal axis. The scale range depends on the filter settings (**Low Freq Cut-off** and **High Freq Cut-off** settings. The maximum displayed frequency is 30 Hz, so if you set **High Freq Cut-off** to 50 or 70, the upper scale remains 30.
Spectral lines	The energy at each frequency is computed and displayed as a spectral line.
Trend lines	EEG values are sampled at configured time intervals and displayed as color-coded trendlines. Trendlines are available for up to three frequency numerics (SEF, MF, and PPF). SEF trendline is white, MF trendline is purple, and PPF trendline is green.
“?” mark	Appears when artifact is detected, electrodes are off or disconnected, or montage is changed.

From the CSA view you can select the following items:

- **EEG Channels**
- **Parameters**
- **Trend Length**

To change **Power Scale** and **CSA Clip** setting, select **CSA Setup**.

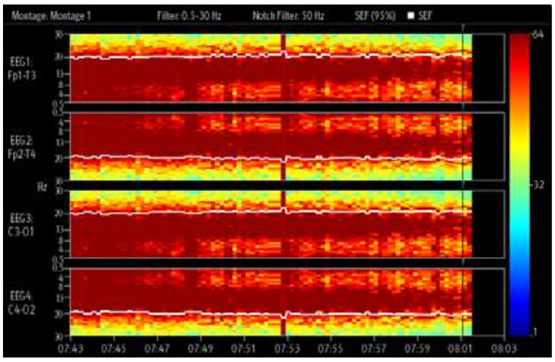
- Changing **Power Scale** can adjust the amplitude of spectral lines. The wider the power scale range, the greater amplitude of the spectral lines is.
- If **CSA Clipping** is switched on, the latest spectral line displays in a normal shape, in which area other go-through spectral lines will be cut out. If the **CSA Clipping** is switched off, all the spectral lines display normally.

27.9.2 DSA View

The Density Spectral Array (DSA) is to show changes in the power spectrum distribution over time.

To display the DSA View, follow this procedure:

1. Select the EEG numerics area or waveform area to enter the **EEG** menu.
2. From the bottom of the **EEG** menu, select **EEG Expand**.
3. Select the **DSA** tab.



The DSA View provides up to DSA of four EEG channels. It provides the following information:

Displayed item	Description
Color bar	It is located at the right of the DSA view. The color bar color codes the power. You can change the setting of **Power Scale** to adjust the color of corresponding power.
Status bar	Displays the current montage, filter setting, notch frequency, SEF percentage (95%), and trendline labels and color codes.
Frequency scale	It is the vertical axis. The scale range depends on the filter settings (**Low Freq Cut-off** and **High Freq Cut-off** setting. The maximum displayed frequency is 30 Hz, so if you set **High Freq Cut-off** to 50 or 70, the upper scale remains 30.
Trend lines	EEG values are sampled at configured time intervals and displayed as color-coded trendlines. Trendlines are available for up to three frequency numerics (SEF, MF, and PPF). SEF trendline is white, MF trendline is purple, and PPF trendline is green.
"?" mark	Appears when high electrode impedance or artifact is detected, electrodes are off or disconnected is changed.

From the DSA view you can select the following items:

- **EEG Channels**
- **Parameters**
- **Trend Length**
- **Power Scale**

27.10 EEG Troubleshooting

This section lists the problems that might occur. If you encounter the problems when using the equipment or accessories, check the table below before requesting for services. If the problem persists after corrective actions have been taken, contact your service personnel.

Problem	Solution
EEG signal is noisy	1. Check that the electrodes are properly connected and not dried out. 2. Check that the electrodes properly contact with skin. 3. Perform electrode impedance check. 4. Calm the patient since frontal muscle activity can cause artifact. 5. Remove sources of external electrical noise (for example, the lamps) from the vicinity of the patient’s head. 6. ECG monitoring may cause artifact; change electrode positioning.
EEG cable and electrodes properly connected, but no EEG waveforms.	1. The number of channels in the montage is smaller than the number of channels connected to the patient. Check the number of channels. 2. Check screen setup and make sure that you have selected the EEG parameter.
The EEG numerics area displays”- -”.	The patient has high muscle activity in the head area, or noise from some interfering equipment is coupling to electrode cables. Relax the patient and remove the source of noise.
EEG waveform baseline fluctuates.	1. Sweating may cause variations in the electrode impedance. Check the patient. 2. If the fluctuation is disturbing, prepare the skin and replace the electrodes.
The electrode impedances show ‘- -’ and there is a message prompting to check the ground electrode?	The ground electrode is poorly connected to the patient. Check the electrode and cable. If the impedance of the electrode is too high, the measurement fails even if the electrode is properly attached. Use better electrodes or prepare the skin better.

NOTE

- **For a comprehensive list of physiological and technical alarm messages, see *D Alarm Messages*.**

This page intentionally left blank.

28 Monitoring Bispectral Index (BIS)

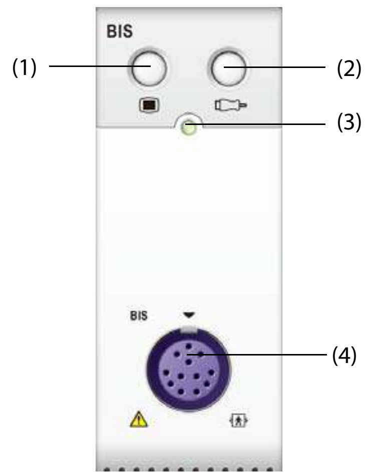
28.1 BIS Introduction

Bispectral Index (BIS) monitoring helps to monitor the level of consciousness of a patient under general anesthesia or sedation in OR and ICU. It is designed to monitor the hypnotic state of the brain based on acquisition and processing of EEG signals. Use of BIS monitoring to help guide anesthetic administration may be associated with the reduction of the incidence of awareness with recall during general anesthesia or sedation.

There are two BIS solutions available for use with the BIS module: using the BISx or using the BISx4. The BISx is for single side BIS monitoring, and the BISx4 is for both single side and bilateral BIS monitoring. The BISx4 provides bilateral BIS monitoring only when the BIS Bilateral Sensor is connected.

The BIS component using on this monitor is purchased from Covidien. It is important to recognize this index is derived using solely that company's proprietary technology. Therefore, it is recommended that clinicians have reviewed applicable information on its utility and/or risks in published articles and literature/web site information from Covidien, or contact Covidien at www.covidien.com for clinical-based BIS questions. Failure to do so could potentially result in the incorrect administration of anesthetic agents and/or other potential complications of anesthesia or sedation. We recommend that clinicians also review the following practice advisory (that includes a section on BIS monitoring): The American Society of Anesthesiologists, Practice Advisory for Intraoperative Awareness and Brain Function Monitoring (Anesthesiology 2006;104:847-64). Clinicians are also recommended to maintain current knowledge of FDA or other federal-based regulatory, practice or research information on BIS and related topics.

BIS monitoring is intended for adult and pediatric patients.



(1) BIS menu hard key	(2) Sensor check hard key
(3) Module status indicator	(4) BIS cable connector

28.2 BIS Safety Information

WARNING

- **BIS monitoring is not intended for neonatal patients.**
- **The conductive parts of sensors and connectors should not come into contact with other conductive parts, including earth.**
- **To reduce the hazard of burns in the high-frequency surgical neutral electrode connection, the BIS sensor should not be located between the surgical site and the electrosurgical unit return electrode.**
- **To reduce the hazard of burns during use of brain-stimulating devices (e.g., transcranial electrical motor evoked potential), place stimulating electrodes as far as possible from the BIS sensor and make certain that sensor is placed according to package instructions.**
- **The BIS sensor must not be located between defibrillator pads when a defibrillator is used on a patient connected to the monitor.**
- **The clinical utility, risk/benefit and application of the BIS component have not undergone full evaluation in the pediatric population.**
- **Due to limited clinical experience, for patients with neurological disorders, patients taking psychoactive medication, and children under one year old, BIS values should be interpreted cautiously.**
- **The BIS monitoring is a complex technology, intended for use only as an adjunct to clinical judgment and training. Clinical judgment should always be used when interpreting BIS in conjunction with other available clinical signs. Reliance on BIS alone for intraoperative anesthetic management is not recommended.**
- **Misinterpretation of BIS can result in incorrect administration of anesthetic agents and/or other potential complications of anesthesia or sedation.**
- **BIS values should be interpreted cautiously with certain anesthetic combinations, such as those relying primarily on either ketamine or nitrous oxide/narcotics to produce unconsciousness.**

CAUTION

- **Ensure that the BISx or BISx4 does not come into prolonged contact with your patient's skin, as it may generate heat and cause discomfort.**
- **Do not use the BIS sensor if the sensor gel is dry. To avoid dryout, do not open the pack until you are ready to use the sensor.**
- **When using electro-convulsive therapy (ECT) equipment during BIS monitoring, place ECT electrodes as far as possible from the BIS sensor to minimize the effect of interference. Certain ECT equipment may interfere with the proper function of the BIS monitoring system. Check for compatibility of equipment during patient setup.**
- **The BIS measurement based on measuring the EEG signal is inherently very sensitive. Do not use electrical radiating equipment close to the BISx or BISx4.**
- **Artifact may lead to inappropriate BIS values. Potential artifact may be caused by unusual or excessive electrical interference or high EMG activity like shivering, muscle activity or rigidity, sustained eye movements, head and body motion. Also, improper sensor placement and poor skin contact (high impedance) may cause artifact and interfere with the measurement.**
- **External radiating devices may disturb the measurement.**
- **Poor signal quality may lead to inappropriate BIS values.**

28.3 BIS Parameters

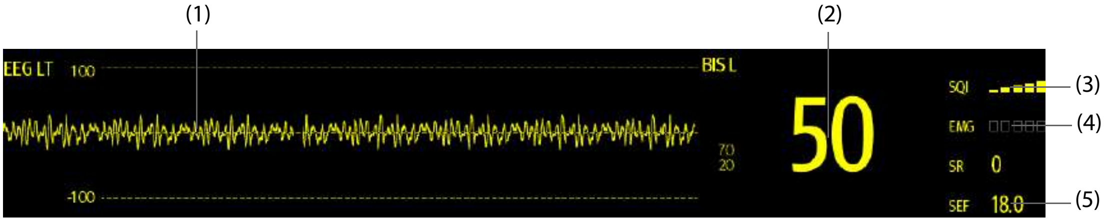
Single side BIS monitoring provides the following parameters:

Parameter	Description
BIS (Bispectral Index)	The BIS numeric reflects the patient's level of consciousness. It ranges from 100 for wide awake to 0 in the absence of brain activity. 100: the patient is wide awake. 70: the patient is underdosed but still unlikely to become aware. 60: the patient is under general anesthesia and loses consciousness. 40: the patient is overdosed and in deep hypnosis. 0: the EEG is a flat line. The patient has no electrical brain activity.
SQI (Signal Quality Index)	The SQI numeric reflects signal quality and provides information about the reliability of the BIS, SEF, TP, and SR numerics during the last minute. The greater the SQI value, the better signal quality.
EMG (Electromyography)	EMG bar graph reflects the electrical power of muscle activity and high frequency artifacts. Low EMG indicates that EMG activity is low. BIS monitoring conditions are optimal when the bar is empty.
SR (Suppression Ratio)	SR numeric is the percentage of time over the last 63-second period during which the EEG is considered to be in a suppressed state.
SEF (Spectral Edge Frequency)	The SEF is a frequency below which 95% of the total power is measured.
TP (Total Power)	TP numeric is a measure of the absolute total power in the frequency ranging from 0.5 to 30.0 Hz. The useful range is from 40 to 100 db.
BC (Burst Count)	A burst means a period (at least 0.5 second) of EEG activity followed and preceded by inactivity. The BC numeric helps you quantify suppression by measuring the number of EEG bursts per minute. For single side BIS monitoring, this parameter is intended for the BIS module with the Extend sensor only. BC numeric is valid only when SQI≥15% and SR≥5%.

Bilateral BIS monitoring simultaneously monitors both cerebral hemispheres. Besides above parameters, it also provides the following parameters:

Parameter	Description
sBIS (BIS Variability Index)	sBIS numeric represents the standard deviation of the BIS variable over the last three minutes.
sEMG (EMG Variability Index)	sEMG numeric represents the standard deviation of the EMG value over the last three minutes.
ASYM (Asymmetry)	ASYM is a processed variable indicating the percentage of EEG power presented in the left or right hemisphere with respect to total (left and right) EEG power. Designation 'L' of the asymmetry data indicates asymmetry to the left side. Designation 'R' of the asymmetry data indicates asymmetry to the right side.

28.4 BIS Display



(1) BIS waveform

The display of BIS waveform area depends on the setting of **Display** from the **BIS** menu. For more information, see *28.7.3 Setting the Display of BIS Waveform Area*.

(2) BIS value

(3) SQI indicator

- Empty: SQI < 15%, unable to calculate BIS and secondary parameter values. BIS and secondary parameter values are displayed as "---".
- 1 to 2 bars: SQI 15% - 49%, parameter values are unreliable.
- 3 to 5 bars: SQI 50% - 100%, parameter values are reliable.

(4) EMG indicator

- Empty: EMG < 30 dB. BIS monitoring conditions are optimal.
- 1 to 4 bars: EMG 30 - 55 dB. BIS monitoring conditions are acceptable.
- 5 bars: EMG > 55 dB. BIS monitoring conditions are unacceptable.

(5) Secondary parameters

The displayed secondary parameters are configurable. For more information, see *28.7.5 Setting the Displayed BIS Parameters*.

28.5 Accessing the On-screen BIS Guide

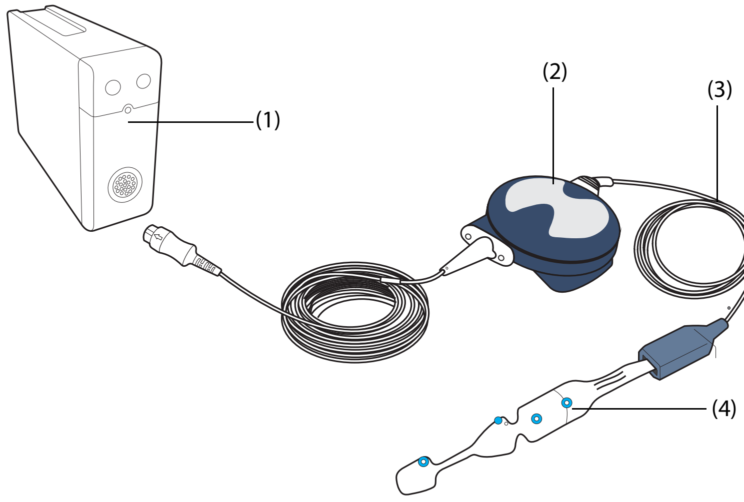
The monitor provides the on-screen BIS guide to help you understand BIS monitoring functions and operating procedure.

To access the on-screen BIS guide, follow this procedure:

1. Select the BIS numerics area or waveform area to enter the **BIS** menu.
2. Select the **Introduction** tab.
3. Select a tab as required.

- Select the **Summary** tab to view the BIS monitoring principles.
- Select the **Target Patient** tab to view the applicable patients for BIS monitoring.
- Select the **Operation Guide** tab to view the BIS monitoring procedure.

28.6 Preparing for BIS Monitoring



(1) BIS module　　(2) BISx or BISx4

(3) Patient cable　　(4) BIS sensor

To perform BIS monitoring, follow this procedure:

1. Connect the BISx or BISx4 to the BIS module.
2. Use the attachment clip to secure the BISx or BISx4 to a convenient location near the patient's head.
3. Connect the BISx or BISx4 to the patient cable.
4. Attach the BIS sensor to the patient following the instructions supplied with the sensor.
5. Insert the BIS sensor into the patient cable connector until it is fully engaged.
6. Observe the results of the automatic sensor check in the numeric area.

Sensor Check is initiated automatically when the BIS sensor and the patient cable are connected to the BISx or BISx4. The measurement starts automatically after the sensor has passed the check.

WARNING

- **To minimize the risk of patient strangulation, the patient cable must be carefully placed and secured.**

CAUTION

- **Make sure the patient's skin is dry. A wet sensor or a salt bridge could result in erroneous BIS and impedance values.**
- **Do not use if sensor is dry. To avoid dry out, do not open pack until ready for use.**
- **Due to intimate skin contact, reuse may pose risk of infection. If skin rash or other unusual symptom develops, stop using and remove.**

28.7 Changing BIS Settings

28.7.1 Setting BIS Alarm Properties

To set the BIS alarm properties, follow this procedure:

1. Select the BIS numeric area or waveform area to enter the **BIS** menu.
2. In the **BIS** menu, select the **Alarm** tab.
3. Enter the password if required.
4. Set alarm properties as desired.

28.7.2 Choosing the BIS Smoothing Rate

The smoothing rate defines how the monitor averages the BIS value. With the smoothing rate becoming smaller, the monitor provides increased response to changes in the patient's state. Contrarily, the monitor provides a smoother BIS trend with decreased variability and sensitivity to artifacts.

To change the smoothing rate, follow this procedure:

1. Select the BIS numeric area or waveform area to enter the **BIS** menu.
2. In the **BIS** menu, select the **Setup** tab.
3. Set **Smoothing Rate** to **10 sec**, **15 sec**, or **30 sec**.

28.7.3 Setting the Display of BIS Waveform Area

To set the display of BIS waveform, follow this procedure:

1. Select the BIS numeric area or waveform area to enter the **BIS** menu.
2. In the **BIS** menu, select the **Setup** tab.
3. Set **Display**.
   - ◆ If you set **Display** to EEG waveforms (**EEG LT** or **EEG LE**), set **Scale** and **Speed** for EEG waveforms.
   - ◆ If you set **Display** to BIS parameter trends, set **Trend Length**.

28.7.4 Switching Off the Filter

The filter can filter EEG interference. It is switched on by default.

To disable the filter, follow this procedure:

1. Select the BIS numeric area or waveform area to enter the **BIS** menu.
2. In the **BIS** menu, select the **Setup** tab.
3. Switch off **Filter**.

28.7.5 Setting the Displayed BIS Parameters

Besides the BIS value, you can also display up to four secondary parameters in the BIS numeric area. To select the displayed parameters, follow this procedure:

1. Select the BIS numeric area or waveform area to enter the **BIS** menu.
2. In the **BIS** menu, select the **Select Parameter** tab.
3. From the **BIS Tile** area, select a secondary parameter block, and then select a secondary parameter from the **Parameters** area.

28.8 Sensor Check

28.8.1 Automatic Sensor Check

Once the BIS sensor is connected, an automatic sensor check starts to check the sensor type, status, and impedance of all the electrodes, including the signal electrodes, the reference electrode and the ground electrode. During the sensor check, the message "Sensor Check In Progress" displays in the information area. If this message continuously displays, enter the sensor check menu and check if the impedance of each electrode is acceptable.

After the initial sensor check, the monitor performs automatic check during BIS monitoring. Automatic sensor check includes the following items:

- The combined impedance of the signal electrodes plus the reference electrode. This is done automatically and continuously and does not affect the EEG waveform. As long as the impedances are within the valid range, there is no prompt message of this check or its results.
- The impedance of the ground electrode. This is done every ten minutes and takes approximately four seconds. It causes artifact in the EEG waveform, and the message **BIS Ground Checking** is displayed on the monitor during the check. If the ground electrode does not pass this check, another check is initiated. This continues until the ground electrode passes the check.

The monitor continually checks impedance levels during a procedure by generating a 128 Hz test signal. Occasionally this signal may interfere with other equipment. If this becomes a problem, you may need to disable the auto checking. Impedance levels will still be tested at startup, but once they pass, they will not be tested again until a new case is begun.

28.8.2 Disabling automatic sensor check

To disable automatic sensor check, follow this procedure:

1. Select the BIS numeric area or waveform area to enter the **BIS** menu.
2. Select the **Setup** tab.
3. Switch off **Auto Check**

CAUTION

- **Automatic sensor check may need to be disabled if the 1 nA 128 Hz impedance check signal interferes with other equipment.**
- **Switching the auto impedance check off will disable automatic prompt to the user of impedance value changes, which may lead to incorrect BIS values. Therefore, this should only be done if the check interferes with or disturbs other measurements.**

28.8.3 Manual Sensor Check

To manually start a sensor check, use either of the following method:

- Press the sensor check hardkey on the BIS module.
- Select the **Sensor Check** tab from the **BIS** menu.

The monitor enters the sensor check window after you start the sensor check. The sensor check window displays the following items:

- Sensor Type
- The status of each electrode
- Expiration time or usable cycles

NOTE

- **For different types of sensors the sensor check window may be different.**

28.8.4 BIS Sensor Status

The color of each electrodes indicates its status:

Color	Status	Description	Action
Red	Lead off	Electrode falls off and has no skin contact	Press the sensor more firmly to skin to ensure good sensor-to-skin contact. If necessary, remove the sensor, and then clean and dry the skin. Reapply the senor or replace the sensor.
Grey	Noise	The EEG signal is too noisy. Impedance cannot be measured	Press the sensor more firmly to skin to ensure good sensor-to-skin contact.
Yellow	High	The impedance is above the limit	Press the sensor more firmly to skin to ensure good sensor-to-skin contact.
Green	Pass	The impedance is within valid range	No action necessary.

Although BIS may still be measured when the electrode status is **Noise** or **High**, for best performance, all electrodes should be in **Pass** status.

The sensor check may fail for the following reasons:

- Impedance too high
- Incorrect sensor application
- Poor sensor connection
- Defective patient interface cable or sensor

To correct the situation:

- Recheck the sensor
- Reapply the sensor according to instructions
- Check sensor connection
- Replace patient interface cable or sensor

28.9 Monitoring Bilateral BIS

By using BISx4 and the Bilateral sensor you can perform bilateral BIS monitoring. You can display the BIS expand view during bilateral BIS monitoring.

28.9.1 Entering the BIS Expand View

To enter the BIS expanded view, follow this procedure:

1. Select the BIS numeric area or waveform area to enter the **BIS** menu.
2. Select **BIS Expand** at the bottom left corner to enter the BIS Expand View.

28.9.2 Selecting BIS Expand View Display

To select how the BIS Expand View display, follow this procedure:

1. Select the BIS numeric area or waveform area to enter the **BIS** menu.
2. Select **BIS Expand** at the bottom left corner to enter the BIS Expand View.
3. Select the **EEG**, **BIS Trend** or **DSA** tab.

28.9.2.1 Displaying the EEG waveforms

The **EEG** tab of the **BIS Expand** view shows the selected EEG waveforms. You can configure the EEG waveforms:

- Select **EEG Waveforms** to set which EEG waveforms you want to display.
- Select **Scale** to set EEG waveform scale.
- Select **Speed** to set EEG waveform speed.

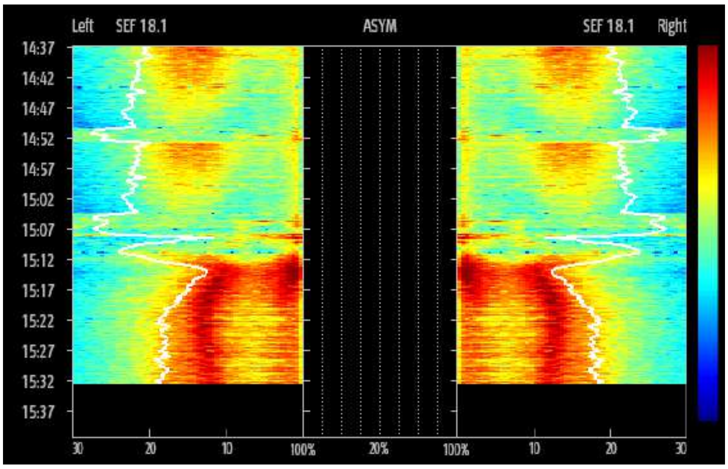
28.9.2.2 Displaying the BIS Trend

The **BIS Trend** tab of the **BIS Expand** view shows the trend of selected parameters. You can configure the BIS trend:

- Select **Parameter 1** and **Parameter 2** to set the parameters whose trend you want to display.
- Set **Trend Length**.

28.9.2.3 Displaying BIS DSA

The Density Spectral Array (DSA) shows changes in the power spectrum distribution over a certain period of time.



DSA view shows the following information:

- y-axis: time scale
- x-axis: signal frequency scale from 0 to 30 Hz
- Color bar: shows range of power. Red indicates maximum power and blue indicates minimum power.
- Spectral edge frequency (SEF) trend: It is the white Spectral Edge line superimposed on the graph where 95% of the total power lies on one side of the line (toward the inside of the graph) and 5% lies on the other.
- The current SEF value: displays above the graph.
- ASYM graph: displays in the center of the DSA view. It shows the degree of asymmetry in EEG power between the left and right hemispheres. The ASYM scale begins at 20% at the center line and runs left or right to 100%. Asymmetry data less than 20% are not displayed on the graph, but are available in the tabular trends.

28.10 BIS Troubleshooting

This section lists the problems that might occur. If you encounter the problems when using the equipment or accessories, check the table below before requesting for services. If the problem persists after corrective actions have been taken, contact your service personnel.

Problem	Solution
Measurement does not start	1. Check the sensor attachment to the patient and the sensor placement. Check the sensor contact with skin. 2. Check the sensor type. 3. Check all connections and the patient cable.

NOTE

- **For a comprehensive list of physiological and technical alarm messages, see *D Alarm Messages*.**

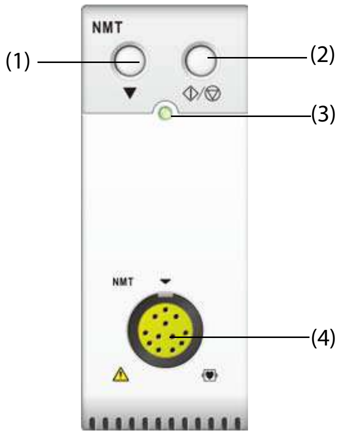
This page intentionally left blank.

29 Monitoring Neuromuscular Transmission (NMT)

29.1 NMT Introduction

The neuromuscular transmission (NMT) module evaluates muscle relaxation of patients under neuromuscular block by measuring the strength of muscle reaction after electrically stimulating the dedicated motor nerve. Two electrodes are placed on the patient's skin over dedicated nerve. A controllable current source delivers stimulation pulses to the two electrodes, and the acceleration of muscle contractions is measured with a 3-axis accelerometer.

NMT monitoring is intended for adult and pediatric patients.



(1) Calibration hard key	(2) Start/stop key
(3) Module status indicator	(4) NMT patient cable connector

29.2 NMT Safety Information

WARNING

- **The NMT measurement is not intended for neonatal patients.**
- **The NMT stimulation should not be applied directly on the eyes, covering the mouth, on the front of the neck, especially the carotid sinus, or from electrodes placed on the chest and the upper back or cross over the heart.**
- **Application of electrodes near the thorax may increase the risk of cardiac fibrillation.**
- **Never apply electrodes to patients in areas where inflammation or injury is evident.**
- **When you are connecting the electrodes or the patient cable, make sure that the connectors do not touch any electrically conductive material including earth.**
- **Patients with nerve damage or other neuromuscular problems may not respond properly to stimulation. The NMT measurement may show unusual patterns when monitoring muscle paralysis in these patients.**
- **NMT stimulation current pulses may interfere with other sensitive equipment, for example, implanted cardiac pacemakers. Do not use the NMT measurement on patients with implanted electronic devices unless so directed by a medical specialist.**
- **Simultaneous use of the NMT with high frequency electrosurgical equipment (ESU) may result in burns at the stimulation site and can also adversely affect measurement accuracy. Make sure the ESU return electrode is properly applied to the patient.**
- **Do not use the NMT in close proximity to shortwave or microtherapy devices, there is a risk of adversely affecting the NMT measurement.**

- **Never touch the electrodes unless the stimulation has been stopped.**
- **Check each time before use that the material insulating the NMT sensor and the stimulation cable is intact and does not show signs of wear and tear.**

CAUTION

- **NMT monitoring is intended as an adjunct in patient assessment and must be used in conjunction with observation of clinical signs and symptoms.**
- **NMT stimulation can be painful to a non-sedated patient. It is recommended not to stimulate before the patient is adequately sedated.**
- **Use only electrodes suitable for nerve stimulation deemed appropriate by the attending physician.**
- **Pay special attention to current densities exceeding 2 mA r.m.s/cm2 for any electrodes.**

29.3 Stimulation Modes

The NMT module provides the following stimulation modes. Some stimulation modes require a minimum neurophysiological recovery time and during this recovery phase no new stimulation can be started. So you cannot start a measurement or calibration.

29.3.1 Train-Of-Four (TOF)

TOF mode is recommended for most cases.

In TOF mode, four stimulation pulses are generated at 0.5 second intervals. Each stimulation of the train causes the muscle to contract. The fade in the individual response to each single stimulation provides a basis for evaluation. The response is measured after each stimulus and the ratio of the fourth to the first response of the TOF sequence is calculated resulting in TOF-Ratio (TOF%).

When relaxation deepens, the TOF% declines until the fourth response disappears and no TOF% is calculated. Low response to the first stimulus (T1) also results in TOF% unavailable. When no TOF% is available, the degree of neuromuscular block is estimated from the number of responses or TOF counts. The fewer the response count is detected, the deeper is the relaxation.

If NMT calibration establishes the reference response amplitude, response to T1 as percentage of the reference value is calculated resulting in T1%.

In TOF mode, the minimum neurophysiological recovery time is 10 seconds. If NMT measurement or calibration is initiated during this period, it will be automatically delayed.

29.3.2 Single Twitch (ST)

In single twitch (ST) stimulation, the module delivers a single electrical pulse and measures the strength of the resulting twitch, the module then calculates the ratio of measured response to the reference twitch resulting in ST-Ratio.

ST mode is practical when using depolarizing relaxants since TOF% does not give any additional information about the patient status. Additionally, when the change of patient's relaxation level is considered, ST stimulation at a frequency of 1 Hz can indicate the relaxation change in a more real-time way.

29.3.3 Post-Tetanic Count (PTC)

When neuromuscular block deepens, different parameters are needed to measure the response. At first, when the response to the fourth TOF stimulation pulse disappears or the first twitch is very weak, the TOF% is not available and only the number of detected counts can be observed. When stimulation pulses no longer give any stimulation response, you do not get the TOF count either. To monitor the relaxation level, you can start tetanic stimulation and estimate the relaxation level from the Post Tetanic Count (PTC).

PTC stimulation mode starts with a sequence of four current pulses delivered at 2 Hz. If a muscle response is detected, the PTC sequence is stopped and the TOF result is reported. If there is no muscle response, the sequence continues with a five seconds long tetanic stimulation delivered at 50 Hz, followed by a pause of 3 seconds, followed by 20 single current pulses delivered at 1 Hz. The number of detected responses is counted and expressed as PTC. The fewer responses are detected, the deeper is the relaxation.

After tetanic stimulation, NMT measurements and calibration are disabled for 20 seconds and PTC is disabled for 2 minutes.

29.3.4 Double Burst Stimulation (DBS)

Double Burst Stimulation (DBS) enables better visual observing of the fading in the responses. DBS consists of two separate bursts at an interval of 750 ms, where each burst consists of certain pulses directly after each other at a frequency of 50 Hz. The response ratio of the second to the first burst is calculated resulting in DBS-Ratio, while the number of responses is detected and expressed as DBS Count.

The module supports DBS 3.2 and DBS 3.3.

- For DBS3.2 mode, the first burst consists of 3 consecutive pulses, and the second burst consists of 2 consecutive pulses.
- For DBS3.3 mode, both bursts consist of 3 consecutive pulses.

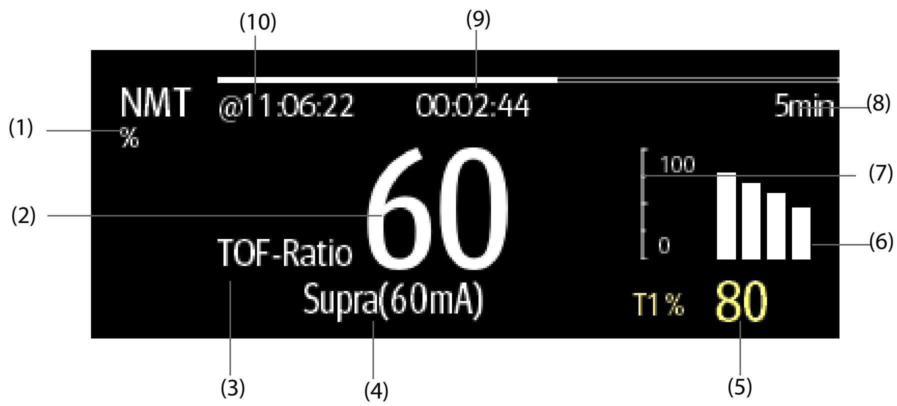
In DBS mode, the minimum neurophysiological recovery time is 15 seconds. If NMT measurement or calibration is initiated during this period, it will be automatically delayed.

29.4 NMT Parameters

The following table lists the NMT parameters in different stimulation modes.

Stimulation Mode	Parameter Label	Unit	Number of Bars
TOF	TOF ratio	%	4
	TOF count	/	4
	T1%	/	/
ST	ST ratio	%	1
	ST count	/	1
PTC	PTC	/	/
DBS	DBS ratio	%	2
	DBS count	/	2

29.5 NMT Display



(1) Parameter unit

(2) Parameter value

(3) Parameter label

(4) Stimulation current

(5) T1%: responses to the first stimulus as percentage of the reference amplitude in TOF mode. This value is not shown if calibration fails.

(6) Bar graph: indicates the amplitude of response to the stimulation. The maximum height of the bar graph displayed is 120%. Bar graph is not shown if calibration is not completed successfully.

(7) Scale: indicates the amplitude of response to stimulation.

(8) Measurement interval: **Manual** is displayed if **Interval** is set to **Manual**.

(9) Measurement countdown: time to the next measurement. The measurement countdown is not shown if **Interval** is set to **Manual**.

(10) The last measurement time.

NOTE

- **The NMT parameter values darken 15 minutes after the NMT measurement is taken.**
- **The PTC value is shown on the display for 20 seconds after which the NMT module returns to the preset stimulation mode.**

29.6 Accessing the On-screen NMT Guide

The monitor provides the on-screen NMT guide to help you understand NMT monitoring functions and operating procedure.

To access the on-screen NMT guide, follow this procedure:

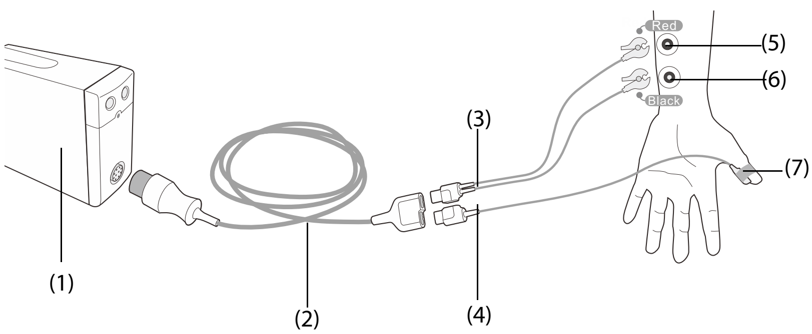
1. Select the NMT numerics area or waveform area to enter the **NMT** menu.
2. Select the **Introduction** tab.
3. Select a tab as required.

   - Select the **Summary** tab to view the NMT monitoring principles.
   - Select the **Target Patient** tab to view the applicable patients for NMT monitoring.
   - Select the **Points to Note** tab to view the precautions before NMT monitoring.
   - Select the **Operation Guide** tab to view the NMT monitoring procedure.

29.7 Preparing for NMT Monitoring

29.7.1 NMT Equipment to Patient Connection

The following picture shows NMT cable and patient connection.



(1) NMT module	(2) NMT patient cable
(3) NMT stimulation cable	(4) NMT sensor cable
(5) Proximal electrode (red)	(6) Distal electrode (black)
(7) NMT sensor	

29.7.2 Preparing the Skin

Good electrode-to-skin contact is important for good signal quality. Before applying the electrodes, clean the application site of oil and dirt and avoid placing the electrodes over excessive body hair or lesions. Insufficient cleaning of the skin can cause high skin impedance which could cause the stimulation to stop.

To properly prepare the skin, follow this procedure:

1. Select sites with intact skin, without lesion of any kind.
2. Shave hair from skin at chosen sites.
3. Gently rub skin surface at sites to remove dead skin cells.
4. Thoroughly cleanse the site with a mild soap and water solution.
5. Dry the skin completely before applying the electrodes.

29.7.3 Placing the Electrodes and Sensor

Stimulation of the ulnar nerve in the wrist and acceleration measurements at the adductor pollicis are preferred for routine monitoring. When monitoring neuromuscular transmission, round surface electrodes with snap connection are a must. Small (pediatric or neonatal) electrodes are advisable to obtain a sufficient current density. In order to ensure a steady signal quality, be sure only to use CE marked electrodes.

Ensure that the thumb can move freely before applying NMT electrodes and sensor. Follow this procedure to place the electrodes and sensor:

1. Place the distal electrode near the wrist.
2. Place the proximal electrode 2 to 3 cm proximal of the distal electrode.
3. Attach the red clamp to the proximal electrode.
4. Attach the black clamp to the distal electrode.
5. Affix the sensor with its large flat side against the palmar side of the thumb with a piece of tape. The cable should be attached in such a way that it does not 'pull' at the sensor and that movement of the thumb is not obstructed.

CAUTION

- **When placing the electrodes, make sure that they do not touch each other.**
- **If the electrodes are placed incorrectly, wrong nerves are stimulated and this causes wrong muscle response.**
- **When multiple nerves are stimulated, the measured response may be affected by activity of other muscles.**
- **If the stimulation electrodes are placed very close to the palm of the hand, the muscles are stimulated directly by the stimulation pulses.**
- **If the current is too strong, it may stimulate the muscles too much.**
- **Moving or touching the patient during measurement may cause incorrect results.**
- **Make sure that the NMT cables does not contact external pacemaker or catheter wires.**
- **To avoid unintentional electrical shocks always make sure that the NMT stimulation has been stopped before touching the electrodes.**
- **Take care to handle the NMT sensor, avoiding forcefully striking the sensor.**
- **After repositioning the patient, check the NMT sensor application site and ensure that the sensor is still properly applied and the thumb can move freely.**

CAUTION

- **Correct positioning of the electrodes is important. Small displacements may result in considerable changes in stimulation current requirements. Furthermore, the electrodes must be positioned in such a way to avoid direct stimulation of the muscle.**
- **The electrodes should be applied properly to the patient skin. It has been found that slight pressure on the electrodes may improve the stimulation considerably. Therefore, taping the electrodes to the skin may be advisable.**
- **The more distal the sensor is placed on the thumb, the stronger the acceleration signal. This effect can be used to adjust the signal strength.**
- **During NMT measurement, the arm applied with NMT electrodes and sensor should be kept immobile during the whole procedure.**

29.8 Calibrating the NMT Measurement

The size of the sensor signal varies from patient to patient. NMT calibration determines supramaximal stimulation current and the reference response amplitude. The reference response amplitude is the twitch at the supramaximal stimulation current when the patient is not paralyzed. The calibration must be done prior to administration of a muscle relaxant drug.

CAUTION

- **Start calibration before the administration of a muscle relaxant drug (but after the induction of sleep in general anesthesia) to prevent voluntary muscle contraction and tension from interfering with the reference search.**

29.8.1 Setting the Calibration Current

If you set **Stimulation Current** to **Supra (60 mA)**, the module automatically searches for supramaximal current to determine the reference response amplitude. If you select a value between 0 and 60 mA, the reference response amplitude is determined using the selected stimulation current. For adults, the supramaximal current is usually between 35 and 55 mA. For more information, see *29.11.2 Changing the Stimulation Current*.

29.8.2 Starting NMT Calibration

To Start NMT calibration, follow this procedure:

1. Select the NMT numeric area to enter the **NMT** menu
2. Select the **Setup** tab.
3. Verify that the settings of **Stimulation Current** and **Pulse Width**.
4. Press the calibration hard key on the NMT module or select **Calibrate** at the bottom of the **NMT** menu to start calibration.

If calibration successes, the message **Calibration Completed** displays on the **NMT** menu. If calibration failed, the NMT module automatically uses the default value as the reference amplitude.

NOTE

- **It is recommended that the patient be anesthetized before setting up the calibration twitch as nerve stimulation can be painful.**
- **Changing the stimulation current or pulse width after calibration invalidates the stored reference data, and therefore recalibration is required.**

29.9 Starting NMT Measurements

At the completion of NMT calibration, the monitor automatically starts a TOF mode measurement.

You can also choose either of the following ways to start NMT measurements:

- Press the Start/stop key on the NMT module.
- From the **Measure** tab of the **NMT** menu, select a measurement mode, set **Interval**, and select **Start (XX)** to start NMT measurement at corresponding mode.

NOTE

- **Stop NMT measurements if you need to change the NMT settings.**
- **Take care when removing the sensor from the patient. Do not pull on the cable.**

29.10 Stopping NMT Measurements

Choose either of the following ways to stop an on-going NMT measurement.

- Press the **Start/stop** key on the NMT module.
- Select **Stop All** at the bottom of the **NMT** menu.

29.11 Changing NMT Measurement Settings

29.11.1 Selecting the NMT Measurement Mode

To select the NMT measurement mode, follow this procedure:

1. Select the NMT numeric area to enter the **NMT** menu.
2. Select the **Measure** tab.
3. Select the desired stimulation mode.
4. If you select **TOF Mode**, **ST Mode**, or **DBS** mode, select **Interval** to set the time interval between two measurements.

29.11.2 Changing the Stimulation Current

Before calibration and NMT measurement, confirm that the desired stimulus current is selected. To set the simulation current, follow this procedure:

1. Select the NMT numeric area to enter the **NMT** menu
2. Select the **Setup** tab.
3. Set **Stimulation Current**.

    - When **Stimulation Current** is set to **Supra**, the module automatically searches for supramaximal current to determine the reference response amplitude. For adults, the supramaximal current is usually between 35 and 55 mA. Smaller currents may be desirable for children.
    - If **Stimulation Current** is set to a value between 0 and 60 mA, the reference response amplitude is determined using the selected stimulation current.

NOTE

- **The of stimulation current is adjusted at an increment of 5 mA.**

29.11.3 Changing the Pulse Width

You can increase the pulse width to increase the effect of the stimulation to help finding the supramaximal current. To set the pulse width, follow this procedure:

1. Select the NMT numeric area to enter the **NMT** menu
2. Select the **Setup** tab.
3. Set **Pulse Width**.

29.11.4 Enabling Block Recovery Notification

The block recovery note alerts you when the set limit is reached. This indicates that the patient is responding more clearly to the stimuli and the neuromuscular block is decreasing. The note can be used, for example, to help maintain a certain relaxation level.

To enable the block recovery note and set the limit for activate the note, follow this procedure:

1. Select the NMT numeric area to enter the **NMT** menu
2. Select the **Setup** tab.
3. Set **NMT Block Recovery**. If **NMT Block Recovery** is set to **Off**, the monitor will not give a note.

29.11.5 Adjusting NMT Stimulation Tone Volume

The monitor gives a beep at the selected volume at each stimulation pulse if the setting is not zero. To adjust the volume of NMT stimulation tone, follow this procedure:

1. Select the NMT numeric area to enter the **NMT** menu
2. Select the **Setup** tab.
3. Set **Stimulation Beep Vol**.

29.12 Recalling Calibration Information

In the situation that the NMT module is power down, or you want move the NMT module to another monitor along with the patient and you want to continue with the already determined calibration information, including stimulation current, pulse width, and reference response amplitude, you can use the recall function.

To recall the calibration information, follow this procedure:

1. Select the NMT numeric area to enter the **NMT** menu
2. Select the **Recall Reference** tab.
3. Select **Recall Reference**.

29.13 NMT Troubleshooting

This section lists the problems that might occur. If you encounter the problems when using the equipment or accessories, check the table below before requesting for services. If the problem persists, contact your service personnel.

Problem	**Solution**
NMT calibration and measurement fail.	1. Check that the electrodes are properly applied. 2. Replacing the electrodes.
NMT measurement is disturbed.	1. Do not touch the arm where electrodes are applied. 2. Check that the electrodes and NMT sensor are properly applied.
Supramaximal current cannot be found.	Check that the electrodes are properly applied. Also, supramaximal current may not be found if the patient is already relaxed.

NOTE

- **For a comprehensive list of physiological and technical alarm messages, see *D Alarm Messages*.**

30 Monitoring NMT from TOF-Watch SX Monitor

30.1 NMT Introduction

This monitor can connect a Organon TOF-Watch SX monitor for NMT(neuromuscular transmission) monitoring. This monitor can display, store and review measurements from TOF-Watch SX monitor, as well as present related alarms. On this monitor, you can separately set the level of NMT related alarms and switch on or off alarm recording; you can also view TOF-Watch SX monitor settings of alarm limits and alarm switch.

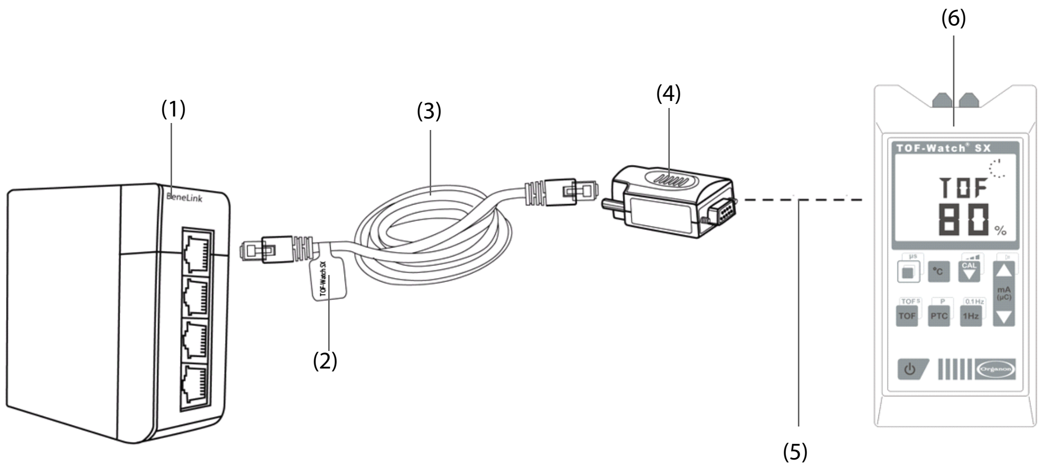
30.2 NMT Safety Information

WARNING

- **TOF-Watch SX monitor is manufactured by Organon. This company provides the technology for measuring NMT parameters. We only provide the connection between this monitor and TOF-Watch SX monitor.**
- **If you have any doubts about the operation and maintenance of the TOF-Watch SX monitor, please see TOF-Watch SX monitor operator's manual or directly contact Organon.**
- **Fully observe TOF-Watch SX monitor operator's manual to make settings and to connect the monitor with a patient.**

30.3 Connecting a TOF-Watch SX monitor

The TOF-Watch SX monitor connects with BeneLink module through an ID adapter, see the figure below.



(1) BeneLink Module	(2) Label
(3) RJ45 connecting cable	(4) ID Adapter
(5) Type C serial port adapting cable & TOF-Watch SX interface cable	
(6) TOF-Watch SX monitor	

To connect the TOF-Watch SX monitor, follow this procedure:

1. Insert a BeneLink module into the module rack.
2. Connect the ID adapter that matches the TOF-Watch SX monitor to the BeneLink module with an RJ45 connecting cable.
3. Connect the ID adapter to the TOF-Watch SX interface with Mindray type C serial port adapting cable.

4. Connect the TOF-Watch SX interface to the TOF-Watch SX monitor.
5. Put a label indicating device name to the RJ45 connecting cable at the end near the BeneLink module. When the BeneLink module is connected to several external devices, you can easily recognize the devices with these labels.
6. Turn on both monitors.

NOTE

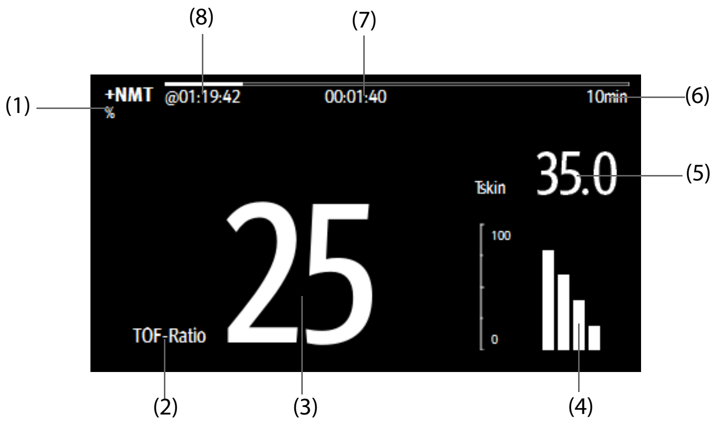
- **For the ID adapter setup of the TOF-Watch SX monitor, see *9.4 Connecting an External Device*.**

30.4 NMT Parameters

TOF-Watch SX monitor provides the following measurements:

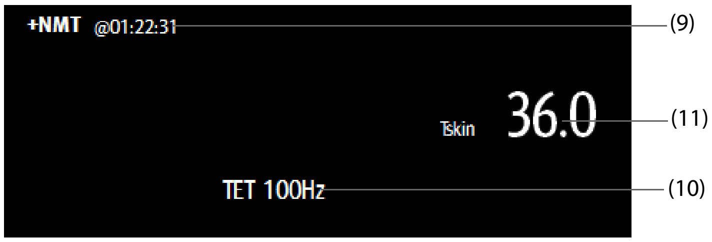
- TOF-Ratio
- TOF-Count
- PTC
- Single
- Tskin

30.5 NMT Display



(1) Parameter unit	(2) Parameter label
(3) Parameter measurement	(4) Response amplitude of stimulation
(5) Skin temperature	(6) Measurement interval
(7) Measurement countdown	(8) Time of last measurement

In the case that you take a measurement in TET50Hz mode, TET100Hz mode, DBS3.3 mode or DBS3.2 mode, only mode label is displayed in the NMT numeric area, which is shown as follows:



(9) Time of last measurement	(10) Skin temperature	(11) Measuring mode

30.6 Changing NMT Settings

30.6.1 Activating the NMT Alarm Sound

To activate the NMT alarm sound, follow this procedure:

1. Select the NMT numeric area to access the **+NMT** menu.
2. Set the **Alarm Sound** to **On**.

After the NMT alarm sound is activated, the monitor gives sound prompts for the alarms of the TOF-Watch SX monitor.

30.6.2 Viewing the Measurement Setup

To view the NMT measurement setup, follow this procedure:

1. Select the NMT numeric area to access the **+NMT** menu.
2. View the settings as follows:

   - ◆ Stimulation Current
   - ◆ Stimulation Charge
   - ◆ Pulse Width
   - ◆ TOFs Interval
   - ◆ Transducer Sensitivity

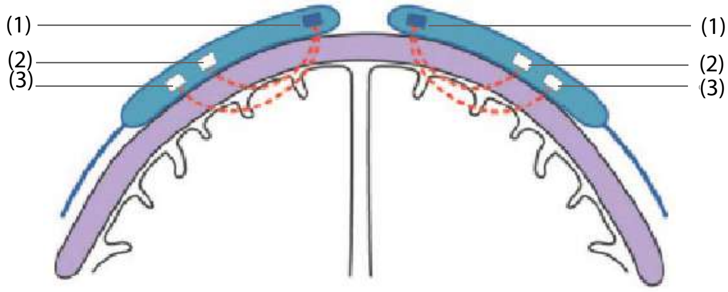
This page intentionally left blank.

31 Monitoring Regional Oxygen Saturation (rSO_2)

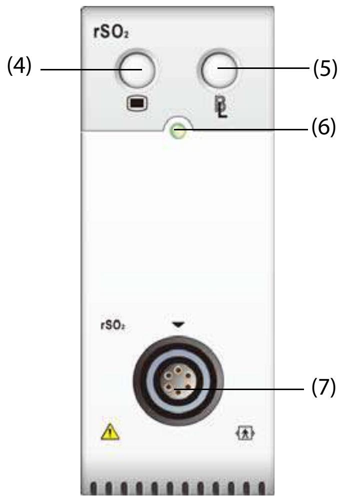
31.1 rSO2 Introduction

The rSO_2 (Regional Oxygen Saturation) monitoring provides noninvasive and continuous information of changes in regional oxygen saturation of blood. The measurement takes place in real time, providing an immediate indication of a change in the critical balance of regional oxygen delivery and oxygen consumption.

The harmless, near-infrared wavelengths generated by the INVOS System's light-emitting diodes pass through scalp and bone tissue beneath the sensor. Once in vivo they are either absorbed or scattered back up to the sensor's shallow and deep detectors. Red-colored hemoglobin molecules within red blood cells have the highest light absorption of the wavelengths used, and the exact shade of red of each hemoglobin molecule indicates the amount of oxygen it is carrying. The type and quantity of absorption data returned to the detectors reflects de-oxyhemoglobin and total hemoglobin, from which a regional oxygen saturation (% rSO_2) value unique to the specific area under the sensor is calculated.



(1) Light source (2) Shallow detector (3) Deep detector



(4) rSO_2 menu hard key (5) Set the baseline for all rSO_2 channels

(6) Module status indicator (7) rSO_2 cable connector

31.2 rSO2 Safety Information

CAUTION

- **rSO_2 monitoring is intended for use in individuals greater than 2.5 kg at risk for reduced-flow or no-flow ischemic states.**
- **Do not use the rSO_2 value as the sole basis for making decisions regarding diagnosis or therapy because the rSO_2 values represent a small volume of tissue beneath the sensor and may not reflect oxygenation disturbances that occur elsewhere.**
- **Use only recommended or provided accessories. Use any other sensor will compromise accuracy.**
- **Use of an electrosurgical instrument in the vicinity of the monitor may interfere with the signal and result in inaccurate rSO_2 measurement.**

NOTE

- **Environments with excessive ambient light such as bright sunlight or strong operating room lighting may require loosely covering the area of the sensor with an opaque drape.**

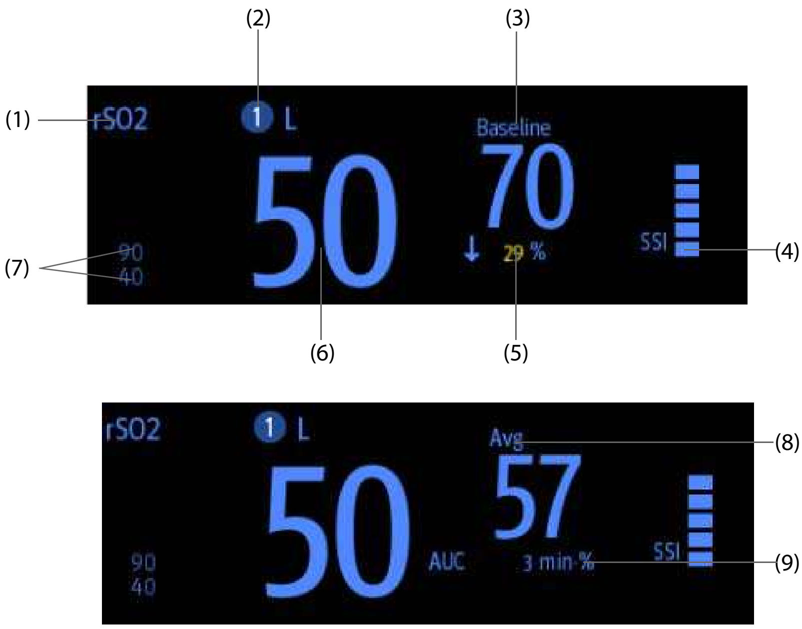
31.3 rSO_2 Measurement Limitations

If present, the following may cause inaccurate readings:

- Cardiogreen, indigo carmine or other intravascular dyes
- Carboxyhemoglobin or other dyshemoglobins
- Hemoglobinopathies
- Conjugated hyperbilirubinemia (direct)
- Myoglobin (Mb) in muscle tissues

31.4 rSO_2 Display

Each rSO_2 numeric area displays one rSO_2 channel, which is shown as below:



(1) rSO_2 label	(2) Channel indicator
(3) Baseline (BL)	(4) Signal Strength Indicator (SSI)

(5) Change percentage of the rSO_2 realtime value and baseline (If the rSO_2 value is greater than or equal to the baseline, the arrowhead is upward; If the rSO_2 value is smaller than the baseline, the arrowhead is downward)

(6) Realtime rSO_2 value

(7) Upper and lower rSO_2 alarm limits

(8)rSO_2 rolling average of latest 60 minutes

(9) Area Under the Curve (AUC)

31.5 Accessing the On-screen rSO_2 Guide

The monitor provides the on-screen rSO_2 guide to help you understand rSO_2 monitoring principles, functions, and operating procedure. To access the on-screen rSO_2 guide, follow this procedure:

1. Select the rSO_2 numeric area to enter the **rSO_2** menu.
2. Select the **Introduction** tab.
3. Select the desired tab of **Summary Target Patients**, **Points To Note**, or **Operation Guides**.

31.6 Preparing for rSO_2 Monitoring

1. Select the site for sensor placement. For more information, see *31.6.1 rSO_2 Sensor Site Selection*.
2. Prepare the patient skin. For more information, see *31.6.2 Preparing the Skin*.
3. Apply the rSO_2 sensor. For more information, see *31.6.3 Applying the rSO_2 Sensor*.
4. Connect the rSO_2 parts. For more information, see *31.6.4 Connecting the rSO_2 Parts*.

31.6.1 rSO_2 Sensor Site Selection

The rSO_2 sensor can be placed on the proper cerebral or somatic site.

- Cerebral site selection: select sensor site on the right and/or left side of forehead. Placement of the sensor in other cerebral locations, or over hair, may cause inaccurate readings.
- Somatic site selection: select sensor site over tissue area of interest (site selection will determine which body region is monitored)

CAUTION

- **For cerebral site selection, do not place the sensor over nevi, sinus cavities, the superior sagittal sinus, subdural or epidural hematomas, injured skin or other anomalies such as arteriovenous malformations, as this may cause readings that are not reflective of brain tissue or no readings at all.**
- **For somatic site selection, avoid placing the sensor over thick fatty deposits, hair or bony protuberances. Do not place the sensor over nevi, hematomas or broken skin, as this may cause readings that are not reflective of somatic tissue or no readings at all.**

NOTE

- **For the somatic site selection, see the instruction for use of corresponding sensor for detailed information.**

31.6.2 Preparing the Skin

To achieve the optimal measurement result, the sensor application site should be clean and dry. To properly prepare the skin, follow this procedure:

1. Shave hair from skin at chosen sites.
2. Gently rub skin surface at sites to remove dead skin cells.
3. Thoroughly cleanse the site with a mild soap and water solution.
4. Dry the skin completely before applying the sensors.

31.6.3 Applying the rSO_2 Sensor

Follow this procedure to apply the rSO_2 sensor to patient:

1. Remove the protective backing label from the adhesive side of the sensor and apply the sensor to the skin.
2. Continue applying the sensor by smoothing it to the skin from the center outward. Ensure edges of the sensor are sealed to prevent light from entering.

CAUTION

- **The sensor is designed for single use only and can not be reused. Reuse may cause inaccurate readings, erratic readings, or no readings at all. Also, reuse may cause an increased risk of cross-contamination among patients.**
- **The sensor is designed for external use only as described in the instructions. Do not use the sensor internally for any reason.**
- **Do not place the sensor on regions with severe tissue edema to reduce the possibility of skin lesions.**
- **Do not autoclave or gas sterilize the sensor.**

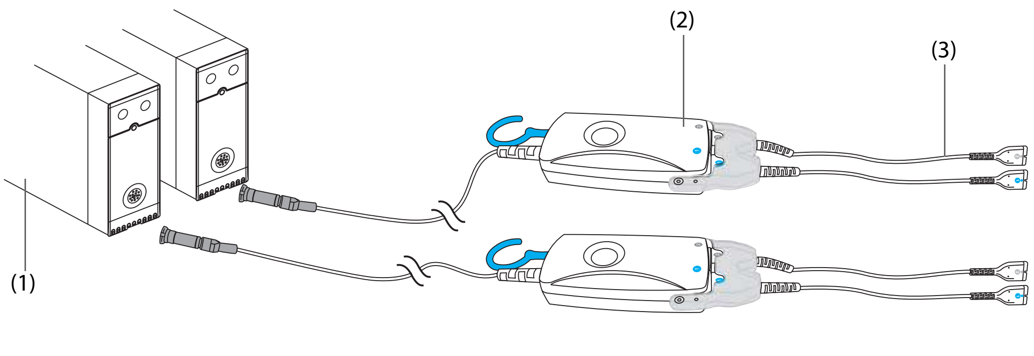
NOTE

- **Use care when placing orremoving sensor. Do not place on broken or undeveloped skin.**
- **For extended monitoring, it is recommended to use a new sensor every 24 hours or if adhesive is inadequate to seal the sensor to the skin.**
- **To avoid pressure sores do not apply external pressure (e.g. headbands, wraps, tape to sensor.**

31.6.4 Connecting the rSO_2 Parts

1. Connect Preamplifier(s) to the rSO_2 module. Align red dot on the silvery connector of the Preamplifier with red dot on rSO_2 cable connector.
2. Connect the following devices as per patient category:

   - ◆ For neonatal patients, connect the neonatal sensor directly to the Preamplifier.
   - ◆ For pediatric or adult patients, a reusable sensor cable is needed for the connection of the Preamplifier and the sensor. Use color-coding when connecting the Preamplifier and the reusable sensor cable.



(1) rSO_2 module (2) Preamplifier (3) Reusable sensor cable

NOTE

- **Different sensors (adult, pediatric and infant/neonatal) cannot be used simultaneously on the same monitor. Cerebral sensors can be used with somatic sensors on the same monitor.**

31.7 Changing rSO_2 Settings

31.7.1 Changing rSO_2 Alarm Settings

To change the rSO_2 alarm settings, follow this procedure:

1. Select the rSO_2 numeric area to enter the **rSO2** menu.
2. Select the **Alarm** tab.
3. Enter the password if required.
4. Set the alarm properties as desired.

31.7.2 Setting the rSO_2 Auto Low Limit Switch

To set the rSO_2 auto low alarm limit, follow this procedure:

1. Select the rSO_2 numeric area to enter the **rSO2** menu.
2. Select the **Alarm** tab.
3. Set **Auto Low Limit** switch.

- ◆ If **Auto Low Limit** is switched on, **rSO2-1 Variance** and **rSO2-2 Variance** are activated to allow you to set the percentage of rSO_2 low limits below the baseline. Then the monitor calculates the rSO_2 low limits automatically based on the setting.
- ◆ If **Auto Low Limit** is switched off, the rSO_2 low limits should be set manually.

31.7.3 Setting the rSO_2 Label

To set the rSO_2 label, follow this procedure:

1. Select the rSO_2 numeric area to enter the **rSO2** menu.
2. Select the **Setup** tab.
3. Set **rSO2-1 Label** and **rSO2-2 Label**.

31.7.4 Setting the AUC Mode

To set the AUC mode, follow this procedure:

1. Select the rSO_2 numeric area to enter the **rSO2** menu.
2. Select the **Setup** tab.
3. Set **AUC Mode**.

- ◆ Select **Fixed** to activate the item **Fixed Threshold**. In this case, AUC is calculated according to the configured fixed threshold.
- ◆ Select **Below Base Percentage** to activate the item **Percentage Below Baseline**. In this case, AUC is calculated according to the configured percentage below baseline.

31.7.5 Setting the Baseline

To set the rSO_2 baseline for the respective channel, follow this procedure:

1. Select the rSO_2 numeric area to enter the **rSO2** menu.
2. Select the **Baseline** tab.
3. Select **Set Baseline**. The monitor automatically sets the current rSO_2 value as the baseline.

You can also set the baselines for all rSO_2 channels by the following two methods:

- ■ Select **Set Baseline**s in the lower left corner of the rSO_2 menu.
- ■ Press the hard key at the upper right of the rSO_2 module.

Then the monitor set the baselines for all rSO_2 channels according to their respective current rSO_2 values.

NOTE

- **Set the rSO_2 value measured when patient is sober and eupraxic as baseline. The baseline will be set automatically if it is not set within 5 to 6 minutes and current rSO_2 value is effective.**

31.7.6 Selecting rSO_2 Parameters for Display

In the rSO_2 numeric area, rSO_2 and SSI are permanently displayed parameters, and other parameters are selectable. To select the parameters for display, follow this procedure:

1. Select the rSO_2 numeric area to enter the **rSO2** menu.
2. Select the **Select Parameter** tab.
3. Select the parameters for display.

32 Review

32.1 Review Overview

Trends are patient data collected over time and displayed in graphic, tabular, or other forms to give you a picture of how your patient's condition is developing. You can review the trend data in the review page, minitrends window, or OxyCRG window. You can also review the events, 12-lead ECG analysis results and waveforms, full disclosure waveforms, and so on.

32.2 Review Page

The **Review** page contains tabs to display trend data in tabular, graphic, or other forms.

NOTE

- **The derived leads are marked with a "d" in front of the lead label, for example "dV1".**

32.2.1 Accessing the Review Page

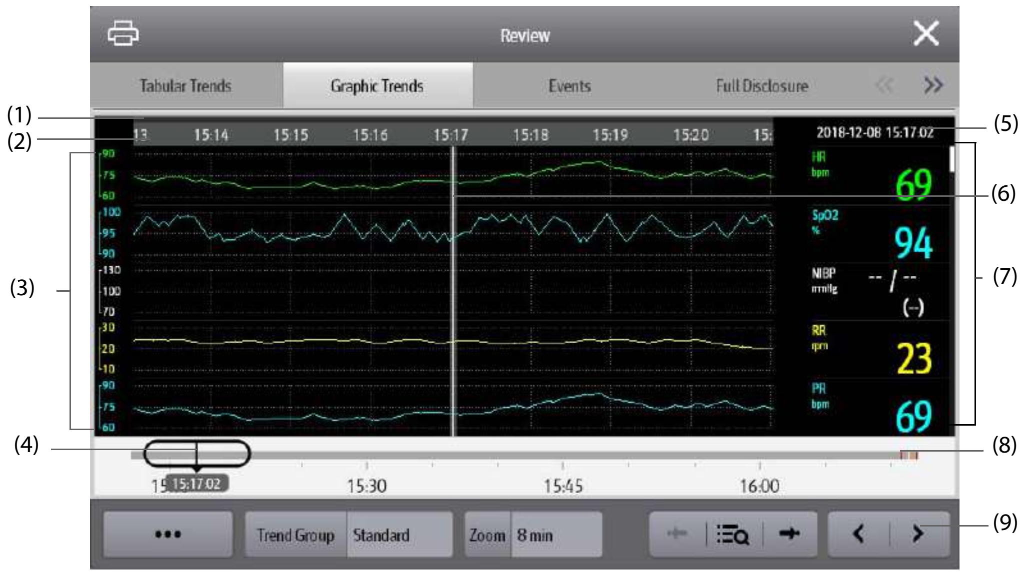
Choose one of the following methods to enter the review page:

■ Select the **Review** quick key.

■ Select the **Main Menu** quick key → from the **Review** column select the desired option.

32.2.2 Example Review Page

The review pages have similar structure. We take the graphic trends review page as an example.



(1) Event type indicator: different color blocks match different types of events:

■ Red: high priority alarm event

■ Yellow: medium priority alarm event

■ Cyan: low priority alarm event

■ Green: manual event

■ White: operation-related event

(2) Current window time line: indicates the time length of the current window. In case of system time change, the question mark "?" is displayed beside the time.

(3) Waveform area: displays trend curves. The color of trend curves is consistent with the color of parameter labels.

(4) Slider: indicates the position of current window time in the entire time length. Dragging this button left or right enables you to locate the trend data at a specific time and also refreshes trend data in current window accordingly.

(5) Event area: displays the event of the cursor time. Selecting the event access the event list. If there is no event at the cursor time, the cursor time is displayed.

(6) Cursor

(7) Numeric area: displays numeric values at the cursor indicated time. The background color of numeric values matches the alarm priority.

(8) Time line: indicates the entire time length.

- : indicates the time length of reviewable trend data. can be moved within this time length.
- : indicates the time length of no trend data. cannot be moved within this time length.
- Different color blocks at the time line indicate events of different types. See the color definition for the event type indicator.

(9) Button area.

32.2.3 Symbols on Review Pages

The following table lists the symbols on review pages.

Symbol	Description
	Slider: indicates the position of current window time in the entire time length. Dragging the slider left or right enables you to locate the trend data at a specific time and also refreshes data in current window accordingly.
 or 	Goes to the previous or next event.
	Event list: displays events in a chronological order. The most recent event is displayed at the top.The number of asterisk symbols before an event matches alarm priority.
 or 	Selecting this symbol displays two review pages simultaneously.
	Record button: select it to output patient information and data through the recorder.
	Print button: select it to output patient information and data through the printer.
+	Indicates that the followed parameter is from an external device connected to the monitor via the BeneLink module.

32.2.4 Common Operations

This section describes common operations for all review pages.

32.2.4.1 Browsing Trend Data

Browse trend data in one of the following ways:

- Move the cursor.
- Move the slider .
- Slide your finger on the screen.

32.2.4.2 Viewing Events

You can view the following types of events:

- Manually triggered events
- Parameter-related operation events and alarm-related events, such as starting C.O. measurement

- Operation events not related to parameters, such as system time change

View events in either of the following ways:

- Select and select the desired event.
- Select or to view the previous or next event.

Events are displayed in a chronological order. The most recent event is displayed at the top. The number of asterisk symbols before and event matches alarm priorities as follows:

- ***: high priority alarm
- **: medium priority alarm
- *: low priority alarm

32.2.4.3 Displaying Two Review Pages Simultaneously

For N22/N19, you can display two review pages simultaneously. To do so, follow this procedure:

1. Enter the desired review page by one of the following methods:
   - Select the **Review** quick key → select the desired tab.
   - Select the **Main Menu** quick key → from the **Review** column select the desired menu item.
2. Select (for landscape display) or (for portrait display).

32.2.5 Tabular Trends Review Page

The tabular trends review page displays trend data in a tabular form.

32.2.5.1 Entering the Tabular Trends Review Page

Choose one of the following methods to enter the tabular trends review page:

- Select the **Review** quick key → select the **Tabular Trends** tab.
- Select the **Main Menu** quick key → from the **Review** column select **Tabular Trends**.

32.2.5.2 Changing the Trend Group

To change the trend group, follow this procedure:

1. Enter the tabular trends review page.
2. Set **Trend Group**.

32.2.5.3 Editing the Trend Group

The setting of the **Trend Group** defines the contents of displayed printed trends. To edit the trend group, follow this procedure:

1. Enter the tabular trends review page by either of the following ways:
   - Select the **Review** quick key → select the **Tabular Trends** tab.
   - Select the **Main Menu** quick key → from the **Review** column select **Tabular Trends**.
2. Select **Group Setup** → select the desired tab.

NOTE

- **You cannot edit trend group labeled All or Standard.**
- **ECG parameter and waveform are always displayed in the first row on the trend page. It cannot be deleted or moved.**

32.2.5.4 Changing the Resolution of Trend Data

The interval of tabular trends defines the interval of displaying trend data. Short interval is especially suited for neonatal applications, where the clinical situation may change very quickly. In adult monitoring, where the patient's status typically changes more gradually, a longer interval may be more informative.

To change the interval of trend data, follow this procedure:

1. Enter the tabular trends review page.
2. Select **Interval**.
   - ◆ **5 sec or 30 sec**: select to view up to 4 hours of tabular trends at an interval of 5 seconds or 30 seconds.
   - ◆ **1 min, 5 min, 10 min, 15 min, 30 min, 1 hr, 2 hrs, or 3 hrs**: select to view up to 120 hours of tabular trends at selected interval.
   - ◆ Select parameters, such as NIBP, C.O. to view the tabular trends when parameter measurements are acquired.

32.2.5.5 Printing a Tabular Trends Report

To print a tabular trends report, follow this procedure:

1. Enter the tabular trends review page.
2. Select  at the upper left corner of the review page to enter the **Print Setup** menu.
3. Set the tabular trends report as described in *37.6.3 Setting Tabular Trends Reports*.
4. Select  in the **Tabular Trends Report** menu to print the report.

32.2.6 Graphics Trends Review Page

The graphic trends review page displays trend data in a graphic form.

32.2.6.1 Entering the Graphic Trends Review Page

Choose one of the following methods to enter the graphic trends review page:

- ■ Select the **Review** quick key → select the **Graphic Trends** tab.
- ■ Select the **Main Menu** quick key → from the **Review** column select **Graphic Trends**.

32.2.6.2 Changing the Trend Group

For more information, see *32.2.5.2 Changing the Trend Group*.

32.2.6.3 Editing the Trend Group

For more information, see *32.2.5.3 Editing the Trend Group*.

32.2.6.4 Changing the Resolution of Trend Data

To change the length of trend data displayed on the current screen, follow this procedure:

1. Enter the graphic trends review page.
2. Select **Zoom**.
   - ◆ **8 min:** the screen displays eight minutes of trend data. You can view the recent one hour data.
   - ◆ **30 min, 1 hr, 2 hrs, 4 hrs**: the screen displays 30 minutes, one hour, two hours, or four hours of trend data. You can view the recent four hour data.
   - ◆ **8 hrs, 12 hrs, 24 hrs, 48 hrs**: the screen displays eight hours, 12 hours, 24 hours, or 48 hours of trend data. You can view the recent 120 hours of data.

32.2.6.5 Changing the Number of Waveforms

To change the number of waveforms displayed on the trend review page, follow this procedure:

1. Enter the graphic trends review page.
2. Select **Trends**.

32.2.6.6 Printing a Graphic Trends Report

To print a graphic trends report, follow this procedure:

1. Enter the graphic trends review page.
2. Select at the upper left corner of the review page to enter the **Graphic Trends Report** menu.
3. Set the graphic trends report as described in *37.6.4 Setting Graphic Trends Reports*.
4. Select in the **Graphic Trends Report** menu to print the report.

32.2.7 Events Review Page

The monitor stores events in real time, including technical alarm events, physiological alarm events, manual events, and operational events. When an event occurs, all the measurement numerics and three event-related waveforms 16 seconds before and after the event are stored.

NOTE

- **A total loss of power has no impact on the events stored.**
- **Alarms are saved as events and will be maintained if the equipment is powered down. The time of equipment power down is not recorded as an event and cannot be reviewed.**
- **Earlier events will be overwritten by later ones if the capacity is reached.**

32.2.7.1 Entering the Events Review Page

Choose one of the following methods to enter the events review page:

- Select the **Review** quick key → select the **Events** tab.
- Select the **Main Menu** quick key → from the **Review** column select **Events**.

The **Event** page displays event list. Events are displayed in descending chronological order. The most recent event is displayed at the top.The number of asterisk symbols before an event indicate alarm priorities. When a parameter label is prefixed with the plus sign (+), it indicates that the trend data is from external devices connected to the monitor.

Different color blocks are displayed on the left of each event to indicate different event types.

- Red: high priority alarm event
- Yellow: medium priority alarm event
- Cyan: low priority alarm event
- Green: manual event
- White: operation-related event

The number of currently selected events and the total number of events are displayed at the top right corner of the event list. For example, 2/4indicates that the selected event is the second event in the filtered events and the total number of filtered events is 4. **Total** indicates the total number of events. For example: **Total**: 28 means that there are a total of 28 events.

32.2.7.2 Configuring the Filter

You can filter events by time, alarm priority, alarm category, or parameter group. To configure the filter, follow this procedure:

1. Enter the **Events** page.
2. Switch on **Filter**.

Select **Filter Setup** and set the desired filter criterion.

32.2.7.3 Editing Events

To edit events, follow this procedure:

1. Enter the **Events** page and tick off the desired events.
2. Select **...** to edit the selected events.
    - **Lock**: manually lock the event. Locked events cannot be deleted.
    - **Note**: enter comments for the event.

32.2.7.4 Viewing Event Details

To view waveforms and parameter values at the event time, follow this procedure:

1. Enter the **Events** page.
2. Select **Overview**.

To display beat labels on the first ECG waveform, switch on **Beat Annotation**. The white beat labels indicate heart beats classification and may explain suspected, missed, or false arrhythmia calls. Heart beats are classified as follows:

- N = Normal
- V = Ventricular ectopic
- S = Supraventricular premature
- P = Paced
- L = Learning
- ? = Insufficient information to classify beats
- I = Inoperative (for example, Lead Off)
- M = Missed beat

If you switch on **Beat Annotation** on the **Events** page, beat labels will also be displayed on the **Full Disclosure** page, and vise versa. Beat labels can be printed out.

32.2.7.5 Printing Event Reports

You can print event reports either via a printer or via a recorder.

To do so, follow this procedure:

1. Enter the events review page.
2. Select to enter the **Print Setup** menu.
3. Select the desired options.
   - **Print Event List**: print the entire event list.
   - **Print List of Selected Events**: print the list of selected events.
   - **Print Detail of Selected Events**: print the details of selected events.
   - **Print Displayed Event Detail**: print the waveforms and parameters of the currently displayed event.
4. To print a report via a recorder, select .

32.2.8 Full Disclosure Review Page

You can review up to 48-hours' waveform data on the full disclosure review page. You can view both the compressed waveforms, full waveforms and numeric values. When Mindray ventilators are connected to the monitor via the BeneLink module, you can also view the waveform data of the ventilator on this review page. Parameter labels from ventilators are prefixed with the plus sign (+). For details about supported ventilators, see the device interfacing manual.

32.2.8.1 Entering the Full Disclosure Review Page

Choose one of the following methods to enter the full disclosure review page:

- Select the **Review** quick key → select the **Full Disclosure** tab.
- Select the **Main Menu** quick key → from the **Review** column select **Full Disclosure**.

32.2.8.2 Selecting Waveforms

Before reviewing compressed waveforms, you must select waveforms you want to store and display. To store and display the desired waveforms, follow this procedure:

1. Enter the full disclosure review page.
2. Select **Setup** to enter the **Select Waveform** page.

3. Select the **Storage** tab and set the desired waveforms to be stored in the monitor. Select the **Display (Maximum: 3)** tab and set the desired waveforms to be displayed on the **Full Disclosure** page.

NOTE

- **The more waveforms selected in the Storage column, the shorter the waveform storage time. The waveforms may not be stored for 48 hours. Please exert caution when selecting waveforms.**

In case of alarms, the background of compressed waveform block at the alarm time is marked with a special color:

- Red: high alarm priority
- Yellow: medium alarm priority
- Cyan: low alarm priority

32.2.8.3 Setting Scale and Duration

To set the length and size of displayed compressed waveforms, follow this procedure:

1. Enter the full disclosure review page.
2. Select **...**, and then select **Scale** to set ECG waveform gain.
3. Select **Duration** to set the length of displayed waveforms.
4. Select parameter label to set scale for each parameter.

32.2.8.4 Viewing Details of Compressed Waveforms

To view the full waveforms and numeric values, follow this procedure:

1. Enter the full disclosure review page.
2. Select **Details**.

You can perform the following operations on the this page:

- Switch on **Beat Annotation**. For more information, see *32.2.7.4 Viewing Event Details*.
- Select **...** and set **Speed** and **ECG Gain**, or **Save As Event**.
- Select **Overview** to switch to the compressed waveform page.

32.2.8.5 Printing the Full Disclosure Waveform Report

To print a compressed waveform report, follow this procedure:

1. Enter the full disclosure review page.
2. Select and set the time range for printing.

32.2.9 OxyCRG Review Page

You can review up to 48 hours' trend curves on the OxyCRG review page. The OxyCRG review functionality is applicable for neonatal monitoring only.

32.2.9.1 Entering the OxyCRG Review Page

Choose either of the following methods to enter the OxyCRG review page:

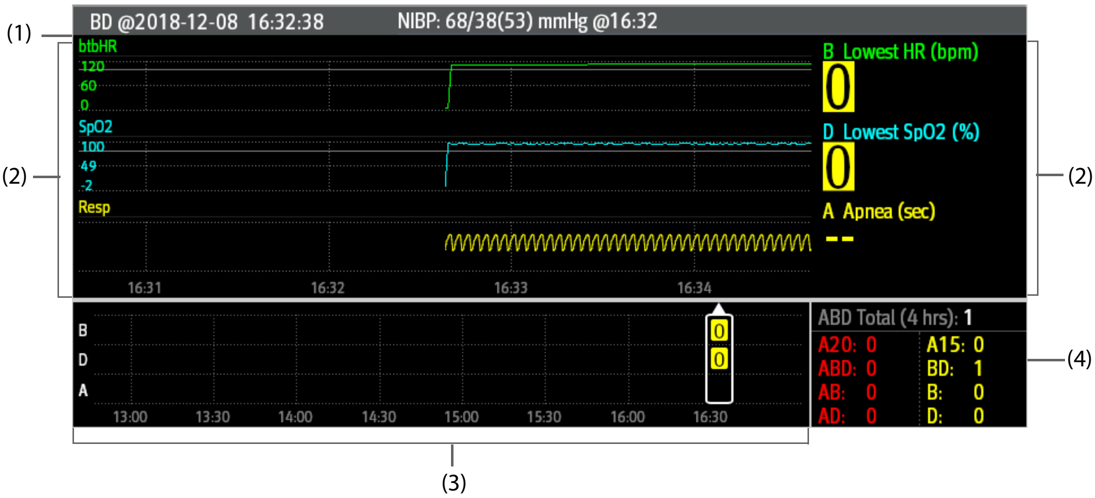
- From the OxyCRG screen, select the ABD events list area.
- Select the **Review** quick key → select the **OxyCRG** tab.
- Select the **Main Menu** quick key → from the **Review** column select **OxyCRG**.

NOTE

- **OxyCRG Review Page is available only when Patient Category is set to Neo.**

32.2.9.2 The Display of the OxyCRG Review Page

The following figure shows the OxyCRG screen:



(1) Event title area: displays information of the selected event, such as the event type and time.

(2) Event detail area: displays parameter trends, compressed waveform, and parameter values of selected event.

(3) Event summary area: displays ABD events within the **Zoom** period. The selected event is enclosed in a white frame.

(4) Event statistics area: displays the total number of ABD events and the numbers of each event within the **Zoom** period.

32.2.9.3 Changing the Resolution of Trend Curves

To set the resolution of trend curves, follow this procedure:

1. Enter the OxyCRG review page.
2. Set **Zoom**.

32.2.9.4 Printing an OxyCRG Review Report

To print an OxyCRG review report, follow this procedure:

1. Enter the OxyCRG review page.
2. Set the desired compressed waveform and duration.
3. Select .

32.2.10 12-Lead ECG Review Page

When 12-lead ECG analysis is performed, you can review the most recent 20 events of 12-lead analysis. For more information, see *12 Resting 12-Lead ECG Analysis*.

32.2.10.1 Entering the 12-Lead Review Page

Choose one of the following methods to enter the 12-lead ECG review page:

- Upon completion of 12-lead ECG analysis, select **Review** from the **12-Lead Interpretation** screen. For more information, see *12 Resting 12-Lead ECG Analysis*.
- Select the **Review** quick key → select **12-Lead ECG**.
- Select the **Main Menu** quick key → from the **Review** column select **12-Lead ECG**.

32.2.10.2 Switching to Median Complex (for Glasgow Algorithm Only)

The median complex template displays 12-lead ECG waveforms on one page in 4 columns, with 3 lines in each column, and one rhythm lead waveform at the bottom. Besides, a short vertical bar appears above each waveform, marking the start and end position of P-wave and QRS-wave and the end position of T-wave.

To view Median Complex, follow this procedure:

1. Enter the 12-lead review page.
2. Select **Median Complex**.

Selecting **Waveform** can return to the 12-lead ECG waveform page.

32.2.10.3 Setting 12-Lead ECG Waveforms

To set the 12-lead ECG waveforms on the review page, follow this procedure:

1. Enter the 12-lead review page.
2. Set **Speed**, **Gain**, and **Layout**.

32.2.10.4 Printing the 12-Lead ECG Report

To print the 12-Lead ECG report, follow this procedure:

1. Enter the 12-lead review page.
2. Select .

32.2.11 ST Review Page

When ST analysis is enabled, the monitor saves ST segments and values at an interval of one minute. You can review the latest 120 hours of ST data.

32.2.11.1 Entering the ST Review Page

Choose either of the following methods to enter the ST review page:

- Select the **Review quick key** → select the **ST** tab.
- Select the **Main Menu** quick key → from the **Review** column select **ST**.

32.2.11.2 Setting the ST Reference

You can set the currently displayed ST as reference. To do so, follow this procedure:

1. Enter the ST review page.
2. Select **Set Reference**.

NOTE

- **The ST baseline is used as ST reference by default.**

32.2.11.3 Displaying/Hiding the ST Reference

To display or hide ST reference, follow this procedure:

1. Enter the ST review page.
2. Select **Display Reference** or **Hide Reference**.

32.2.11.4 Displaying/Hiding Markers

To display or hide markers, follow this procedure:

1. Enter the ST review page.
2. Select **Display Marker** or **Hide Marker**.

32.2.11.5 Printing ST Data

To print ST data, follow this procedure:

1. Enter the ST review page.
2. Select .

32.3 Reviewing Discharged Patients

For discharged patients, you can review the trend data in the review page. You can also review the events and 12-lead ECG analysis results.

32.3.1 Checking the Data of a Discharged Patient

1. Access the **Discharged Patients** dialog box by either of the following ways:
   - ◆ Select the **Discharged Patients** quick key.
   - ◆ Select the **Main Menu** quick key → from the **Patient Management** column select **Discharged Patients**.
2. From the patient list select the desired patient.
3. Select **Detail**.

32.3.2 Checking the Information of a Discharged Patient

1. Access the **Discharged Patients** dialog box by either of the following ways:
   - ◆ Select the **Discharged Patients** quick key.
   - ◆ Select the **Main Menu** quick key → from the **Patient Management** column select **Discharged Patients**.
2. From the patient list select the desired patient.
3. Select **Detail**.
4. Select the  icon to enter the **Patient Management** dialog box.
5. Select **OK** to exit the **Patient Management** dialog box.

33 HemoSight™

33.1 HemoSight™ Introduction

This monitor provides the **HemoSight™** function. You can easily view and review hemodynamic parameters through the **HemoSight** menu.

The **HemoSight** menu is available when you are using the following modules:

- PiCCO module
- $ScvO_2$ module
- C.O. module
- ICG module

CCO/SvO_2 module (measured from the Vigilance II, Vigileo, EV1000, and HemoSphere monitor)

For detailed information on monitoring and setting hemodynamic-related parameters, see ***22 Monitoring Continuous Cardiac Output (from PiCCO Module), 19 Monitoring Central Venous Oxygen Saturation ($ScvO_2$), 18 Monitoring Cardiac Output (C.O.), 21 Monitoring Impedance Cardiography (ICG), and 20 Monitoring CCO/SvO_2***. This chapter only introduces functions operated through the **HemoSight** menu.

33.2 Accessing the HemoSight Menu

Access the **HemoSight** menu by either of the following ways:

- Select the **HemoSight** quick key.
- Select the **CCO** numeric area, **$ScvO_2$** numeric area, **SvO_2** numeric area, or **ICG** numeric area → from the bottom of the pop-up menu select **HemoSight**.
- Select the **Main Menu** quick key → from the **CAA** column select **HemoSight**.

33.3 Viewing Hemodynamic Parameters

To view hemodynamic parameters, select the desired tab on the **Diagnosis** page of the **HemoSight** menu:

- ◆ Select **All** to view all hemodynamic parameters. For more information, see ***32.2.1 Hemodynamic Parameters***.
- ◆ Select **Physiology Graphics** to view dynamic graphics for parameters' changes. For more information, see *33.3.2 Physiology Graphics*.
- ◆ Select **Physiology Relationship** to view the realtime relationship of parameters. For more information, see *33.3.3 Physiology Relationship*.
- ◆ Select **Decision Model** to view measured values and targeted values. The **Decision Model** page is only available for the PiCCO module. For more information, see *33.3.4 Decision Model (Only Available for PiCCO Module)*.

The symbols beside the hemodynamic parameters have the following meanings:

- *: indicates an intermittent parameter.
- **: indicates an oxygenation parameter.
- ***Measure Time:** refers to the measurement time of the intermittent parameter.
- ↑ or ↓: indicates that a parameter value exceeds its upper or lower limit.

33.3.1 Hemodynamic Parameters

33.3.1.1 Hemodynamic Parameters from the ICG module

The following table lists hemodynamic parameters from the ICG module.

	Abbreviation	Full Spelling	Unit
Output	C.O.	Cardiac Output	L/min
	C.I.	Cardiac Index	L/min/m^2
	SV	Stroke Volume	ml
	SVI	Stroke Volume Index	ml/m^2
	HR	Heart Rate	bpm
Contractility	LCW	Left Cardiac Work	kg·m
	LCWI	Left Cardiac Work Index	kg·m/m^2
	LVSW	Left Ventricular Stroke Work	g·m
	LVSWI	Left Ventricular Stroke Work Index	g·m/m^2
	ACI	Acceleration Index	/100s^2
	PEP	Pre-ejection Period	ms
	VI	Velocity Index	/1000s
	STR	Systolic Time Ratio	No unit
	LVET	Left Ventricular Ejection Time	ms
Preload Volume	TFI	Thoracic Fluid Index	Ω
	TFC	Thoracic Fluid Content	/kΩ
	CVP	Central Venous Pressure	mmHg
	PAWP	Pulmonary Artery Wedge Pressure	mmHg
Afterload	SVR	Systemic Vascular Resistance	DS/cm^5
	SVRI	Systemic Vascular Resistance Index	DS·m^2/cm^5
	PVR	Pulmonary Vascular Resistance	DS/cm^5
	PVRI	Pulmonary Vascular Resistance Index	DS·m^2/cm^5
	Art-M	Mean Arterial Pressure	mmHg
	Art-S	Systolic Arterial Pressure	mmHg
	Art-D	Diastolic Arterial Pressure	mmHg

33.3.1.2 Hemodynamic Parameters from PiCCO module and $ScvO_2$ module

The following table lists the hemodynamic parameters from the PiCCO module and $ScvO_2$ module.

	Abbreviation	**Full Spelling**	**Unit**
Output	CCO	Continuous Cardiac Output	L/min
	CCI	Continuous Cardiac Index	L/min/m^2
	SV	Stroke Volume	ml
	SVI	Stroke Volume Index	ml/m^2
	HR	Heart Rate	bpm

	Abbreviation	Full Spelling	Unit
Contractility	GEF	Global Ejection Fraction	%
	CFI	Cardiac Function Index	1/min
	dPmx	Left Ventricular Contractility	mmHg/s
Preload Volume	GEDV	Global End Diastolic Volume	ml
	GEDI	Global End Diastolic Volume Index	ml/m^2
	ITBV	Intrathoracic Blood Volume	ml
	ITBI	Intrathoracic Blood Volume Index	ml/m^2
	SVV	Stroke Volume Variation	%
	PPV	Pulse Pressure Variation	%
Afterload	SVR	Systemic Vascular Resistance	DS/cm^5 or kPa-s/l
	SVRI	Systemic Vascular Resistance Index	$DS•m^2/cm^5$ or $kPa-s-m^2/l$
	pArt-M	Mean Artery Pressure from the PiCCO module	mmHg, kPa or cmH_2O
	pArt-D	Diastolic Artery Pressure from the PiCCO module	mmHg, kPa or cmH_2O
	pArt-S	Systolic Artery Pressure from the PiCCO module	mmHg, kPa or cmH_2O
Organ Function	EVLW	Extravascular Lung Water	ml
	ELWI	Extravascular Lung Water Index	ml/kg
	CPO	Cardiac Power Output	W
	CPI	Cardiac Power Index	W/m^2
	PVPI	Pulmonary Vascular Permeability Index	no unit
	TB	Blood Temperature	ºC
Oxygenation Parameters	$ScvO_2$	Central Venous Oxygen Saturation	%
	Hb	Hemoglobin	g/L, g/dl, mmol/L
	Hct	Haematocrit	%
	DO_2	Oxygen Delivery	ml/min
	DO_2I	Oxygen Delivery Index	$ml/min/m^2$
	VO_2	Oxygen Consumption	ml/min
	VO_2I	Oxygen Consumption Index	$ml/min/m^2$
	SaO_2	Arterial Oxygen Saturation	%

33.3.1.3 Hemodynamic Parameters from CCO/SvO_2 module

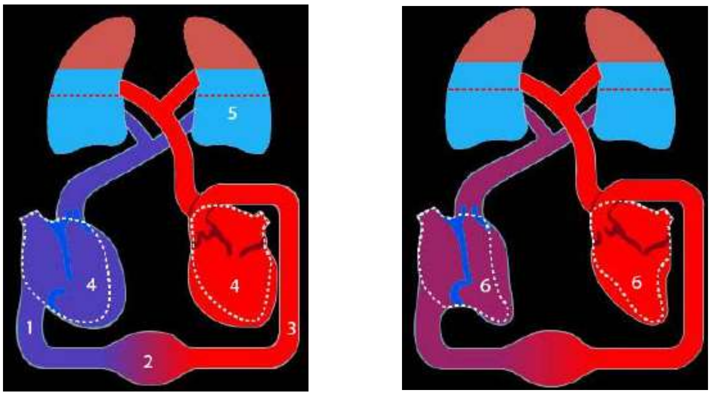
The following table lists the hemodynamic parameters from the Vigilance II, Vigileo, EV1000, and HemoSphere monitors.

	Abbreviation	Full Spelling	Unit	Applicable Device
Output	CCO	Continuous Cardiac Output	L/min	All
	CCI	Continuous Cardiac Index	L/min/m^2	All
	C.O.	Cardiac Output	L/min	Vigilance II, EV1000, HemoSphere
	CI	Cardiac Index	L/min/m^2	Vigilance II, EV1000, HemoSphere
	SV	Stroke Volume	ml	All
	SVI	Stroke Volume Index	ml/m^2	All
	PR	Pulse Rate	bpm	EV1000
Contractility	ESV	End Systolic Volume	ml	Vigilance II
	ESVI	End Systolic Volume Index	ml/m^2	Vigilance II
	RVEF	Right Ventricular Ejection Fraction	%	Vigilance II, HemoSphere
	GEF	Global Ejection Fraction	%	EV1000
	CFI	Cardiac Function Index	l/min	EV1000
Preload Volume	HR	Heart Rate	bpm	Vigilance II
	CVP	Central Venous Pressure	cmH_2O, kPa, or mmHg	All
	MAP	Mean Arterial Pressure	mmHg or kPa	Vigilance II, HemoSphere
	EDV	End Diastolic Volume	ml	Vigilance II
	EDVI	End Diastolic Volume Index	ml/m^2	Vigilance II
	SVV	Stroke Volume Variation	%	Vigileo, EV1000
	GEDV	Global End Diastolic Volume	ml	EV1000
	GEDI	Global End Diastolic Volume Index	ml/m^2	EV1000
	ITBV	Intrathoracic Blood Volume	ml	EV1000
	ITBI	Intrathoracic Blood Volume Index	ml/m^2	EV1000
	PPV	Pulse Pressure Variation	%	HemoSphere
Afterload	SVR	Systemic Vascular Resistance	DS/cm^5 or kPa-s/l	All
	SVRI	Systemic Vascular Resistance Index	DS•m^2/cm^5 or kPa-s-m^2/l	All
	eArt-S	Systolic Arterial Pressure from the EV1000 monitor	mmHg or kPa	EV1000
	eArt-M	Mean Arterial Pressure from the EV1000 monitor	mmHg or kPa	EV1000
	eArt-D	Diastolic Arterial Pressure from the EV1000 monitor	mmHg or kPa	EV1000

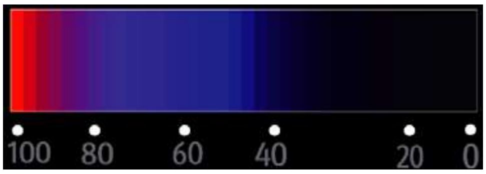
	Abbreviation	Full Spelling	Unit	Applicable Device
Oxygenation Parameters	$ScvO_2$	Central Venous Oxygen Saturation	%	All
	SvO_2	Mixed Venous Oxygen Saturation	%	All
	Hb	Hemoglobin	g/L, g/dl, or mmol/L	EV1000
	DO_2	Oxygen Delivery	ml/min	Vigilance II
	DO_2I	Oxygen Delivery Index	$ml/min/m^2$	EV1000
	VO_2	Oxygen Consumption	ml/min	Vigilance II
	VO_2I	Oxygen Consumption Index	$ml/min/m^2$	EV1000
	VO_2E	Estimated Oxygen Consumption	ml/min	EV1000
	VO_2IE	Estimated Oxygen Consumption Index	$ml/min/m^2$	EV1000
	SpO_2	Arterial Oxygen Saturation from Pulse Oximetry	%	EV1000
	O_2EI	Oxygen Extraction Index	%	Vigilance II
	SaO_2	Arterial Oxygen Saturation	%	Vigilance II
Organ Function	EVLW	Extravascular Lung Water	ml	EV1000
	ELWI	Extravascular Lung Water Index	ml/kg	EV1000
	PVPI	Pulmonary Vascular Permeability Index	no unit	EV1000
	TB	Blood Temperature	ºC or ºF	EV1000

33.3.2 Physiology Graphics

The lungs, heart and circulatory system vary according to the patient's condition at the time of the thermodilution measurement. The **Physiology Graphics** displays monitored parameters using animation, which gives a visual representation of the interaction between the heart, lungs, blood, and vascular system . The continuous parameter values are displayed in realtime. When the intermittent data is available, the animation changes to reflect this change. The heart rate showed by the animation is also a visual reflection of the patient heart rate.

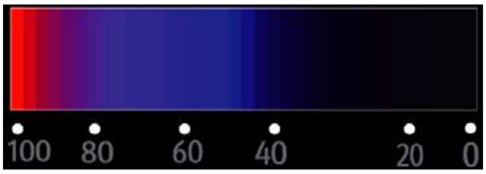


(1) When $ScvO_2$ or SvO_2 is available, the change in color indicates the change of $ScvO_2$ or SvO_2 values.



(2) When CVP and SVRI are available, the change in blood vessel diameter indicates the change of SVRI values. For more information, see *33.3.2.1 Systemic Vascular Resistance Status*.

(3) When SpO_2 is available, the change in color indicates the change of SpO_2 values.



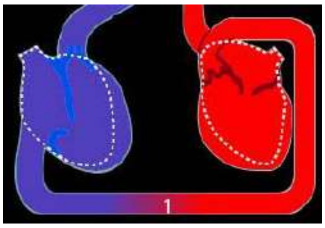
(4) When EDVI or GEDI is available, the size change in the diastole indicates the change of end diastolic volume index. For more information, see *33.3.2.3 End Diastolic Volume Status*.

(5) When ELWI is available, the change in liquid level of lung indicates the change of ELWI values. For more information, see *33.3.2.2 Lung Water Status*.

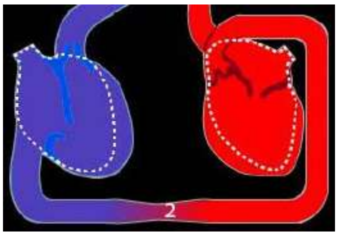
(6) When RVEF or GEF is available, the size change in the systole indicates the change of ejection fraction. For more information, see *33.3.2.4 Ejection Fraction Status*.

33.3.2.1 Systemic Vascular Resistance Status

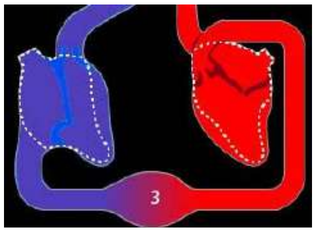
Systemic vascular resistance status is indicated by SVRI. The following pictures show the systemic vascular resistance status.



Normal resistance



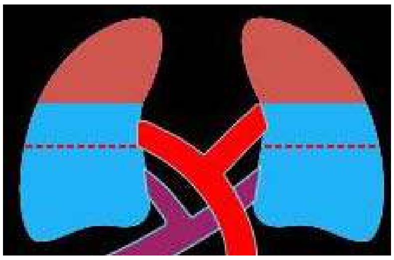
High resistance



Low resistance

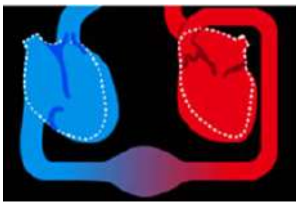
33.3.2.2 Lung Water Status

Lung water status is indicated by ELWI. The following picture shows the lung water status, which is indicated by the liquid level of lung. The dotted line marks the high limit of ELWI. The ELWI is considered too high if the liquid level exceeds the dotted line. When ELWI is not available, the lung is displayed in gray color.

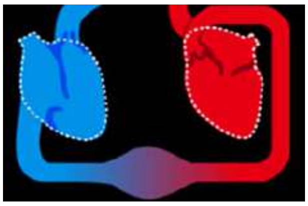


33.3.2.3 End Diastolic Volume Status

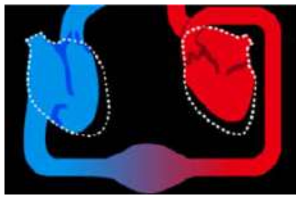
End diastolic volume status is indicated by EDVI (from the CCO/SvO_2 module) or GEDI (from the PiCCO module). The following pictures show different end diastolic volume statuses. The dotted line marks the normal end diastolic volume status. When EDVI or GEDI is not available, the heart in the diastole is displayed in gray color.



High end diastolic volume



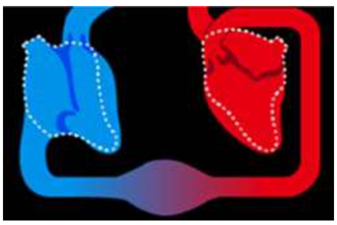
Normal end diastolic volume



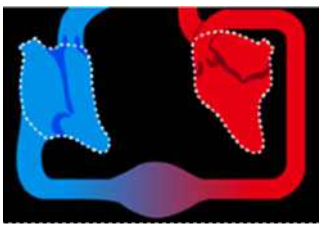
Low end diastolic volume volume

33.3.2.4 Ejection Fraction Status

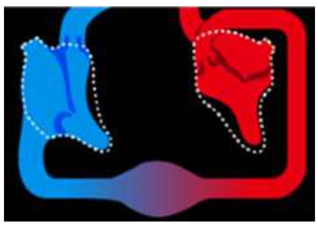
Ejection fraction status is indicated by RVEF (from the CCO/SvO_2 module) or GEF (from the PiCCO module). The following pictures show different ejection fraction statuses. The dotted line marks the normal ejection fraction status. When RVEF or GEF is not available, the heart in the systole is displayed in gray color.



Low ejection fraction



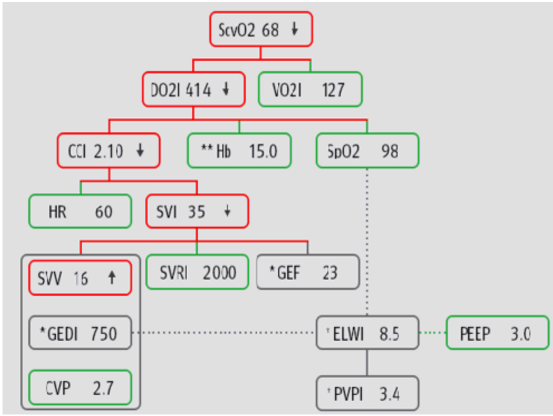
Normal ejection fraction



High ejection fraction

33.3.3 Physiology Relationship

The **Physiology Relationship** screen depicts the balance between oxygen delivery (DO_2) and estimated oxygen consumption (VO_2). It automatically updates as parameter values change so the displayed values are always current. The connecting lines highlight the relationship of the parameters to each other.



In the **Physiology Relationship** screen, the connecting lines have the following meanings:

- Solid line: indicates that parameters connected have direct relationship.
- Dotted line: indicates that parameters connected have indirect relationship.
- Red frame: the parameter value is out of its normal range.
- Green frame: the parameter value is within its normal range.
- Gray frame: the parameter value is not available.

In the **Physiology Relationship** screen, each parameter frame displays the following contents:

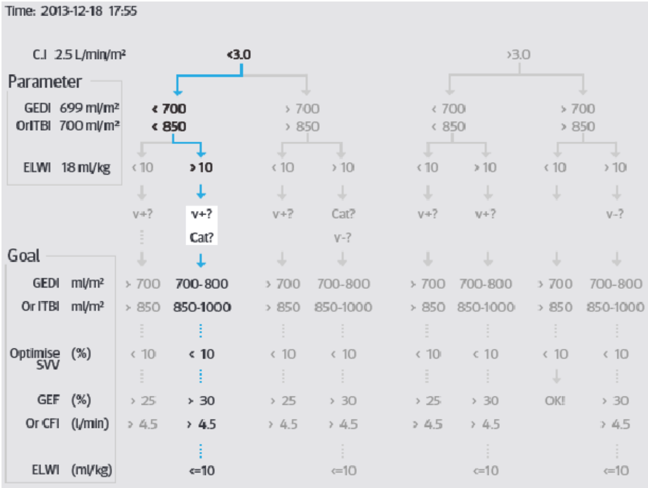
- Parameter name
- Parameter value ("--" if parameter value is not available)
- * (if the parameter is intermittent)
- ** (if the parameter value is input manually)
- ↑ or ↓ (if the parameter value exceeds its upper or lower limit)

NOTE

- **For different modules, parameters displayed in the Physiology Relationship screen are different.**

33.3.4 Decision Model (Only Available for PiCCO Module)

The decision model provides target values of related parameters. You can make a therapeutic decision by referring to the highligted route, as shown in the following picture.



NOTE

- **The data of decision model is from PULSION Medical Systems.**
- **The decision model is not obligatory. It cannot replace the individual therapeutic decision of the treating physician.**

33.4 Hemodynamic Test

The **Test** page in the **HemoSight** window provides the trends before and after a hemodynamic test. To access the **Test** page, follow this procedure:

1. Select the numeric area of **CCO**, **ScvO2,** or **SvO2**.
2. Select **HemoSight**.
3. Select the **Test** tab.

33.4.1 Renaming a Test

The passive leg raising(PLR) test and rapid fluid loading(RFL) test are defaut tests, and their names cannot be changed. To rename a custom defined test, follow this procedure:

1. Access the **HemoSight** menu. For more information, refer to *33.2 Accessing the HemoSight Menu*.
2. Select the **Test** tab.
3. Select **Custom1**, **Custom2**, **Custom3** or **Custom4**.
4. Select the  symbol at the upper left corner of the current window.
5. Input the test name in the input field.

33.4.2 Setting Test Time Duration

To set test time duration, follow this procedure:

1. Access the **HemoSight** menu. For more information, refer to *33.2 Accessing the HemoSight Menu*.
2. Select the **Test** tab.
3. Set **Test Duration**.

33.4.3 Selecting Parameters for Testing

To set test parameters, follow this procedure:

1. Access the **HemoSight** menu. For more information, refer to *33.2 Accessing the HemoSight Menu*.

2. Select the **Test** tab.
3. Select **Setup**.
4. From desired parameter page, select parameters for testing.

33.4.4 Performing a Hymodynamic Test

To perform a hymodynamic test, follow this procedure:

1. Access the **HemoSight** menu. For more information, refer to *33.2 Accessing the HemoSight Menu*.
2. Select the **Test** tab.
3. Select **Parameter** to select the involved parameters.
4. Select **Test Duration** to set test duration.
5. Select the **Start** button.
6. Wait until the test finishes automatically, or select the **Stop** button to end the test.
7. View the parameter trends. After the test, the **Test** page displays the current parameter value, reference parameter value, and Delta value (the variation of current value and reference value). For more information, see *32 Review*.

NOTE

- **Hemodynamic test can also run in background. If the Test page is closed during a test, the monitor gives a prompt tone and pops up the Test page after the test ends.**

33.5 Following Up the Patient Hemodynamic Status

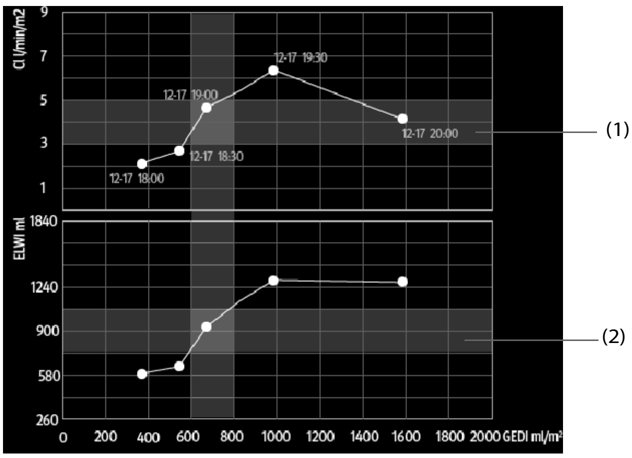
You can view the cardiac function curve, lung water curve and SVV/PPV slope indicator in the **Follow-up** menu. To view these curves or indicator, follow this procedure:

1. Access the **HemoSight** menu. For more information, refer to *33.2 Accessing the HemoSight Menu*.
2. Select the **Follow-up** tab.
3. View the following curves or indicator:

- ◆ Cardiac function curve
- ◆ SVV/PPV slope indicator
- ◆ Lung water curve

33.5.1 Cardiac function Curve and Lung Water Curve

Cardiac function curve and the lung water curve are used to assess the fluid responsiveness.



(1) Cardiac function curve (2) Lung water curve

For more information on the setup of X-axis or Y-axis parameter, see*33.5.2 Setting the Cardiac Function Curve and Lung Water Curve*.

33.5.2 Setting the Cardiac Function Curve and Lung Water Curve

To set the cardiac function curve and lung water curve, follow this procedure:

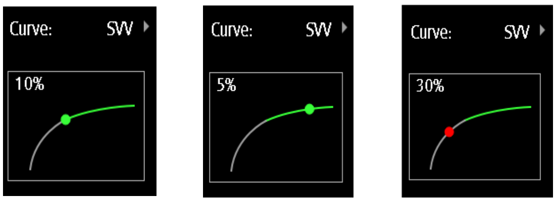
1. Access the **HemoSight** menu. For more information, refer to *33.2 Accessing the HemoSight Menu*.
2. Select the **Follow-up** tab.
3. Make the following settings:
   - **Interval**: set the time interval between coordinate points on the X-axis and Y-axis of the cardiac function curve and lung water curve. This setting is effective only when continuous parameters are selected at both the X-axis and Y-axis. When ELWI is unavailable and all the other parameters selected are continuous parameters, coordinate points will not be drawn on the lung water curve, but will be drawn on the cardiac function curve at the configured interval.
   - **Output**: set the Y-axis parameter for cardiac function curve.
   - **Preload Volume**: set the X-axis parameter for both cardiac function curve and lung water curve.

NOTE

- **If intermittent parameters are selected at either the X-axis or Y-axis, coordinate points will be drawn for all the intermittent parameters. In this case, coordinates drawn for continuous parameters and intermittent parameters are consistent.**

33.5.3 SVV/PPV Slope Indicator

The SVV/PPV slope indicator is a visual representation of the cardiac function curve used when assessing the stroke volume variation value or pulse pressure variation. The curved line indicates the SVV/PPV slope.



The dot moves up and down the curved line according to the SVV or PPV value. The color of the dot changes based upon set target ranges.

- SVV/PPV≤10%: the dot is green, and may predict that the patient is fluid unresponsive.
- SVV/PPV ＞ 10%: the dot is red, and may predict that the patient is fluid responsive.

CAUTION

- **PPV and SVV is only applicable in patients on controlled mechanical ventilation and sinus rhythm.**

33.5.4 Setting the SVV/PPV Slope Indicator

To set the SVV or PPV slope, follow this procedure:

1. Access the **HemoSight** menu. For more information, refer to *33.2 Accessing the HemoSight Menu*.
2. Select the **Follow-up** tab.
3. Select **SVV** or **PPV** as indicator. You can also select **Off** to hide the indicator.

33.6 Evaluating the Hemodynamic Parameters

You can review the hemodynamic parameter trends on the **Evaluation** page. The changes of hemodynamic parameters are shown by the trends or spider vision diagram. The trends and spider vision diagram display both current values and reference values of parameters, which let you conveniently see the hemodynamic status at different timepoints.

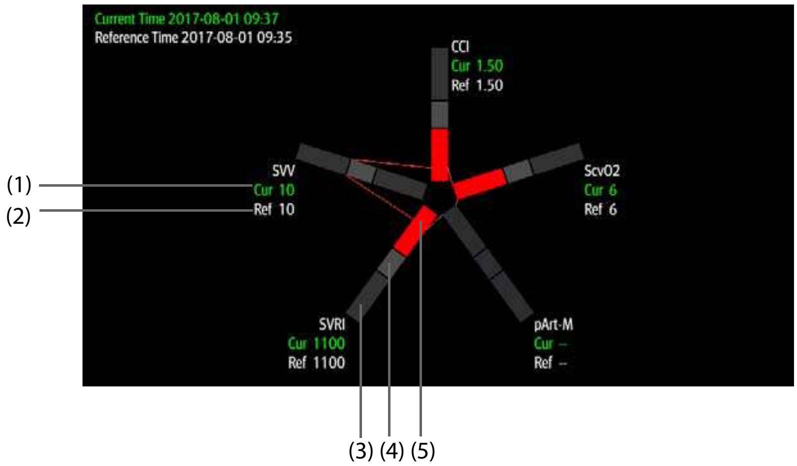
To enter the **Evaluation** page, follow this procedure:

1. Access the **HemoSight** menu. For more information, refer to *33.2 Accessing the HemoSight Menu*.
2. Select the **Evaluation** tab.

33.6.1 Viewing the Spider Vision Diagram

The spider vision diagram shows hemodynamic parameters in dynamic conjunction. To enter the **Spidervision** diagram, follow this procedure:

1. Access the **HemoSight** menu. For more information, refer to *33.2 Accessing the HemoSight Menu*.
2. Select the **Evaluation** tab.
3. Select the **Spidervision** tab.



(1) Current value
(2) Reference value
(3) Outer segment
(4) Middle segment
(5) Inner segment

Each spider leg is divided into 3 segments indicating different value ranges for the respective parameters. The middle segment indicates the normal range for the respective parameter. The outer segment will be highlighted when corresponding parameter value exceeds the upper limit. The inner segment will be highlighted when its corresponding parameter value exceeds the lower limit.

- The links between spider legs are displayed in green when all displayed parameters are within the normal range.
- The links between spider legs and the corresponding spider segment are displayed in yellow immediately when one of the displayed parameters is outside the normal range.
- The links between spider legs and the corresponding spider segments are displayed in red when two or more displayed parameters are outside the normal range.

33.6.2 Viewing Trends

To view the trends of hymodynamic parameters, follow this procedure:

1. Access the **HemoSight** menu. For more information, refer to *33.2 Accessing the HemoSight Menu*.
2. Select the **Evaluation** tab.
3. Select the **Trends** tab.

For more information on trends review, see *32.2.2 Example Review Page*.

33.6.3 Viewing Hemodynamic Prameters

You can view the hemodynamic parameters on the **Evaluation** page. The timeline below the **Spidervision** diagram indicates the entire time length. The timeline below the **Trends** page indicates the time length of current window (for more information, see *33.6.4 Changing the Time Length of Trends*). Different color blocks at the timeline indicate different types of events:

- Red: high priority physiological alarm event
- Yellow: medium priority physiological alarm event
- Cyan: low priority physiological alarm event
- Green: manual event
- White: operation-related event, such as accepting the C.O. average

To locate a hemodynamic event, choose any of the following methods:

- Move the slider to the target position.
- Use the following buttons:
  - Select or beside to go to the previous or next hemodynamic event.
  - Select to enter the event list, and select the desired hemodynamic event.
  - Select or beside to go to the previous or next C.O. average aceptance event.
  - Select to enter the list of C.O. average acceptance events, and select the desired C.O. average acceptance event.
  - Select < or > to move the slider at a one-minute interval to the left or right.

NOTE

- **If a physiological alarm event or manual event occurs simultaneously with a C.O. average acceptance event, this event will be displayed in preference to a C.O. average acceptance event.**

33.6.4 Changing the Time Length of Trends

To change the time length of trends, follow this procedure:

1. Access the **HemoSight** menu. For more information, refer to *33.2 Accessing the HemoSight Menu*.
2. Select the **Evaluation** tab.
3. Select **Trends** Tab.
4. Select **Zoom** and set the time length of trends.

33.6.5 Selecting the Pattern

The pattern defines the hemodynomic parameters and their numbers displayed in **Spidervision** diagram and **Trends** page. To select the pattern, follow this procedure:

1. Access the **HemoSight** menu. For more information, refer to *33.2 Accessing the HemoSight Menu*.
2. Select the **Evaluation** tab.
3. Select the **Spidervision** tab or **Trends** tab.
4. Click the **Pattern** button and select a pattern.

For more information, see ***33.7.3 Setting the Pattern*** for detailed information of creating or updating a pattern.

33.6.6 Saving Reference Values

To save the hemodynamic parameter values of any moment as reference values, follow this procedure:

1. Access the **HemoSight** menu. For more information, refer to *33.2 Accessing the HemoSight Menu*.
2. Select the **Evaluation** tab.
3. Select the **Spidervision** tab or **Trends** tab.

4. Select a desired time or event. For more information, see ***33.6.3 Viewing Hemodynamic Prameters7***.
5. Select **Set Reference** to save the parameter values at the selection time as reference values.

33.7 Changing Hemodynamic Parameter Settings

33.7.1 Setting Hemodynamic Parameter Ranges

To set the ranges of hemodynamic parameters, follow this procedure:

1. Access the **HemoSight** menu. For more information, refer to *33.2 Accessing the HemoSight Menu*.
2. Select the **Setup** tab.
3. Set the normal ranges of the hemodynamic parameters.

33.7.2 Restoring Default Values

To restore the default values, follow this procedure:

1. Access the **HemoSight** menu. For more information, refer to *33.2 Accessing the HemoSight Menu*.
2. Select the **Setup** tab.
3. Select the **Default** button.

NOTE

- **Selecting Default restores all the parameter ranges to defaults.**

33.7.3 Setting the Pattern

To set the pattern, follow this procedure:

1. Access the **HemoSight** menu. For more information, refer to *33.2 Accessing the HemoSight Menu*.
2. Select the **Setup** tab.
3. Select the **SpiderVision** tab.
4. Make the following settings:

    - Select the number of parameters (three to seven).
    - Select the parameter to be displayed.
    - Select **Save**, **Save As** or **Delete** to save, create or delete a pattern.

NOTE

- **You cannot delete the default pattern or the pattern that is in use.**

34 Clinical Assistive Applications (CAA)

The Clinical Assistive Applications (CAA) function integrates some commonly used clinical guidelines and tools into the monitor. It puts the currently monitoring parameter measurements together and provides comprehensive analysis results.

CAA can improve the clinician's working efficiency. However, it is not directly used for diagnosis and cannot not replace the clinician's judgement.

34.1 BoA Dashboard™

The Balance of Anesthesia (BoA) Dashboard helps the clinicians to monitor the patient's status during anesthetic induction, maintenance, and postoperative recovery.

34.1.1 Accessing BoA Dashboard™

Access BoA Dashboard in any of the following ways:

- Select the **BoA** quick key.
- Select the **Screen Setup** quick key → Select the **Choose Screen** tab → select **BoA Dashboard**.
- Select the **Main Menu** quick key → from the **CAA** column select **BoA Dashboard**.

BoA Dashboard has three pages:

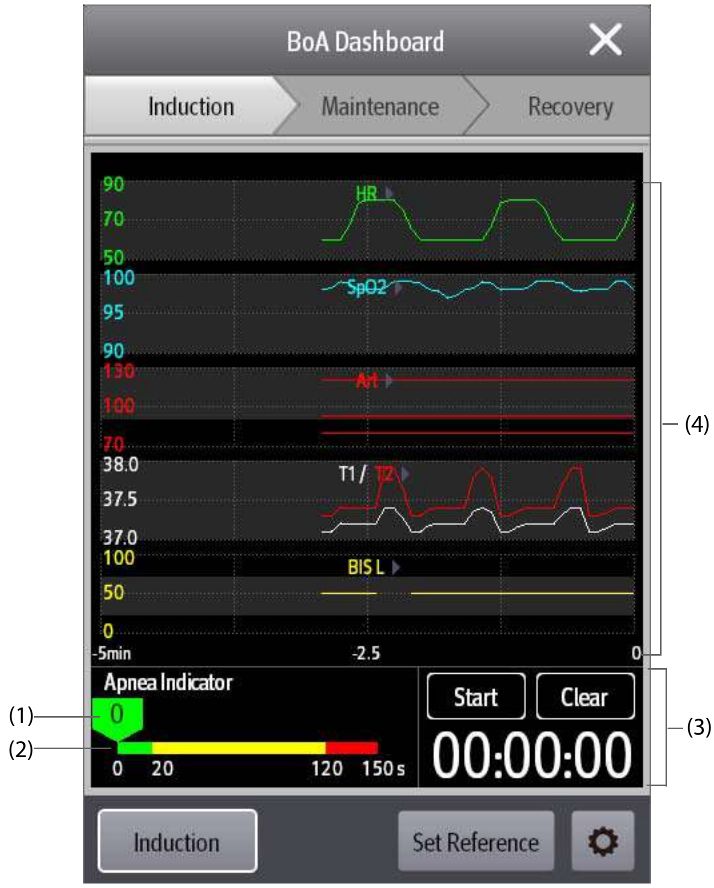
- Induction
- Maintenance
- Recovery

34.1.2 Induction

Select the **Induction** tab to enter the **Induction** page. You can check parameter minitrends and apnea time from the **Induction** page.

Select **Induction** to start apnea detection, mark the induction event, and start an NIBP STAT measurement. The systolic pressure value will be saved as the reference.

The following figure shows the **Induction** page. Your display may be configured to look slightly different.



(1) Cursor: indicates the current apnea time.

(2) Apnea indicator: provides apnea time scale.

(3) Timer: displays the time elapsed since the timer was started.

(4) Minitrends area: provides parameter minitrends. You can select the parameters you want to view. For more information, see *34.1.5.1 Selecting Parameters for Viewing Trends*.

34.1.3 Maintenance

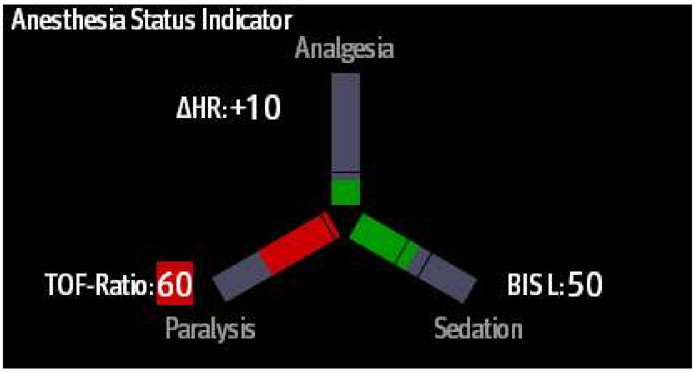
You can check the patient's parameter trends, anesthesia status, and triple low status.

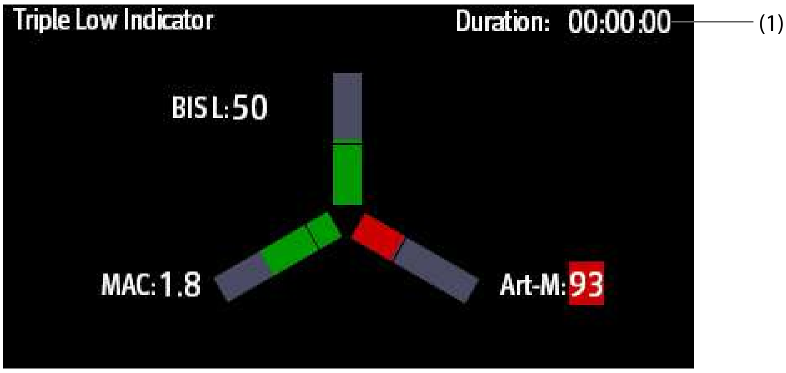
Select **Anesthesia Status** or **Triple Low** to choose the indicator.

The anesthesia status indicator presents the patient's status in terms of pain, consciousness, and neuromuscular blockage.

The triple low indicator presents BIS, MAC and mean pressure. Postoperative mortality and hospital stay are increased in patients having low MAC and low blood pressure. With low BIS value, the postoperative mortality and hospital stay are further increased. (Sessler et al: Hospital Stay and Mortality Are Increased in Patients Having a "Triple Low" of Low bood Pressure, Low Bispectral Index, and Low Minimum Alveolar Concentration of Volatile Anesthesia.Anesthesiology 2012; 116: 1195–203)

The following figures show the anesthesia status indicator and triple low indicator:





(1) Total triple low duration: if BIS, MAC, and Art-M values are lower than the threshold, the patient is in triple low status. For information on setting the triple low threshold, see *34.1.5.5 Setting Thresholds for Triple Low Parameters*.

- The three arms of the anesthesia status indicator respectively indicate pain (Analgesia), consciousness (Sedation), and neuromuscular blockage (Paralysis). You can select parameters for the anesthesia status indicator. For more information, see *34.1.5.2 Selecting Parameters for Anesthesia Status Indicator*.
- The three arms of the triple low indicator respectively indicate BIS, MAC, and mean blood pressure.
- The length of the filling indicates parameter value.
- The color of the arms indicates parameter status: green indicates that parameter value is within normal range. Red indicates that parameter value is beyond normal range. Gray indicates that parameter value is unavailable or invalid.
- The black lines on the parameter arms indicate the normal range of corresponding parameters.

34.1.4 Recovery

You can view parameter trends from the **Recovery** page.

Select **Aldrete Score** to show the latest score and scoring time. To understand the current patient status, select a score for each item and then select **Confirm** to get a new score.

WARNING

- **The Aldrete score and recommendation is for reference only. Clinicians must make the decision of discharging the patient from recovery according to the patient's actual condition.**

34.1.5 Setting the BoA Dashboard

From the BoA Dashboard, you can set the parameters, anesthesia status indicator, and triple low indicator.

34.1.5.1 Selecting Parameters for Viewing Trends

You can view the trends of up to 6 parameters from the **Maintenance** page and **Recovery** page.

To select the parameters you want to view, use either of the following ways:

- Select .
  - Select the **Maintenance** tab or **Recovery** tab to set the parameters you want to view.
  - Selecting **Defaults** resumes the default setting.
- Select a parameter on the trend view, and set which parameter you want to display in this position.

34.1.5.2 Selecting Parameters for Anesthesia Status Indicator

In the anesthesia maintenance stage, you can evaluate the patient's pain status by heart rate and/or blood pressure values. You can evaluate the patient's consciousness status by BIS or MAC value. The muscle relaxant status is evaluated by NMT.

To select parameters for the anesthesia status indicator, follow this procedure:

1. Select .
2. Select the **Maintenance** tab.
3. From the **Parameters** area, set **Analgesia** and **Sedation**.

34.1.5.3 Setting References for Heart Rate and Systolic Blood Pressure

The current heart rate and systolic blood pressure references are displayed as white lines in minitrends area. To set the references, follow this procedure:

1. Select **Set Reference**.
2. Select **Ok** to set the current HR and BP-S measurements as the reference. You can also input HR and BP-S values and then select **Ok**.

You can also follow this procedure to set HR and BP-S reference:

1. Select .
2. Select the **Maintenance** tab.
3. From the **Reference** area, set **HR** and **BP-S**.

34.1.5.4 Setting Thresholds for Anesthesia Status Parameters

To set low limits for triple low parameters, follow this procedure:

1. Select .
2. Select the **Maintenance** tab.
3. From the **Threshold** area, set threshold for each parameter.

34.1.5.5 Setting Thresholds for Triple Low Parameters

To set low limits for triple low parameters, follow this procedure:

1. Select .
2. Select the **Maintenance** tab → **Triple Low** tab.
3. Set low limits for BIS, MAC, and MAP.

34.2 Early Warning Score (EWS)

The Early Warning Scores (EWS) can help you recognize the early sign of deterioration in patients based on vital signs and clinical observations. Depending on the score calculated, appropriate recommendations are displayed.

The monitor supports the following scores:

- MEWS (Modified Early Warning Score)
- NEWS (National Early Warning Score)
- NEWS2 (National Early Warning Score 2)
- Custom Score

There are two types of scoring tools:

- Total score: A subscore is given for each parameter based on the measured or entered value. When all the required parameters are entered or measured, the subscores are added together to calculate the total early warning score. Each subscore has a color coding to indicate associated level of risk, When the total score is outside of the thresholds, actions are recommended. MEWS, NEWS and NEWS2 can give total scores.
- IPS (individual parameter score): A color-coded score is given for each parameter based on the measured or entered value. Each parameter has upper and lower thresholds. When an individual parameter measured or entered is outside of the thresholds, actions are recommended.

Custom Score is based on user-defined parameters. It can be a total score or an IPS, depending on the configuation.

MEWS, NEWS and NEWS2 are intended for adult patients only. The patient category applied to the Custom Score is defined by Mindray Clinical Score Configuration Tool. For more information, see *Mindray Clinical Scoring Config Tool Instruction for Use (P/N: 046-007126-00).*

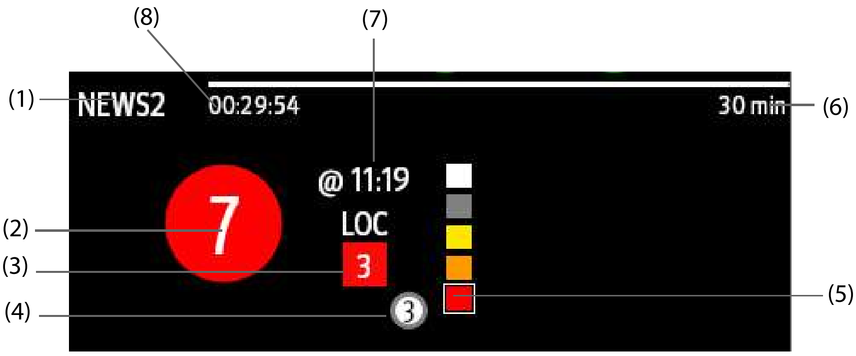
WARNING

- **The EWS scores and recommended actions are for reference only and cannot be directly used for diagnostic interpretation.**
- **EWS cannot be used as an prognosis index. It is not a clinical judgement tool. Clinicians must use their clinical judgement in conjunction with the EWS tool at all times.**
- **MEWS and NEWS are not applicable to pregnant woman, COPD (Chronic Obstructive Pulmonary Disease) patients and patients under 16 years old. NEWS2 is not applicable to pregnant woman and patients under 16 years old.**

34.2.1 Displaying the EWS Numerics Area

To display the EWS numerics area, follow this procedure:

1. Access **Tile Layout** in either of the following ways:
   - Select the **Screen Setup** quick key → select the **Tile Layout** tab.
   - Select the **Main Menu** quick key → from the **Display** column select **Tile Layout**.
2. Select the parameter area where you want to display the EWS score, and then from the popup list select **EWS**.



(1) EWS protocol label

(2) Total score. The color of the circle indicates the level of risk. For IPS, no score is displayed. Only level of risk is shown: white means normal and red indicates alert.

(3) Single parameter whose score reaches 3

(4) Latest history total score

(5) Risk level indicator. The level of risk increases from top down. The current level is enclosed by a white square frame. For IPS, this indicator does not display.

(6) Scoring interval

(7) The current scoring time

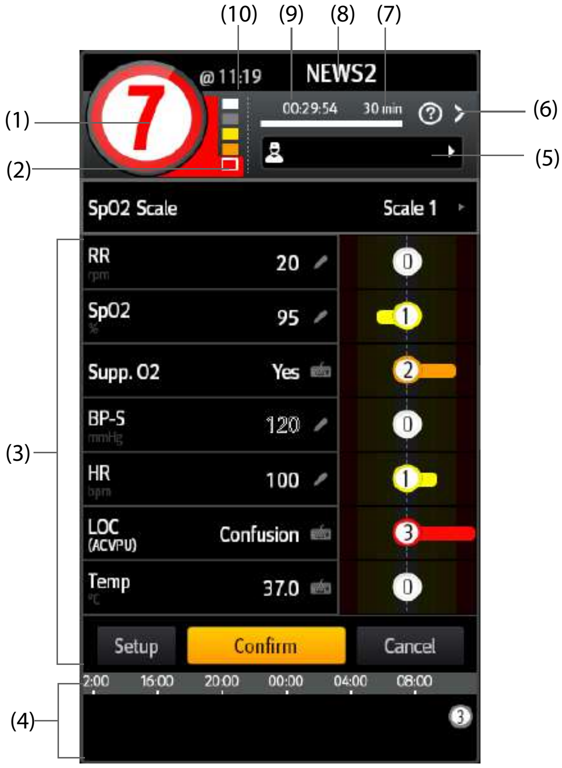
(8) Scoring countdown: time to the next scoring.

34.2.2 Accessing the EWS Screen

Access the EWS window in any of the following ways:

- Select the EWS parameter area
- Select the **EWS** quick key.
- Select the **Screen Setup** quick key → select the **Choose Screen** tab → select **EWS**.
- Select the **Main Menu** quick key → from the **CAA** column select **EWS**.

Take NEWS2 as an example, the EWS screen is shown as follows. Your screen may be slightly different due to the configuration.



(1) Total score. The color of the circle indicates the level of risk. For IPS, no numeric score is displayed. Only level of risk is shown: white means normal and red indicates alert by default.

(2) Risk level indicator. The level of risk increases from top down. The current level is enclosed by a white frame. For IPS, this indicator does not display.

(3) Parameter area: display the subscore and parameter value of each parameter. The keyboard symbol indicates that the parameter value is manually entered.

(4) History total scores

(5) Operator ID (displays only when the operator ID is selected)

(6) Selecting this button to see the clinical response to the current score

(7) Scoring interval

(8) EWS protocol label

(9) Scoring countdown: time to the next scoring.

(10) The scoring time

34.2.3 Performing EWS Scoring

To perform scoring, follow this procedure:

1. Select **Reset** to clear the previous score and update values of currently monitored parameters and relevant subscores.
2. For NEWS2, set the **SpO2 Scale**.
   - ◆ **Scale 1**: for patient without hypercapnic respiratory failure.
   - ◆ **Scale 2**: for patients with a prescribed oxygen saturation requirement of 88–92% (for example, in patients with hypercapnic respiratory failure).
3. Measure or manually enter other required parameters and observations.
4. If enabled, select the operator ID  .
5. Select **Calculate** to get the total score.
6. If **Score Confirmation** is enabled, select **Confirm** to save current scoring, or select **Cancel** to give up current scoring. Refer to section *34.2.5.2 Setting the Scoring Confirmation Switch* for more information.

CAUTION

- **The decision to use Scale 2 of the SpO2 Scale should be made by a competent clinical decision maker and should be recorded in the patient's clinical notes.**

NOTE

- **Before calculating the score, select Reset to clear the previous score.**
- **The keyboard symbol at the right of the parameter value indicates that the value is manually entered.**
- **You can get the score only when all required parameters have been measured or entered.**

34.2.4 EWS Alarm

If enabled, the monitor can automatically give alarms and refreshes the score.

34.2.4.1 Setting the EWS Alarm

If enabled, the monitor can automatically give alarms in the following cases:

- ■ The total score exceeds the configured threshold
- ■ The score of auto obtained parameter is 3.

To configure the EWS alarm, follow this procedure:

1. From the EWS page select **Setup**.
2. Select the **Alarm** tab.
3. Turn on the **Alarm** switch.
4. Set the alarm switches for the single parameters listed in the **3 in single parameter** area.
5. Set the alarm switch and threshold of the total score in the **EWS Score** area.

34.2.4.2 Auto Refreshing Scores

If enabled, the monitor can automatically refresh the score in the following cases:

- ■ The total score reaches the configured threshold, or falls from the configured threshold to a lower score.
- ■ The score of auto obtained parameter reaches 3, or falls from 3 to a lower score.

To enable the auto refreshing score function, follow this procedure:

1. From the EWS page select **Setup**.
2. Select the **Alarm** tab.
3. Turn on the **Auto Refresh Score** switch.

34.2.5 Changing EWS Settings

34.2.5.1 Changing the Scoring Protocol

The monitor is configured with a default scoring protocol. To change the scoring protocol, follow this procedure:

1. From the EWS page select **Setup**.
2. Set **Score**.

34.2.5.2 Setting the Scoring Confirmation Switch

To select if confirmation is required before saving score, follow this procedure:

1. From the EWS page select **Setup**.
2. Set **Scoring Confirmation** switch.
    - ◆ Off: the monitor automatically saves the scoring result after the scoring is completed.
    - ◆ On: you need to confirm that whether the scoring result is saved or not after the scoring is completed.

34.2.5.3 Setting the Manual Data Timeout

The manually input parameter data become invalid after a preset time. To set the timeout period for the input data, follow this procedure:

1. From the EWS screen select **Setup**.
2. From the **Manual Data Timeout** area, select a desired parameter and set its timeout period.

NOTE

- **If the data is expired and not updated, the monitor displays the corresponding parameter score in outline font, and gives a timeout alarm.**

34.2.5.4 Setting Auto Scoring

The monitor automatically starts scoring at the preset interval. To set auto scoring, follow this procedure:

1. From the EWS page select **Setup**.
2. Set **Auto Scoring**:
    - ◆ **Interval**: the monitor automatically starts scoring at the preset interval.
    - ◆ **NIBP**: the monitor automatically starts scoring at the completion of each NIBP measurement.
    - ◆ **Alarm**: the monitor automatically starts scoring when an alarm occurs to the parameter for scoring.
    - ◆ If no option is selected, the monitor does not initiate auto scoring.

34.2.5.5 Setting Auto Scoring Interval

1. From the EWS page select **Setup**.
2. Set **Interval**:
    - ◆ **By Score**: the monitor automatically starts scoring as per the interval selected for corresponding total score.
    - ◆ **5 min** - **24 h**: If **Auto Scoring** is set to **Interval**, the monitor automatically starts scoring as per the selected interval. If **Auto Scoring** is not set to **Interval**, the countdown timer of manual scoring is selected.

34.2.5.6 Managing Operator ID

To manage the Operator ID, follow this procedure:

1. From the EWS page select **Setup**.
2. Select the **Manage Operator ID** button at the bottom left corner to add or delete the operator IDs.

NOTE

- **Manage Operator ID button is available when it is enabled in the Maintenance menu. For more information, see section *39.5 The CAA Settings*.**

34.3 Glasgow Coma Scale (GCS)

The Glasgow Coma Scale (GCS) function is based on 1974_Lancet_ Teasdale Assessment of Coma and Impaired Consciousness-A Practical Scale. Three aspects of behavior are independently measured: eye opening, verbal response, and motor response. The scores are added together to indicate that patient's level of consciousness.

GCS is intended for adults and pediatric patients.

CAUTION

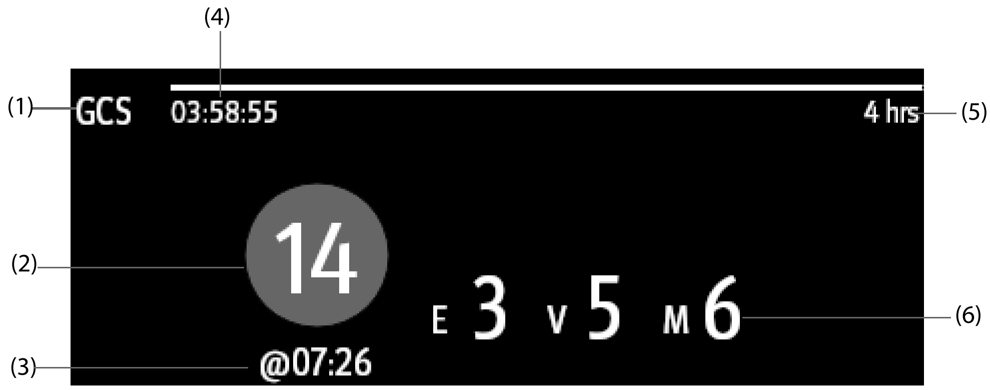
- **GCS is for reference only. Consult other clinical observations for diagnosis.**
- **GCS is not applied to patients that are sedated, muscularly relaxed, with artificial airway, drunk, or in status epilepsies.**
- **GCS is not applied to deaf people and patients having language barrier or with mental disorder.**
- **When applied to children younger than five years old or elder people who are slow, the GCS score might be low.**

34.3.1 Displaying the GCS Parameter Area

To Display the GCS parameter area, follow this procedure:

1. Access **Tile Layout** in either of the following ways:
   - ◆ Select the **Screen Setup** quick key → select the **Tile Layout** tab.
   - ◆ Select the **Main Menu** quick key → from the **Display** column select **Tile Layout**.
2. Select the parameter area where you want to display the GCS score, and then from the popup list select **GCS**.

The following figure shows the GCS parameter area. Your display may be configured to look slightly different.



(1) GCS label

(2) Total score and level of consciousness. The color of the circle indicates the level of risk.

(3) Scoring time

(4) Scoring countdown: time to the next scoring.

(5) Scoring interval

(6) Subscores

- E: eye opening
- V: verbal response
- M: motor response

34.3.2 Accessing the GCS Menu

Enter the GCS menu in any of the following ways:

- Select the GCS parameter area
- Select the **GCS** quick key.
- Select the **Main Menu** quick key → from the **CAA** column select **GCS**.

(1) Subscore (2) Total score

34.3.3 Performing GCS Scoring

To perform scoring, follow this procedure:

1. From the **Eye Opening** area, **Verbal Response** area, and **Motor Response** area, respectively select an item that represents the patient's status.
2. Select **OK** to accept the total score.

   The following table lists the default score range and color of relevant consciousness level.

Level	Range	Color	Description
Mild	13-15	White	The brain function is normal or mildly damaged.
Moderate	9 - 12	Yellow	The brain function is suffered from moderate to severe damage.
Severe	3 - 8	Red	Can be brain death or remain vegetative.

34.3.4 Setting GCS Scoring Interval

From the **GCS** menu, select **Interval** to set GCS scoring interval. When the scoring interval is reached and you do not perform another scoring, the score will be invalid and displayed as outline fonts.

34.3.5 Reviewing GCS Trend Data

From the **GCS** menu, select **Review** to enter the **Review** menu and view the GCS trend data from the **Tabular Trends**.

34.4 SepsisSight™

The SepsisSight™ function is based on Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3) and Surviving Sepsis Campaign: International Guidelines for Management of Sepsis and Septic Shock: 2016 (SSC Guidelines 2016). It assists you in recognizing the early signs and symptoms of sepsis by comparing the state of your patient to the defined criteria and then guides you through the recommended treatment protocol.

The monitor provides SSC screening and recommendations, as well the patient's parameter trends.

SepsisSight™ is intended for adult patients suffering from sepsis or suspicious of sepsis.

CAUTION

- **SepsisSight is not a diagnostic or therapeutic tool and is not intended to replace the competent judgment of a clinician.**

NOTE

- **Due to space limitations on the screen, the recommendations cannot always be reproduced in the full detail available in the printed and on-line guidelines.**

34.4.1 Accessing the SepsisSight Menu

Enter the SepsisSight menu in any of the following ways:

- Select the **SepsisSight** quick key.
- Select the **Main Menu** quick key → from the **CAA** column select **SepsisSight**.

34.4.2 Screening

As per Sepsis-3, SepsisSight supports quick Sepsis-Related Organ Failure Assessment (qSOFA, or quick SOFA) and Sepsis-Related Organ Failure Assessment (SOFA). qSOFA is intended for quickly screening, while SOFA is intended for further screening patients suspicious of sepsis.

34.4.2.1 Performing qSOFA

qSOFA evaluate the patient's respiration rate, systolic blood pressure and altered mental status.

RR and BP-S being monitored are automatically obtained. You can also manually enter these values by selecting the symbol. Select whether the patient's mental status is altered. Then qSOFA score is calculated.

If the qSOFA score is greater than or equal to 2, or sepsis is suspected, select **SOFA>>** to perform SOFA.

NOTE

- **The keyboard symbol indicates that the parameter value is manually entered.**
- **The question mark (?) in the score circle indicates that more parameter values are required.**

34.4.2.2 Performing SOFA

SOFA score is used to identify sepsis-related organ failure.

To perform SOFA, enter the value or select a range for each item, SOFA score will be automatically calculated.

If Sepsis criteria is met, make a comprehensive judgement on the clinical features.

34.4.2.3 Clearing the Current Score

To clear the current qSOFA score or SOFA score, select **Reset**.

34.4.2.4 Changing Screening Settings

From the **Screening** page select **Setup**. You can change the following settings:

- In the **Screening** area, set **RR (rpm)** high limit and **BP-S (mmHg)** low limit for qSOFA scoring.
- In the **Unit** area, set the unit of **Bilirubin** and **Creatinine**.

34.4.3 Recommendations

As per the SSC Guidelines 2016, SepsisSight provides graded recommendations. Pages **Part I** and **Part II** in the SepsisSight screen list these recommendations.

34.4.3.1 Viewing Detailed Recommendations

Select the ••• icon at the right side of each item to view detailed recommendations of SSC Guideline 2016. The star symbol ★ indicates the grade of recommendation:

- ★★: strong recommendation
- ★: weak recommendation
- No ★ symbol: ungraded strong recommendation

34.4.3.2 Marking Implemented Items

Check off implemented items. Then the time and date are automatically recorded and displayed.

- You can select the symbol to change the date and time.
- Select **Reset** to clear the current results.

34.4.4 Reviewing SepsisSight Trend Data

Select the **Graphic Trends** tab to view the trend of parameters of resuscitation.

When a recommended treatment is checked off on the **Part I** page and **Part II** page, relevant event is marked in the tabular trend. Vertical lines of different colors indicate the event type:

- White: inspection performed
- Blue: medication
- Green: goal achieved
- Purple: other treatment

34.5 Rescuing Mode

You can put the monitor into the rescue mode when rescuing a patient. In the rescue mode, the monitor displays the following information:

- Values and waveforms of physiological parameters
- CPR parameters and CQI (CPR quality index) trend
- CPR Dashboard

You can output the rescue report.

The rescue mode is intended for adult and pediatric patients.

WARNING

- **The rescue mode is not intended for neonatal patients.**
- **In the rescue mode, all physiological alarms and part of technical alarms are disabled.**

NOTE

- **Licenses are required for the CQI and CPR Dashboard function.**

- **A responsible nurse is required to record the rescue process. Recording shall not affect patient rescue.**

34.5.1 Entering the Rescue Mode

To enter the rescue mode, choose either of the following ways:

- Select the **Rescue Mode** quick key.
- Select the **Main Menu** quick key → from the **Alarm** column select **Rescue Mode**.

34.5.2 Monitoring CPR

If your monitor is configured with the MPM module with Mindray SpO_2, by monitoring CPR parameters you can know compression quality and the patient's peripheral circulation status when administrating CPR.

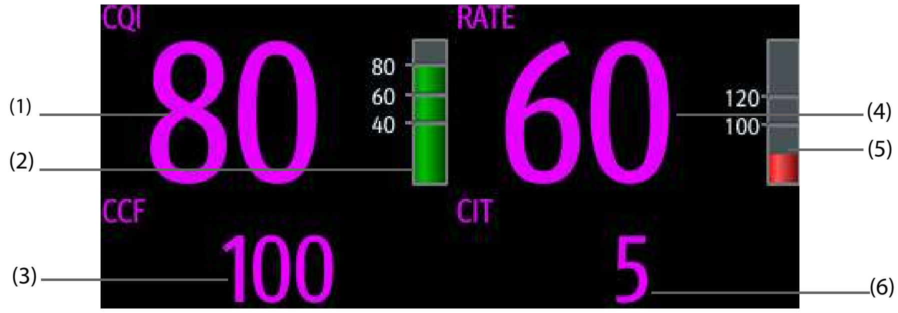
CAUTION

- **Apply the SpO_2 sensor properly. If the sensor is improperly applied or wrong SpO2 sensor is used, erroneous CQI and CPR parameters could result. For more information, refer to *14.3 SpO_2 Measurement Limitations***

34.5.2.1 CPR Parameters

You can monitor the following parameters when administrating CPR:

- CQI: CPR quality index. It indicates the compression quality. The greater the CQI, the better the compression quality.
- RATE: times of chest compression per minute.
- CCF: CPR compression fraction. It indicates the percentage of compression time within the CPR duration.
- CIT: compression interruption time in second.



(1) CQI value

(2) CQI indicator: dark green indicates good compression quality.

(3) CCF: CCF value with no background indicates proper compression time. CCF value with a red background indicates short compression time.

(4) RATE value

(5) RATE indicator: green indicates proper compression rate.

(6) CIT value: CIT value with no background indicates proper interrupt time. CIT value with a red background indicates long interruption.

34.5.2.2 CQI Trend

The following figure shows the CQI trend.

(1) CQI scale

(2) CQI trend: indicates the change of CQI values.

(3) CQI trend length: time span till the current time

34.5.2.3 Setting the CQI Trend Length

To set the CQI trend length, follow this procedure:

1. Select the CPR parameter area to enter the **CPR** menu.
2. Set **Trend Length**.

34.5.3 CPR Dashboard

The CPR Dashboard helps you record the medications and treatments administrated during patient rescue. You can record the following information on the monitor:

- Rescue start time and end time
- The use of drugs, for example adenaline, amiodarone and other drugs
- The administrated treatments, for example, CPR, defibrillation, and other treatments

34.5.3.1 Accessing the CPR Dashboard

If you are entering the rescue mode for the first time, the CPR Dashboard opens automatically. If you have closed the CPR Dashboard, to open it, choose either of the following ways:

- Select the **Main Menu** quick key → from the **CAA** column select **CPR Dashboard**.
- Select the CPR parameter area, from the **CPR** menu, select **CPR Dashboard**.

34.5.3.2 Recording the Rescue Process

To record the rescue process using the CPR Dashboard, do as follows:

- To record the rescue start time: select **Start Rescue**. When entering the rescue mode, the monitor automatically records the rescue start time.
- To record the medications and the doses, select **Adrenaline**, **Amiodarone**, or **Other Drugs** accordingly.
- To record the treatments, select **Start Compression/Pause Compression**, **Defibrillation**, or **Other Treatment** accordingly.
- To record the rescue end time, select **End Rescue**.

34.5.3.3 Saving the Rescue Record

On the CPR Dashboard, select **Save** to save the rescue record.

34.5.3.4 Exporting the Rescue Record

You can export the rescue record using a USB drive. To do so, follow this procedure:

1. For N22/N19, connect the USB drive to the monitor's MSB connector. For N17/N15/N12/N12C, connect the USB drive in to the monitor's USB connector.
2. Select **Export**.

34.5.3.5 Closing the CPR Dashboard

CPR Dashboard automatically closes when you exit the rescue mode. In the rescue mode, if you want to close the CPR Dashboard, choose any of the following ways:

- Select the exit key at the top right corner of the CPR Dashboard.
- Select the **Main Menu** quick key → from the **CAA** column select **Exit CPR Dashboard**.
- Select the CPR parameter area, from the **CPR** menu, select **Exit CPR Dashboard**.

34.5.4 Exit the Rescue Mode

To exit the rescue mode, choose either of the following ways:

- Select the **Exit Rescue Mode** quick key.
- Select the **Main Menu** quick key → from the **Alarm** column select **Exit Rescue Mode**.

34.6 ECG 24h Summary

The ECG 24h Summary provides ECG statistics of the current patient over the latest 24 hours. You can view the following information through the ECG 24h Summary:

- Heart rate statistics
- Arrhythmia event statistics
- QT/QTc measurement statistics
- Maximum and minimum ST statistics of each lead
- Pacer statistics
- Typical ECG strips

NOTE

- **The ECG 24h Summary is intended for the current patient. It is not intended for discharged patients.**
- **Pacer statistics is intended for paced patients.**
- **Patient data is saved, collected and displayed together in the ECG 24h Summary. Data displayed in the ECG 24h Summary is not recalculated.**
- **If BeneView T1 is used to monitor a patient, when BeneView T1 is connected with the host monitor, data sent to the host monitor is not included in the ECG 24h Summary.**
- **A license is required for the ECG 24h Summary function.**

34.6.1 Viewing the ECG 24h Summary

To view the ECG 24h Summary, choose either of the following ways:

- Select the **ECG 24h Sum** quick key.
- Select the **Main Menu** quick key → from the **CAA** column select **ECG 24h Summary**.

34.6.2 Selecting Typical ECG Strips

The **Typical Strips** area displays ECG strips of the following situations:

- Maximum heart rate
- Minimum heart rate
- Four arrhythmia events

You can select a typical ECG strip of each situation. For example, to select the typical ECG strip of asystole, follow this procedure:

1. Select the currently displayed asystole strip.
2. From the popup strips, select the desired strip as the typical strip of asystole.

34.6.3 Reviewing ECG Summary

From the ECG 24h Summary window, you can review corresponding trends and events.

- Select the **Heart Rate** area to review HR graphic trends.
- Select the **Max ST/Min ST** area to review the current ST reference and ST graphic trends.
- Select the **Pace** area to review historic pace events.
- Select the **QT** area to review QT/QTc graphic trends.
- Select the **Arrhythmia** area to review arrhythmia statistics.
- Select **Full Disclosure** to review ECG full disclosure waveforms. For more information, refer to *32.2.8 Full Disclosure Review Page*.

34.7 Pace View

Pace View helps you view pace pulse details, including amplitude, width, shape, and duration.

NOTE

- **The Pace View function is intended for patients with implanted pacemaker. It is available only when Paced is set to Yes.**
- **A license is required for the Pace View function.**

34.7.1 Accessing Pace View

Access Pace View by any of the following ways:

- Select the **Pace View** quick key.
- From the **ECG** menu, select the **Pacer** tab → **Pace View**.
- Select the **Main Menu** quick key → from the **CAA** column select **Pace View**.

34.7.2 Viewing the Current Pace Pulse

From the **Current** page of **Pace View**, view the details of the current pace pulse.

- Select the **Pace Magnifier** tab, view the pace pulse duration.
- Select the **Spike Magnifier** tab, view the amplitude, width, and shape of the pace pulse.

From Pace View, you can perform the following operations:

- Select **Refresh** to obtain the current pace pulse
- Select **Save as Event** to save the current pace as an event.
- Select **Lead** to define the lead you want to view.
- Select the left and right arrows to select pace pulse you want to view.

34.7.3 Viewing Historic Pace Events

To view the details of historic pace events, including pacer not paced, pacer not captured, choose either of the following ways:

- From **Pace View** select the **Event** tab. For more information, see *34.7.1 Accessing Pace View*.
- From **ECG 24h Summary** select the **Pace** area. For more information, see *34.6.1 Viewing the ECG 24h Summary*.

Select the desired event, and then select **Detail** to view pace pulse details of the selected event.

You can also view historic pace events from the **Review** menu. To do so, follow this procedure:

1. From the **Review** menu, select the **Events** tab.
2. Select the desired event, and then select **Detail**.
3. Select **Pace View**.

34.8 InfusionView

InfusionView helps you monitor the patient's vital signs during drug infusion. The monitor provides InfusionView when connecting the Mindray BeneFusion DS5 infusion supervision system via the BeneLink module.

The InfusionView displays the following information:

- Vital sign trends
- Name and flow rate of vital sign related drugs, as well as the time when flow rate is changed
- alarm statistics

NOTE

- **The InfusionView is available only when the BeneFusion DS5 infusion supervision system is used with the BeneFusion SP5 series syringe pumps and VP5 series infusion pumps.**
- **Software requirements of the InfusionView are as follows:**
    - **DS5 infusion supervision system: V06.11 and above**
    - **SP5 series syringe pumps: V04.01 and above**
    - **VP5 series infusion pumps: V05.01 and above**
    - **BeneLink module: V2.9 and above.**
- **A license is required for the InfusionView function.**

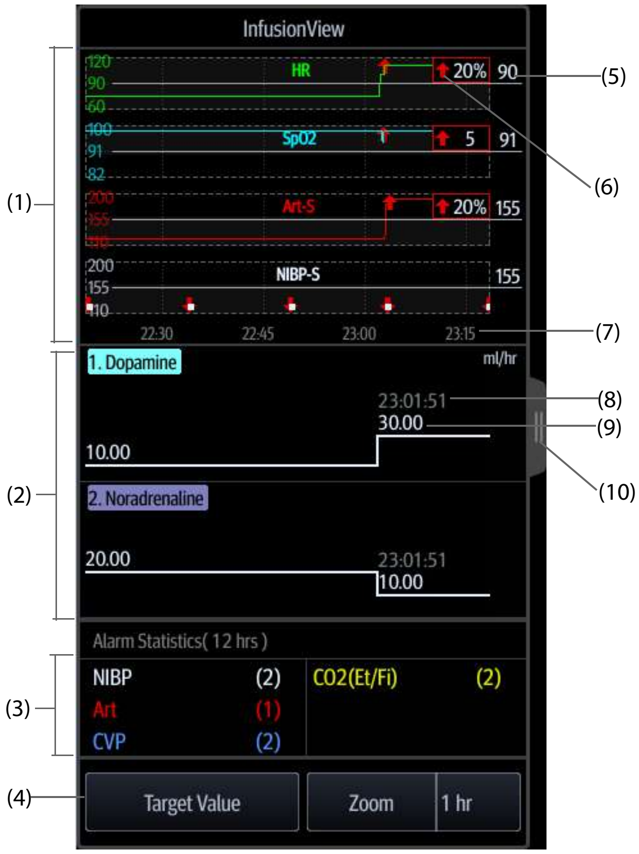
34.8.1 Entering the InfusionView

Choose one of the following methods to enter the InfusionView:

- Select the **InfusionView** quick key.
- Select the **Screen Setup** quick key → select the **Choose Screen** tab→ select **InfusionView**.
- Select the **Main Menu** quick key → from the **Display** column select **Choose Screen** → select **InfusionView**.
- Select the **Main Menu** quick key → from the **CAA** column select **InfusionView**.

34.8.2 The Display of InfusionView

The following figure shows the InfusionView. Your display may be configured to look slightly different.



(1) Parameter minitrends area: displays the minitrends of vital sign parameters.

(2) Drug area: displays the name and flow rate of vital sign related drugs, such as vasoactive drugs, sedative drugs, and antiarrhythmic drugs, as well as the time when the flow rate changes. Dragging this area up and down can view trends of more drugs.

(3) Alarm statistic area: displays the statistics of physiological alarms over the extended minitrend length.

(4) Button area: sets parameter target values and minitrend length.

(5) Target value: expected vital sign value.

(6) Vital sign fluctuation prompt: a red arrow is marked if the parameter value reaches prompt threshold for the set duration. The current mark is enclosed by a red box, If target value settings are changed, the marks update accordingly. The color of history marks turns dark red.

(7) Minitrend time: the length of minitrends displayed on the current screen.

(8) Time when the drug flow rate is changed.

(9) Drug flow rate

(10) Select this symbol to view extended length of vital signs minitrends.

34.8.3 Selecting Trend Parameters and Target Values

To select displayed parameter and target values, follow this procedure:

1. Enter the InfusionView.
2. Select the **Target Value**.
3. Set the following parameters as required:
   - ◆ Select trend parameters: only selected parameters will be displayed.
   - ◆ Set target values: the target values are displayed as white lines.

- Set vital signs fluctuation prompts (thresholds for fluctuation and duration of parameter values): a red arrow is marked if the thresholds are reached.

34.8.4 Setting the Minitrend Length

To change the length of trend data, follow this procedure:

1. Enter the InfusionView.
2. Select **Zoom**.

35 Calculation

35.1 Calculation Overview

The monitor provides calculation functions. The calculated values, which are not directly measured, are computed based on the values you provide. The calculation feature is independent of other monitoring functions and can be therefore used for patients being monitored by other monitors. Any operation in a calculation window does not affect the patient monitored by the current monitor.

You can perform the following calculations:

- Drug calculations
- Hemodynamic calculations
- Oxygenation calculations
- Ventilation calculations
- Renal calculations

35.2 Calculation Safety Information

WARNING

- **Decisions on the choice and dosage of drugs administered to patients must always be made by the physician in charge. The drug calculations are based on the values input, it does not check the plausibility of the calculation performed.**
- **Check that the entered values are correct and the calculated values are appropriate. We assume no responsibility for any consequences caused by wrong entries and improper operations.**

35.3 Drug Calculations

The monitor provides the drug calculation function.

35.3.1 Performing Drug Calculations

To perform drug calculations, follow this procedure:

1. Access drug calculator by either of the following ways:
   - Select the **Calculations** quick key.
   - Select the **Main Menu** quick key → from the **Calculations** column select **Drug**.
2. Set **Drug Name** and **Patient Category.** If the dose of drug is weight dependent, you must input the patient's weight. The dose calculation program has a library of commonly used drugs, of which Drug A through Drug E are user defined.
3. Enter the known values, for example **Drug Amount** and **Solution Volume.**
4. Select **Calculate**. The calculated values are indicated by red arrows.

NOTE

- **If available, the patient category and weight from the Patient Management menu are automatically entered when you first access drug calculation. You can change the patient category and weight. This will not change the patient category and weight stored in the patient demographic information.**

35.3.2 Checking the Titration Table

The titration table shows information on the currently used drugs. Use the titration table to see what dose of a drug your patient will receive at different infusion rates. To access the titration table, follow this procedure:

1. Access drug calculator by either of the following ways:
    - ◆ Select the **Calculations** quick key.
    - ◆ Select the **Main Menu** quick key → from the **Calculations** column select **Drug**.
2. Select the **Titration Table** tab.
3. Select **Dose Type** to set the type of dose unit in the titration table.
4. Select **Interval** to set the interval between two adjacent titration table items.

You can select how to display the titration table:

- ■ **Dose**: the titration table is listed in the sequence of increased drug dose.
- ■ **Infusion Rate**: the titration table is listed in the sequence of increased infusion rate. Normally the resolution of the infusion rate is one (1). By selecting **Exact Rate** the resolution of the infusion rate can reach 0.01 so that you can display the infusion rate more accurately.

35.3.3 Drug Calculation Formula

Description	Unit	Formula
Dose	Dose/hr Dose/min	Dose = Infusion Rate × Concentration
Dose (weight based)	Dose/kg/hr Dose/kg/min	Dose (weight based) = Infusion Rate × Concentration/Weight
Drug Amount	g series: mcg, mg, g unit series: Unit, KU, MU mEq series: mEq	Drug Amount =Dose × Duration
Drug Amount (weight based)	g series: mcg, mg, g unit series: Unit, KU, MU mEq series: mEq	Drug Amount (weight based) = Dose × Duration × Weight
Duration	hr	Duration = Amount/Dose
Duration (weight based)	hr	Duration (weight based) = Amount/(Dose × Weight)
Concentration	mcg/ml, mg/ml, g/ml, Unit/ml, KU/ml, MU/ml, mEq/ml	Concentration = Drug Amount/Solution Volume
Solution volume	ml	Volume = Infusion Rate × Duration
Infusion rate	ml/hr	Infusion Rate = Dose/Concentration
Infusion rate (weight based)	g•ml/hr	Infusion Rate = Dose × Weigh/Concentration

35.3.4 Titration Table Calculation Formula

Description	Unit	Formula
Infusion Rate	ml/hr	Infusion Rate = Dose/Concentration
Infusion Rate (weight based)	ml/hr	Infusion Rate = Weight × Dose/Concentration
Dose	Dose/hr Dose/min	Dose = Infusion Rate × Concentration
Dose (weight based)	Dose/kg/hr Dose/kg/min	Dose (weight based) = INF Rate × Concentration/ Weight

35.4 Hemodynamic Calculations

The monitor provides the hemodynamic calculation function. The monitor can save the results of up to 10 calculations, which are displayed in groups.

35.4.1 Performing Hemodynamic Calculations

To perform hemodynamic calculation, follow this procedure:

1. Access hemodynamic calculation by either of the following ways:
   - Select the **Calculations** quick key → **Hemodynamics** tab.
   - Select the **Main Menu** quick key → from the **Calculations** column select **Hemodynamics**.
2. Enter the known values. For a patient who is being monitored, the currently measured values are automatically taken.
3. Select **Calculate**.

   The calculated value greater than the normal upper limit is indicated by an up arrow "↑". The calculated value lower than the normal lower limit is indicated by a down arrow "↓".

You can select **Range** to show the normal range of each parameter.

35.4.2 Input Parameters for Hemodynamic Calculations

Input Parameter	Label	Unit
cardiac output	C.O.	L/min
heart rate	HR	bpm
pulmonary artery wedge pressure	PAWP	mmHg
artery mean pressure	PMAP	mmHg
pulmonary artery mean pressure	PA Mean	mmHg
central venous pressure	CVP	mmHg
end-diastolic volume	EDV	ml
height	Height	cm
weight	Weight	kg

NOTE

- **If you enable Use PA-D as PAWP, PA-D value will be used to replace PAWP value for hemodynamic calculation. For more information, refer to *17.6.8 Setting the Use PA-D as PAWP Switch*.**

35.4.3 Calculated Parameters and Formulas for Hemodynamic Calculations

Calculated Parameters	Label	Unit	Formula
cardiac index	C.I.	L/min/m^2	C.I. (L/min/m^2) = C.O. (L/min)/BSA (m^2)
body surface area	BSA	m^2	BSA (m^2) = $Wt^{0.425}$ (kg) × $Ht^{0.725}$ (cm) × 0.007184
stroke volume	SV	ml	SV (ml) = 1000× C.O. (L/min)/HR (bpm)
stroke index	SVI	ml/m^2	SVI (ml/m^2) = SV (ml)/BSA (m^2)
systemic vascular resistance	SVR	DS/cm^5	SVR (DS/cm^5) = 79.96 × [APMAP (mmHg) - CVP (mmHg)]/C.O. (L/min)

Calculated Parameters	Label	Unit	Formula
systemic vascular resistance index	SVRI	DS•m^2/cm^5	SVRI (DS•m^2/cm^5) = SVR (DS/cm^5) × BSA (m^2)
pulmonary vascular resistance	PVR	DS/cm^5	P VR (DS/cm^5) = 79.96 × [PAMAP (mmHg) - PAWP (mmHg)]/C.O. (L/min)
pulmonary vascular resistance index	PVRI	DS•m^2/cm^5	PVRI (DS•m^2/cm^5) = PVR (DS/cm^5)× BSA (m^2)
left cardiac work	LCW	kg•m	LCW (kg•m) = 0.0136 × APMAP (mmHg) × C.O. (L/min)
left cardiac work index	LCWI	kg•m/m^2	LCWI (kg•m/m^2) = LCW (kg•m)/BSA (m^2)
left ventricular stroke work	LVSW	g•m	LVSW (g•m) = 0.0136 × APMAP (mmHg) × SV (ml)
left ventricular stroke work index	LVSWI	g•m/m^2	LVSWI (g•m/m^2) = LVSW (g.m)/BSA (m^2)
right cardiac work	RCW	kg•m	R CW (kg•m) = 0.0136 × PAMAP (mmHg) × C.O. (L/min)
right cardiac work index	RCWI	kg•m/m^2	R CWI (kg•m/m^2) = RCW (kg.m)/BSA (m^2)
right ventricular stroke work	RVSW	g•m	R VSW (g•m) = 0.0136 × PAMAP (mmHg) × SV (ml)
right ventricular stroke work index	RVSWI	g•m/m^2	R VSWI (g•m/m^2) = RVSW (g•m)/BSA (m^2)
ejection fraction	EF	%	EF (%) = 100 × SV (ml)/EDV (ml)
End-diastolic volume index	EDVI	ml/m2	EDVI (ml/m^2) = EDV (ml)/BSA (m^2)
End-systolic Volume	ESV	ml	ESV (ml) = EDV (ml) –SV (ml)
End-systolic Volume index	ESVI	ml/m^2	ESVI (ml/m^2) = ESV (ml)/BSA (m^2)

35.5 Oxygenation Calculations

The monitor provides the oxygenation calculation function. The monitor can save the results of up to 10 calculations, which are displayed in groups.

35.5.1 Performing Oxygenation Calculations

To perform oxygenation calculations, follow this procedure:

1. Access oxygenation calculation by either of the following ways:
   - Select the **Calculations** quick key → **Oxygenation** tab.
   - Select the **Main Menu** quick key → from the **Calculations** column select **Oxygenation**.
2. Enter the known values. For a patient who is being monitored, the currently measured values are automatically taken.
3. Select **Calculate**.

   The calculated value greater than the normal upper limit is indicated by an up arrow "↑". The calculated value lower than the normal lower limit is indicated by a down arrow "↓".

In the **Oxygenation** page, you can also perform the following operations:

- Select **Oxycont Unit**, **Hb Unit**, and **Pressure Unit**. Then corresponding parameter values will be automatically converted and updated accordingly.
- Select **Range** to show the normal range of each parameter.

35.5.2 Input Parameters for Oxygenation Calculations

Input Parameter	Label	Unit
cardiac output	C.O.	L/min
percentage fraction of inspired oxygen	FiO_2	%
partial pressure of oxygen in the arteries	PaO_2	mmHg, kPa
partial pressure of carbon dioxide in the arteries	$PaCO_2$	mmHg, kPa
arterial oxygen saturation	SaO_2	%
partial pressure of oxygen in venous blood	PvO_2	mmHg, kPa
venous oxygen saturation	SvO_2	%
hemoglobin	Hb	g/L, g/dl, mmol/L
respiratory quotient	RQ	None
atmospheric pressure	ATMP	mmHg, kPa
height	Height	cm, inch
weight	Weight	kg, lb

35.5.3 Calculated Parameters and Formulas for Oxygenation Calculations

Calculated Parameters	Label	Unit	Formula
body surface area	BSA	m^2	BSA (m^2) = $Wt^{0.425}$ (kg) × Ht $^{0.725}$ (cm) × 0.007184
oxygen consumption	VO_2	ml/min	VO_2 (ml/min) = C(a-v)O_2 (ml/L)× C.O. (L/min))
arterial oxygen content	CaO_2	ml/L, ml/dL	CaO_2 (ml/L) = 10× (0.0134 × Hb (g/dl) × SaO_2 (%)) +0.031× PaO_2 (mmHg)
venous oxygen content	CvO_2	ml/L, ml/dL	CvO_2 (ml/L) = 10× (0.0134 × Hb (g/dl) × SvO_2 (%)) +0.031 × PvO_2 (mmHg)
arteriovenous oxygen content difference	C(a-v)O_2	ml/L, ml/dl	C(a-v)O_2 (ml/L) = CaO_2 (ml/L) - CvO_2 (ml/L)
oxygen extraction ratio	O_2ER	%	O_2ER (%) = 100×C(a-v)O_2 (ml/L)/CaO_2 (ml/L)
oxygen transport	DO_2	ml/min	DO_2(ml/min) = C.O. (L/min) × CaO_2(ml/L)
partial pressure of oxygen in the alveoli	PAO_2	mmHg, kPa	PAO_2 (mmHg) = [ATMP (mmHg) - 47 mmHg] × FiO_2 (%)/100 - $PaCO_2$ (mmHg) × [FiO_2 (%)/100 + (1 - FiO_2 (%)/100)/RQ]
alveolar-arterial oxygen difference	$AaDO_2$	mmHg, kPa	$AaDO_2$ (mmHg) = PAO_2 (mmHg) - PaO_2 (mmHg)
capillary oxygen content	CcO_2	ml/L, ml/dl	CcO_2 (ml/L) = Hb (g/L) × 1.34 + 0.031 × PAO_2 (mmHg)
venous admixture	QS/QT	%	QS/QT (%) = 100× [1.34 × Hb (g/L) × (1 - SaO2 (%)/100) + 0.031 × (PAO2 (mmHg) - PaO2 (mmHg))]/[1.34 × Hb (g/L) × (1 - SvO2 (%)/100) + 0.031× (PAO2 (mmHg) - PvO2 (mmHg))]
oxygen transport index	DO_2I	ml/min/m^2	DO2I (ml/min/m^2) = CaO2 (ml/L) × (C.O. (L/min)/BSA (m^2))
oxygen consumption	VO_2I	ml/min/m^2	VO2I (ml/min/m^2) = C (a-v) O2 (ml/L) ×(C.O. (L/min)/BSA (m^2))

35.6 Ventilation Calculations

The monitor provides the ventilation calculation function. The monitor can save the results of up to 10 calculations, which are displayed in groups.

35.6.1 Performing Ventilation Calculations

To perform ventilation calculations, follow this procedure:

1. Access ventilation calculation by either of the following ways:
   - Select the **Calculations** quick key → **Ventilation** tab.
   - Select the **Main Menu** quick key → from the **Calculations** column select **Ventilation**.
2. Enter the known values. For a patient who is being monitored, the currently measured values are automatically taken. If the anesthesia machine or ventilator is connected, measured values for ventilation calculation are also automatically taken.
3. Select **Calculate**.

   The calculated value greater than the normal upper limit is indicated by an up arrow "↑". The calculated value lower than the normal lower limit is indicated by a down arrow "↓".

On the **Ventilation** page, you can also perform the following operations:

- Select **Pressure Unit**. Then corresponding parameter values will be automatically converted and updated accordingly.
- Select **Range** to show the normal range of each parameter.

35.6.2 Input Parameters for Ventilation Calculations

Input Parameter	Label	Unit
percentage fraction of inspired oxygen	FiO_2	%
respiration rate	RR	rpm
partial pressure of mixed expiratory CO2	$PeCO_2$	mmHg, kPa
partial pressure of carbon dioxide in the arteries	$PaCO_2$	mmHg, kPa
partial pressure of oxygen in the arteries	PaO_2	mmHg, kPa
tidal volume	TV	ml
respiratory quotient	RQ	None
atmospheric pressure	ATMP	mmHg, kPa

35.6.3 Calculated Parameters and Formulas for Ventilation Calculations

Calculated Parameters	Label	Unit	Formula
partial pressure of oxygen in the alveoli	PAO_2	mmHg, kPa	PAO_2 (mmHg) = [ATMP (mmHg) - 47 mmHg] × FiO_2 (%)/100 - $PaCO_2$ (mmHg) × [FiO_2(%)/100 + (1 - FiO_2 (%)/100)/RQ]
alveolar-arterial oxygen difference	$AaDO_2$	mmHg, kPa	$AaDO_2$ (mmHg) = PAO_2 (mmHg) - PaO_2 (mmHg)
oxygenation ratio	Pa/FiO_2	mmHg, kPa	Pa/FiO_2(mmHg) = 100 × PaO_2 (mmHg)/FiO_2 (%)
arterial to alveolar oxygen ratio	a/AO_2	%	a/AO_2 (%) = 100 × PaO_2 (mmHg)/PAO_2 (mmHg)
minute volume	MV	L/min	MV (L/min) = [TV (ml) × RR (rpm)]/1000

Calculated Parameters	Label	Unit	Formula
volume of physiological dead space	Vd	ml	Vd (ml) = TV (ml) × [1 - $PeCO_2$ (mmHg)/$PaCO_2$ (mmHg)]
physiologic dead space in percent of tidal volume	Vd/Vt	%	Vd/Vt (%) = 100 × Vd (ml)/TV (ml)
alveolar volume	VA	L/min	VA (L/min) =[TV (ml) - Vd (ml)] × RR (rpm)/ 1000

35.7 Renal Calculations

The monitor provides the renal calculation function. The monitor can save the results of up to 10 calculations, which are displayed in groups.

35.7.1 Performing Renal Calculations

To perform renal calculations, follow this procedure:

1. Access renal calculation by either of the following ways:
   - ◆ Select the **Calculations** quick key → select the **Renal** tab.
   - ◆ Select the **Main Menu** quick key → from the **Calculations** column select **Renal**.
2. Enter the known values. .
3. Select **Calculate**.

   The calculated value greater than the normal upper limit is indicated by an up arrow "↑". The calculated value lower than the normal lower limit is indicated by a down arrow "↓". You can select **Range** to show the normal range of each parameter.

35.7.2 Calculated Parameters and Formulas for Renal Calculations

Input Parameter	Label	Unit
urine pstassium	URK	mmol/L
urinary sodium	URNa	mmol/L
urine	Urine	ml/24 hrs
plasm osmolality	Posm	mOsm/kgH_2O
urine osmolality	Uosm	mOsm/kgH_2O
serum sodium	SerNa	mmol/L
creatinine	Cr	μmol/L
urine creatinine	UCr	μmol/L
blood urea nitrogen	BUN	mmol/L
height	Height	cm
weight	Weight	kg

35.7.3 Calculated Parameters and Formulas for Renal Calculations

Calculated Parameters	Label	Unit	Formula
urine sodium excretion	URNaEx	mmol/24 hrs	URNaEx (mmol/24 hrs) = Urine (ml/24 hrs) × URNa (mmol/L)/1000
urine potassium excretion	URKEx	mmol/24 hrs	URKEx (mmol/24 hrs) = Urine (ml/24 hrs) × URK (mmol/L)/1000
sodium potassium ratio	Na/K	%	Na/K (%) = 100 × URNa (mmol/L)/URK (mmol/L)
clearance of sodium	CNa	ml/24 hrs	CNa (ml/24 hrs) = URNa (mmol/L) × Urine (ml/24 hrs)/SerNa (mmol/L)
creatinine clearance rate	Clcr	ml/min	Clcr (ml/min) = Ucr (μmol/L) × Urine (ml/24 hrs)/[Cr (μmol/L) × (BSA (m^2)/1.73) × 1440]
fractional excretion of sodium	FENa	%	FENa (%) = 100 × URNa (mmol/L) × Cr (μmol/L)/[SerNa (mmol/L) × Ucr (μmol/L)]
osmolar clearance	Cosm	ml/min	Cosm (ml/min) = Uosm (mOsm/kgH_2O) × Urine (ml/24 hrs)/(Posm (mOsm/kgH_2O) × 1440)
free water clearance	CH2O	ml/hr	CH2O (ml/hr) = Urine (ml/24 hrs) × [1 - Uosm (mOsm/kgH_2O)/Posm (mOsm/kgH_2O)]/24
urine to plasma osmolality ratio	U/P osm	None	U/P osm = Uosm (mOsm/kgH_2O)/Posm (mOsm/kgH_2O)
blood urea nitrogen creatinine ratio	BUN/Cr*	Mmol/L	BUN/Cr = 1000 × BUN (mmol/L)/Cr (μmol/L)
urine-serum creatinine ratio	U/Cr	None	U/Cr (mmol/L) = Ucr (μmol/L)/Cr (μmol/L)

*: BUN/Cr is a ratio at mol unit system.

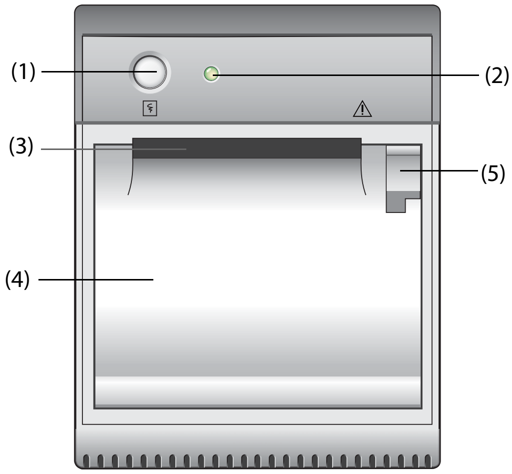
36 Recording

36.1 Recorder

The thermal recorder records patient information, measurement data, and up to three waveforms.

N17/N15/N12/N12C can be configured with a built-in recorder. If the recorder is not configured, you can insert an external recorder module into the SMR to perform recording.

N22 and N19 do not have a built-in recorder. To perform recording, insert the recorder module into the SMR.



(1) Start/Stop key: press to start a recording or stop the current recording.

(2) Module status indicator

- On: when the recorder works correctly.
- Off: when the monitor is switched off.
- Flashes: if an error occurred to the recorder.

(3) Paper outlet

(4) Recorder door

(5) Latch: pull it backward to open the recorder door.

36.2 Starting Recordings

Recordings can be started manually or automatically.

36.2.1 Manually Starting Recordings

To manually start a recording, you can either:

- Press the hardkey on the front of the recorder.
- Select on the current page.

36.2.2 Automatic Recordings

In the following conditions, you can set the recorder to automatically start recording:

- At a preset interval. For more information, see *36.5 Setting the Recorder*.
- When a parameter alarm is triggered. For more information, see *36.6 Enabling Auto Recording on Alarm*.

36.3 Stopping Recordings

Recordings can be stopped manually or automatically.

36.3.1 Stopping Recordings Manually

To manually stop a recording, choose either of the following method:

- Press the hardkey again.
- select **Clear All Tasks** in the **Record Setup** menu.

36.3.2 Stopping Recordings Automatically

Recordings stop automatically in the following conditions:

- The recording is completed.
- The recorder runs out of paper.
- The recorder has an alarm condition.

36.4 Recording Related Flags

You can find the following flags on the recording reports:

- For automatically stopped recordings, there are two columns of asterisks "*" at the end of the report.
- For manually or abnormally stopped recordings, there is one column of asterisks "*" at the end of the report.
- If the parameter data is from external devices connected to the monitor via the BeneLink module, the parameter label is prefixed with the plus sign "+".

36.5 Setting the Recorder

To set the recorder, follow this procedure:

1. Select the **Main Menu** quick key → from the **Report** column select **Record Setup**.
2. In the **Record Setup** menu, select the desired waveform for **Waveform 1**, **Waveform 2** and **Waveform 3** in turn. The recorder can record up to 3 waveforms at a time.
3. Switch on or off **IBP Overlap** to enable or disable IBP recordings in the overlapping format.
   - When the **IBP Overlap** is enabled: If two or more waveforms in the selected waveforms for recording are IBP waveforms, the IBP waveforms will be recorded in the overlapping format.
   - When the **IBP Overlap** is disabled: IBP waveforms will be recorded normally.
4. Select **Length** to set the duration of real-time recording.
5. Select **Interval** to set the time interval for automatic recording.
6. Select **Paper Speed** to set the speed for recording waveforms.

36.6 Enabling Auto Recording on Alarm

To initiate automatic recording via recorder when a parameter alarm is triggered, follow this procedure:

1. Access the **Alarm** menu for the desired parameter in one of the following ways:
   - Select the **Alarm Setup** quick key at the bottom of the screen.
   - Select the numerics area or waveform area of the desired parameter → select the **Alarm** tab.
   - Select the **Parameters Setup** quick key → select the desired parameter → select the **Alarm** tab.
2. Switch on **Alarm Outputs**.

NOTE

- **Auto recording on alarm happens only when Print on Alarm is set to Recorder. For more information, see *39.4.6 The Other Tab*.**

36.7 Clearing Recording Tasks

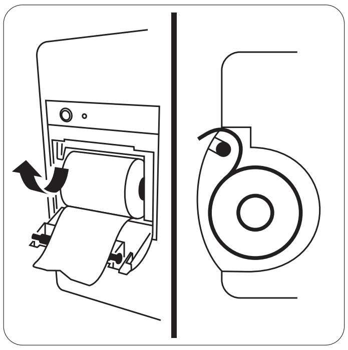
To clear recording tasks, follow this procedure:

1. Select the **Main Menu** quick key → from the **Report** column select **Record Setup**.
2. In the **Record Setup** menu, select **Clear All Tasks**. This clears all queued recording tasks and stops the current recording.

36.8 Loading Paper

To loader paper, follow this procedure:

1. Use the latch at the upper right of the recorder door to pull the door open.
2. Insert a new roll into the compartment as shown below. Feed the paper through and pull some paper out from the top of the roller.
3. Close the recorder door.



CAUTION

- **Use only specified thermal paper. Otherwise, it may cause damage to the recorder's printhead, the recorder may be unable to print, or poor print quality may result.**
- **Never pull the recorder paper with force when a recording is in process. Otherwise, it may cause damage to the recorder.**
- **Do not leave the recorder door open unless you reload paper or remove troubles.**

36.9 Removing Paper Jam

If the recorder works incorrectly or produces unusual sounds, check if there is a paper jam first. If a paper jam is detected, follow this procedure to remove it:

1. Open the recorder door.
2. Take out the paper and tear off the draped part.
3. Reload the paper and close the recorder door.

37 Printing

The monitor can output patient reports via network printer or print server.

37.1 Supported Printer

The monitor supports the following printer:

- HP LaserJet Pro M202dw
- HP LaserJet Pro M203dn
- HP LaserJet Pro M203dw
- HP LaserJet Enterprise M605
- HP LaserJet P4015n
- HP LaserJet Pro 400 M401n
- HP LaserJet Pro 403n
- HP LaserJet 600 M602

NOTE

- **For more details about the printer, see the document accompanying the printer. With product upgrades, the monitor may support more printers and no prior notice will be given. If you have any doubt about the printer you have purchased, contact Mindray.**

37.2 End Case Reports

37.2.1 Printing the End Case Report

To print the end case report, choose one of the following ways:

- Select **Print** from the **End Case Report** menu.
- Select **Print End Case Report** when you discharge a patient
- Select the **End Case Report** quick key.

37.2.2 Setting a Report as An End Case Report

The following reports can be set as end case reports:

- Tabular Trends Report
- Graphic Trend Report
- Event Report
- 12-lead Interpretation
- Alarm Limits Report
- Realtime Report
- ECG Report

To set a report as an end case report, follow this procedure:

1. Select the **Main Menu** quick key → from the **Report** column select **End Case Report**.
2. From the **Select Reports** page, select the checkbox before the desired report, for example **ECG Report**.

37.2.3 Setting the End Case Report

To set the end case report, follow this procedure:

1. Select the **Main Menu** quick key → from the **Report** column select **End Case Report**.
2. From the **Report Setup** page, set the following end case reports:
   - ◆ Select the **Tabular Trends Report**, **Graphic Trends Report**, **Realtime Report**, and **ECG Report** tab, and set these end case report by referring to section *37.6 Setting Reports*.
   - ◆ Select the **Event Report** tab, and select the event that needs to be printed.
   - ◆ Select the **12-Lead Interpretation** tab, and set the switch of **Median Complex**, **Measurements**, **Interpretation**, or **Interpretation Summary**. For other settings, refer to section *37.6 Setting Reports*.

37.2.4 Setting the End Case Report Period

To set the end case report print period, follow this procedure:

1. Select the **Main Menu** quick key → from the **Report** column select **End Case Report**.
2. From the **Select Reports** page, set the **Period**.

NOTE

- **End case report print period is calculated from the patient discharged time to the configured period.**
- **Period setting is applicable to all of the end case report.**

37.3 Manually Starting a Printing Task

You can start a printing task manually.

37.3.1 Starting Printing from the Current Page

From the current page, select the  button, if available, to start printing.

37.3.2 Printing Realtime Reports

Select the **Print** quick key to print a realtime report. You can also print a realtime report from the **Report Setup** page. For more information, see *37.3.3 Printing Normal Reports*.

37.3.3 Printing Normal Reports

Normal reports refers to the following types of reports:

- ■ ECG Report
- ■ Realtime Report
- ■ Tabular Trends Report
- ■ Graphic Trend Report.

To print normal reports, follow this procedure:

1. Select the **Main Menu** quick key →from the **Report** column select **Report Setup**.
2. Select the desired report tab.
3. Check the settings.
4. Select **Print**.

37.4 Automatically Printing Reports

When a parameter alarm switch is set to on and an alarm is triggered for this parameter, you can set a printer to start alarm printing automatically.

To do so, follow this procedure:

1. Access alarm related tabs such as the **Alarm** tab for a parameter in one of the following ways:
   - Select the **Alarm Setup** quick key at the bottom of the screen.
   - Select the parameter or waveform area of the desired parameter → select the **Alarm** tab.
   - Select the **Parameters Setup** quick key at the bottom of the screen → select the desired parameter → select the **Alarm** tab.
2. Switch on **Alarm outputs** for desired parameters.

37.5 Stopping a Printing Task

To stop a printing task, follow this procedure:

1. Select the **Main Menu** quick key → from the **Report** column select **Print Queue**.
2. Select desired printing tasks and then select **Delete**. Selecting **Delete All** to stop all the printing tasks.

37.6 Setting Reports

This section focuses on how to set ECG reports, realtime reports, tabular trends reports, and graphic trends reports.

37.6.1 Setting ECG Reports

To set ECG reports, follow this procedure:

1. Select the **Main Menu** quick key → from the **Report** column select **Report Setup**.
2. Select **ECG Report**.
3. Set the desired options. The following table only lists some of the options.

Menu item	**Function**	**Description**
Speed	Set the print speed of ECG waveforms	25 mm/sec: prints 25 mm of ECG waveform per second. 50 mm/sec: prints 50 mm of ECG waveform per second.
Auto Interval	Defines the spacing between the ECG waveforms on a printout	**On:** automatically adjusts the space between waveforms to avoid overlapping. **Off**: each waveform area has the same size on a printout.
	Note: This setting is only relevant when **12×1** is selected for **12-Lead Format**.	
12-Lead Format	Select the format of 12-lead ECG waveforms on a printout.	**12×1:** displays 12-lead ECG waveforms on one page in one column. **6×2**: displays 12-lead ECG waveforms on one page in two columns, with 6 lines in each column. **6×2+1**: displays 12-lead ECG waveforms on one page in two columns, with 6 lines in each column, and one rhythm lead waveform at the bottom. **3×4+1**: displays 12-lead ECG waveforms on one page in 4 columns, with 3 lines in each column, and one rhythm lead waveform at the bottom. **3×4+3**: displays 12-lead ECG waveforms on one page in 4 columns, with 3 lines in each column, and three rhythm lead waveforms at the bottom.
Rhythm Lead 1 Rhythm Lead 2 Rhythm Lead 3	Select the lead that will be used as Rhythm Lead 1, 2, or 3.	I, II, III, aVR, aVL, aVF, V1, V2, V3, V4, V5, V6
	Note: This setting is only relevant when **6×2+1**,**3×4+1**, or **3×4+3** is selected for **12-Lead Format**.	
Format sequence	Select the recording method of ECG report generated by auto measurement	**Sequential**: 12-lead ECG data are recorded sequentially and displayed in 3 lines and 4 columns with 2.5 seconds of ECG data for each column. **Simultaneous**: Record simultaneous 12-lead ECG data.

NOTE

- **When ECG Lead Set is set to 3-Lead, ECG report cannot be printed.**

37.6.2 Setting Realtime Reports

To set tabular realtime reports, follow this procedure:

1. Select the **Main Menu** quick key → from the **Report** column select **Report Setup**.
1. Select **Realtime Report**.
2. Set the desired options. The following table only list some of the options.

Menu item	Function	Description
Select Waveform	Select the desired waveform to print	**Current Waveforms**: prints the realtime report for current waveforms. **Selected Waveforms**: prints the realtime report for the selected waveforms.

37.6.3 Setting Tabular Trends Reports

To set tabular trends reports, follow this procedure:

1. Select the **Main Menu** quick key → from the **Report** column select **Report Setup**.
2. Select **Tabular Trends Report**.
3. Set the desired options. The following table only list some of the options.

Menu Item	Function	Description
Period	Select the period during which a tabular trends report will be printed.	**Auto**: one page of a tabular trends before the current time will be printed at the selected **Interval**. **All**: all stored tabular rends will be printed at the selected **Interval**. **30 min** to **90 hrs**: 30 min to 96 hrs of tabular trends before the selected **Time** will be printed at the selected **Interval**.
Interval	Select the resolution of the tabular trends printed on a report.	**NIBP, EWS**, **GCS**, **TempIF**, **C.O**.: at an interval of acquiring the values of selected parameter.. **Auto**: using the **Interval** setting of the **Tabular Trends** review page. **5 sec** to **3 hrs**: the tabular trends will be printed at the interval of **5 sec** to **3 hrs**.
Report Format	Select the printing principle.	**Parameter Oriented**: parameter values are listed vertically and trend time is listed horizontally.. **Time Oriented**: trend time is listed vertically and parameter values are listed horizontally.

37.6.4 Setting Graphic Trends Reports

To set graphic trends reports, follow this procedure:

1. Select the **Main Menu** quick key → from the **Report** column select Report Setup.
2. Select **Graphic Trends Report**.

3. Set the desired options.

Menu Item	Function	Description
Period	Select the period during which a graphic trends report will be printed.	**Auto**: one page of a graphic trends before the current time will be printed. **All**: all stored graphic rends will be printed.. **30 min** to **90 hrs**: 30 min to 96 hrs of graphic trends before the selected **Time** will be printed.

37.7 Viewing Printer Status

You can view the status of the recent ten printing tasks in the **Print Queue** window. To view the status of printing tasks, select the **Main Menu** quick key, from the **Report** column select **Print Queue**.

Each printing task includes the following information:

- Print time
- Report title
- Printer name (when using the print server) or IP address (when using the network printer)
- Printing status, for example, printing, failed, retrying, and waiting.

37.8 Printer Out of Paper

When the printer runs out of paper, the print request will not be responded. If there are too many print jobs that are not responded, a printer error may occur. In these cases, you need to install paper and then re-send the print request. Restart the printer if necessary.

Therefore, you'd better ensure that there is enough paper in the printer before sending a print request.

This page intentionally left blank.

38 Using the On-Screen Timers

The monitor has a Timer function to notify you when a preset time period is expired. You can simultaneously display up to four timers.

38.1 Displaying Timers

To display a timer, follow this procedure:

1. Access **Tile Layout** in either of the following ways:
   - ◆ Select the **Screen Setup** quick key → select the **Tile Layout** tab.
   - ◆ Select the **Main Menu** quick key → from the **Display** column select **Tile Layout**.
2. Click the parameter area where you want to display the timer, and then select a timer from the popup list.

38.2 Controlling the Timer

The timer provides the following controls:

- ■ **Start**: starts the timer.
- ■ **Pause**: pauses the timer.
- ■ **Resume**: resumes the timer.
- ■ **Reset**: clears the timer and end this timer episode.

WARNING

- **Do not use the timers to schedule critical patient-related tasks.**

38.3 Setting the Timer

You can set each timer independently. To set the timer, follow this procedure:

1. Select the timer area to enter the **Timer Setup** menu.
2. Set **Timer Type**:
   - ◆ **Normal**: The timer has a single and defined run time, and stops when the run time is reached.
   - ◆ **Advanced**: The timer has a single and defined run time. When the run time is reached, the timer continuously displays the time beyond the end of run time.
   - ◆ **Cycled**: The timer has a single and defined run time. When the run time is reached, the timer restarts automatically. The cycles is also displayed.
   - ◆ **Unlimited**: The timer displays the time elapsed since the timer was started.
   - ◆ **Clock**: The timer displays the system time.
3. Set **Direction**.
   - ◆ **Down**: the timer counts down.
   - ◆ **Up**: the timer counts up.
4. Set **Run Time**.
5. Set **Reminder Volume**. A progress bar is shown with the run time. When the remaining time is 10 seconds, the monitor issues a reminder tone and the timer flashes in red, prompting you that the run time is to expire.

NOTE

- **You cannot change timer settings when a timer is running.**
- **You can set Direct, Run Time, and Reminder Volume only for normal, advanced, and cycled timers.**

39 User Maintenance Settings

User maintenance enables you to customize your equipment to best meet your needs. Accessing the **Maintenance** menu is password protected.

This chapter describes the settings and functions in the **Maintenance** menu.

CAUTION

- **The maintenance settings can only be changed by authorized personnel. Contact your department manager or biomedical engineering department for the passwords used at your facility.**

39.1 Accessing the Maintenance Menu

To perform user maintenance, follow this procedure:

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select desired tab.

39.2 The Device Location Settings

Menu Item	Default Setting	Description
Monitor Name	/	/
Facility		
Department		
Location	Fixed	• **Fixed**: the **Patient Management** dialog displays Bed No. and Room No., but you cannot change them. • **Unfixed**: you can change Bed No. and Room No. from the **Patient Management** dialog.
Room No.	/	/
Bed No.		

NOTE

- **If Location is set to Unfixed, Bed No. and Room No. are cleared each time you discharge a patient.**

39.3 The Patient Management Settings

39.3.1 The Field Tab

Menu Item	Default Setting	Description
Room No	Unselected	Selects which items can be displayed and edited from the **Patient Management** menu.
Visit Number	Unselected	
Patient ID	Selected	
Middle Name	Unselected	
Race	Unselected	
Age	Selected	
Custom Filed 1 -Custom Filed4	Unselected	

NOTE

- **If the monitor is connected with the CMS, the patient information items and customized fields are loaded from the CMS.**

39.3.2 The ADT Query Tab

Menu Item	Default Setting	Description
Facility	Unselected	Selects which criteria can be used to search patients in the ADT server
Department		
Room No		
Bed No		
Visit Number		
Patient ID	Selected	
Patient Name		

39.3.3 The Transfer Tab

Menu Item	Default Setting	Description
Apply Module Settings	Off	Selects whether the N1/T1/MPM settings are transferred when transferring the N1/T1/MPM data.
Transfer Data Length	4 hrs	/

Menu Item	Default Setting	Description
Data Transfer Strategy	Always Ask	The monitor needs a data transfer strategy if the monitor detects that the patient demographic information in the monitor and the N1/T1/MPM is not consistent. • **Always Ask**: always prompts a dialog box to ask for strategy. • **Continue Patient in Module**: continues to use the patient information in the N1/T1/MPM. The monitor discharges the patient, and automatically admits a new patient and copies all the patient information from the N1/T1/MPM. • **Continue Patient in Monitor:** continues to use the patient information in the monitor. The monitor deletes all the patient information in the N1/T1/MPM and copies the parameter settings in the monitor to the N1/T1/MPM.
Tabular Trends	Selected	Selects what kind of data will be transferred.
Event		
Event Detail		
Waveform		
12-Lead		

39.3.4 The Discharge Tab

Menu Item	Default Setting	Function
Auto Discharge When Power Off	Never	Automatically discharges the patient when the monitor is turned off for the designated period of time. **Never**: not discharge a patient no matter for how long the monitor has been switched off.
Auto delete discharged patients on storage space is full	On	/
Prompt on patient auto deleted	On	**On:** an alarm is issued when the monitor automatically deletes earlier discharged patients.
Alarm on storage is nearly full	Med	Selects whether an alarm is issued when the monitor memory is very low and the priority of this alarm.
Clear All Patient Data	/	Deletes all patient information and data. Clearing patient data will discharge the current patient.

39.3.5 The Location Tab

Menu Item	Default Setting	Description
Location 1 - Location 10	/	Selects where the patient goes after patient monitoring stops.

39.3.6 The Display Tab

Menu Item	Default Setting	Description
Primary Screen Display Full Name	On	Selects whether patient name is displayed in the patient information area on the primary display.
Secondary Screen Display Full Name	On	Selects whether patient name is displayed in the patient information area on the secondary display, if configured.
Remote View Display Full Name	On	Selects whether patient name is displayed in the patient information area on the remote monitors when this monitor is viewed by other monitors.
Remote View Bedlist Display Full Name	On	Defines whether patient name is displayed in beds list on the remote monitors when this monitor is viewed by other monitors.

39.4 The Alarm Settings

39.4.1 The Audio Tab

Menu Item	Default Setting	Description
Minimum Alarm Volume	2	/
Alarm Sound	ISO	Defines the alarm tone pattern to distinguish the heart beat tone, pulse tone, and keystroke tone by frequency.
High Alarm Interval	10 sec	Defines the interval between alarm tones for the ISO mode.
Med Alarm Interval	20 sec	
Low Alarm Interval	20 sec	
Auto Increase Volume	2 Steps	• **2 Steps**: if an alarm is not reset within the designated delay time after the alarm occurs, the alarm volume automatically increases by two levels. • **1 Step**: if an alarm is not reset within the designated delay time after the alarm occurs, the alarm volume automatically increases by one level. • **Off**: if an alarm is not reset within the designated delay time after the alarm occurs, the volume of the alarm tone does not change.
Increase Volume Delay	20 sec	Defines the delay time of alarm volume escalation

NOTE

- **The alarm volume escalation function is not applied to the latched alarms.**
- **The monitor provides the same alarm tone pattern for the remote device alarms as those for your monitor alarms.**

39.4.2 The Pause/Reset Tab

Section	Menu Item	Default Setting	Description
Pause	Pause	Alarm Pause	Selects the pause function. • **Alarm Pause**: pauses alarms. • **Audio Pause**: pauses alarm tones.
	Pause Time	2 min	Selects the alarm pause time. The alarm pause time can be set to **1 min**, **2 min**, **3 min**, or **Permanent**.
	Pause Priority	All	Selects alarms of what priority can be paused. • **All**: pressing the **Alarm Pause** quick key pauses all alarms. • **Med & Low**: pressing the **Alarm Pause** quick key pauses alarms of medium and low priority. The high priority alarms will not be paused. • **Disabled**: the **Alarm Pause** quick key is disabled.
	Pause 5 min	Off	Selects how long the alarm can be paused if switched on..
	Pause 10 min	Off	
	Pause 15 min	Off	
Alarm Reset	Alarm Light	On When Reset	• **On When Reset**: when the alarm system is reset, the alarm tones of the current alarms are switched off, but the alarm lamp remains flashing. • **Off When Reset**: when the alarm system is reset, both the alarm tone and alarm lamp of the current alarms are switched off.
Reminder Tone	Alarm Reset Reminder	On	Selects the reminder tone rule when the alarm volume is set to zero, or the alarm is reset or switched off. • **On**: the monitor issues reminder tones at a designated interval. • **Re-alarm**: if the alarm condition persists the acknowledged alarms marked with "√" will be regenerated after the designated reminder tone interval. • **Off**: the monitor does not issue reminder tones at a designated interval. The acknowledged alarms marked with "√" will be silenced.
	Alarm Off Reminder	On	• /
	Reminder Interval	5 min	• **10 min**: the monitor issues reminder tones every 10 minutes. • **5 min**: the monitor issues reminder tones every five minutes. • **3 min**: the monitor issues reminder tones every three minutes. • **2 min**: the monitor issues reminder tones every two minutes. • **1 min**: the monitor issues reminder tones every one minute.

39.4.3 The Latching Tab

Menu Item		Default Setting	Description
Lethal	Visible	Unselected	• Selects alarm latching rules:If **Visual** is selected, you can separately latch visual alarm signal. • Latching audible alarm signal simultaneously latches visual signal. • Selecting alarms of lower priority simultaneously latches higher priority alarms.
	Audible		
High	Visible		
	Audible		
Med	Visible		
	Audible		
Low	Visible		
	Audible		

39.4.4 The Remote View Tab

Menu Item	Default Setting	Description
Reset Remote Bed Alarms	Off	Selects whether you can reset alarms occurring to the remote devices from your monitor. **On**: the **Alarm Reset** button appears on the bottom left of the **Remote View** screen.
Alarm Reset by Other Bed	On	**On**: alarms on your monitor can be reset by remote devices.
Alarm Reminder	Visible+Audible	Selects what alarm indicators are necessary for the remote devices. • **Visible + Audible**: the monitor provides visual alarm indication, and continuous audible alarm indication if the alarm persists at the remote device. • **Visible + Single Tone**: the monitor provides visual alarm indication, and a single tone when the alarm occurs at the remote device. • **Visible Only**: the monitor only provides visual alarm indication.
Alarm Priority	All	Selects what priority of remote device alarms are presented for audible notification • **All**: the monitor sounds if an alarm occurs. • **High&Med**: the monitor sounds if a high or medium priority alarm occurs. • **High Only**: the monitor sounds only if a high priority alarm occurs.
Alarm Sound	ISO	Selects the alarm tone pattern for the remote device alarms.
Remote Disconnected Alarm	On	Selects whether an alarm is issued if a remote device is disconnected.

39.4.5 The Nurse Call Tab

Menu Item	Default Setting	Description
Signal Type	Continuous	Selects the type of alarms that are sent to the nurse call system. • **Pulse**: the nurse call signal is a pulse signal and each pulse lasts one second. When multiple alarms simultaneously occur, only one pulse signal is outputted. If an alarm occurs but the previous one is not cleared, a new pulse signal will also be outputted. • **Continuous**: the nurse call signal lasts until the alarm ends. That is to say the duration of a nurse call signal is equal to that of the alarm condition.
Contact Type	Normally Closed	Selects the work mode of the nurse call relay
Alarm Priority	High Only	Selects the priority of alarms sent to the nurse call system
Alarm Type	Physiological Only	Selects the type of alarms sent to the nurse call system.
Receive Call Help	On	Receives the calling signal if a monitor in the same department calls for help.

39.4.6 The Other Tab

Section	Menu Item	Default Setting	Description
Alarm Priority	ECG Lead Off	Low	Selects the priority of the ECG lead off alarm.
	SpO2 Sensor Off	Low	Selects the alarm level for SpO_2 sensor off alarm.
	IBP No Sensor	Med	Selects the alarm level for IBP No Sensor alarm.
	CMS/eGW Disconnected	Low	Selects the priority of the CMS and eGateway disconnection alarm.
Alarm Delay	Alarm Delay	6 sec	For continuously measured parameters, the monitor does not present the alarm if the alarm condition is resolved within the delay time. The setting of **Alarm Delay** is not applied to the apnea alarms and the ST alarms.
	ST Alarm Delay	30 sec	The monitor does not present the ST alarm if the alarm condition is resolved within the delay time.
Alarm Light Brightness	Primary Screen	Med	Selects the alarm light brightness on the primary display. **Auto**: the monitor automatically adjusts the alarm light brightness according to the ambient light. The stronger the ambient light is, the brighter the alarm light is.
	Secondary Screen (for N22/N19)	Med	Selects the alarm light brightness on the secondary display. **Auto**: the monitor automatically adjusts the alarm light brightness according to the ambient light. The stronger the ambient light is, the brighter the alarm light is.

Section	Menu Item	Default Setting	Description
Other	Lethal Arrhy Alarms Off	Disable	Selects whether arrhythmia alarms can be switched off. • **Disable**: arrhythmia alarms cannot be switched off. • **Enable**: arrhythmia alarms can be switched off from the **ECG** menu.
	SpO2 Desat Alarm Off	Disable	Selects whether the SpO_2 Desat alarm can be switched off. • **Disable**: the SpO_2 Desat alarm cannot be switched off. • **Enable**: the SpO_2 Desat alarm can be switched off.
	Apnea Alarm Off	Disable	Selects whether the apnea alarm can be switched off. • **Disable**: the apnea alarm cannot be switched off. • **Enable**: the apnea alarm can be switched off.
	Arrhy Shield Time	2 min	Alarm light and alarm tone will be disabled for designated period of time when certain arrhythmia alarms are detected. **0**: disables this function.
	Intubation Mode Period	2 min	Selects the time for intubation.
	Print on Alarm	Printer	**Printer**: enables automatic printing via printer when a parameter alarm is triggered. **Recorder**: enables automatic recording via recorder when a parameter alarm is triggered.
	CMS/eGW Disconnected Alarm	Off	Selects whether an alarm is issued when the monitor is not connected or disconnected from the CMS/eGateway. **Off**: the "Offline" alarm is not presented when the monitor is not connected or disconnected from the CMS/eGateway.

39.5 The CAA Settings

39.5.1 The EWS Tab

Menu Item		Default Setting	Description
Operator ID		Off	Selects whether to display the operator ID on the EWS screen
Operator ID Timeout		Off	Selects how long the operator ID will be invalid
Default Adult Score		NEWS	Selects the default scoring tool for different patient category.
Default Ped Score		/	
Default Neo Score		/	
Manage Score	Local	/	**Delete**: deletes the selected scoring tools. The monitor provide MEWS, NEWS, and NEWS2 by default. You cannot delete them.
	USB Drive	/	**Import**: imports the desired scoring tools to the monitor.

39.5.2 The GCS Tab

Menu Item		Default Setting	Description
Mild	High limit	15	Selects the threshold and color of each consciousness level.
	Low limit	13	
	Color	White	
Moderate	High limit	12	
	Low limit	9	
	Color	Yellow	
Severe	High limit	8	
	Low limit	3	
	Color	Red	

39.5.3 The CPR Tab

Tab	Default Setting	Description
Customized Drug	/	Customizes drugs and treatments.
Customized Treatment		

39.6 The Module Settings

39.6.1 The ECG Tab

Menu Item	Default Setting	Description
ECG Standard	AHA	Selects the ECG standard according to the leadwires you are using.
QTc Formula	Hodges	Selects the QTc formula used to correct the QT interval for heart rate. • Hodges: $QTc = QT + 1.75 \times (HearRate - 60)$ • Bazett: • $QTc = QT \times \left(\frac{HearRate}{60}\right)^{\frac{1}{2}}$ • Fridericia: $QTc = QT \times \left(\frac{HeartRate}{60}\right)^{\frac{1}{3}}$ • Framingham: $QTc = QT + 154 \times \left(1 - \frac{60}{HeartRate}\right)$
12-Lead Order	No	Selects whether to send the order of 12-lead interpretation report to the hospital information system while saving the report.

39.6.2 The Other Tab

Menu Item	Default Setting	Description
IBP Filter	12.5 Hz	/

Menu Item	Default Setting	Description
PAWP Timeout	15 min	The measurements become outline fonts after a preset time. This avoids older values being misinterpreted as current measurements.
C.O. Timeout	15 min	
NIBP Timeout	15 min	
TempIF Timeout	30 min	
CO2 Flow Rate for Neo (For Sidestream CO_2 Module Without O_2)	90 ml/min	Selects flow rate when using the sidestream CO_2 without the O_2 monitoring function to monitor a neonatal patient.
Outline Font for Suspected Values	On	Selects whether unreliable HR, SpO_2, and BIS measurements are displayed in outline font. This prevents unreliable measurements from being misinterpreted as normal measurements,

39.7 The Review Settings

39.7.1 The Tabs Tab

Menu Item	Default Setting	Description
Tabular Trends	Selected	Hides the trends you do not need to review if deselected.
Graphic Trends		
Events		
Full Disclosure		
OxyCRG		
12-Lead ECG		
ST		

39.7.2 The Event Tab

Menu Item		Default Setting	Description
Lethal	Lock	Selected	Selects what kind of events will be locked. Locked events will not be deleted.
High		Unselected	
Med			
Low			
Rename Event		On	Selects whether arrhythmia events can be renamed.

39.7.3 The Arrhy Mark Tab

From the **Arrhy Mark** page, you can define whether the compressed ECG waveform segments for arrhythmia events are marked with a specific background color.

39.8 The Display Settings

Menu Item	Default Setting	Function
D22/D19 (for N22/N19)	On	**On**: you can only use Mindray secondary display. **Off**: you can use display of the third party as the secondary display
Screen Contents	Independent	• **Mirrored** (for N22/N19): The contents of the secondary display is exactly the same with the primary display. The orientation of the secondary display is also the same with the primary display. • **Independent**: You can separately configure the contents and layout of the primary display and secondary display. The independent secondary display cannot share the mouse and keyboard with the primary display. For N22/N19, separate mouse and keyboard connected to the MSB connectors of the secondary display is required. • **Extended**: You can separately configure the contents and layout of the primary display and secondary display. The extended secondary display shares the mouse and keyboard with the primary display. You cannot use separate mouse and keyboard to operate the extend secondary display.
Secondary Screen Location	/	For extended secondary display, selects the layout of primary display and secondary displays. That is to say, the position of secondary display relative to the primary display.
Alarm Sound/Light (for N22/N19)	Off	Selects whether the secondary display presents alarm light and alarm sound.

39.9 The Print Settings

39.9.1 The Printer Tab

Menu Item		Default Setting	Description
Connection Type		Printer	Selects you want to output patient reports via the print server or a network printer.
Printer IP Address		0.0.0.0	For printer only.
Paper Size		A4	
Printer Resolution		300 dpi	
Print Server Address		/	For print server only. If the CMS is used as the printer server, set the **Port** to 6603.
Print Server IP Address		/	
Port		6603	
General Report (For print server only.)	Print Action	Paper	Selects the media of the reports.
	Printer	/	Selects the default printer (for paper report only).
	Printer Resolution	/	Selects the resolution for the default printer (for paper report only).
	PDF Resolution	600 dpi	Selects the resolution for the default printer (for PDF report only).

Menu Item		Default Setting	Description
End Case Report (For print server only.)	Print Action	Paper	Selects the media of the reports.
	Printer	/	Selects the default printer (for paper report only).
	Printer Resolution	/	Selects the resolution for the default printer (for paper report only).
	PDF Resolution	600 dpi	Selects the resolution for the default printer (for PDF report only).
Print on Alarm Report (For print server only.)	Print Action	Paper	Selects the media of the reports.
	Printer	/	Selects the default printer (for paper report only).
	Printer Resolution	/	Selects the resolution for the default printer (for paper report only).
	PDF Resolution	600 dpi	Selects the resolution for the default printer (for PDF report only).
Print Test Page		/	Tests whether the printer works properly.

39.9.2 The Report Layout Tab

Menu Item	Default Setting	Description
Report Layout	/	Selects the contents and location of the patient information included in non-ECG reports. **N/A**: refers to no information. Patient information configured in the Report Layout page is not applied to ECG reports.

39.9.3 The ECG Report Tab

Menu Item	Default Setting	Description
Patient Name/Age/Gender	/	Selects the patient information you want to display on ECG reports.
Patient ID	Selected	
Visit Number/DOB/Race/Medication/Class/Physician/Technician/Department/Room No/Bed No	Unselected	

39.9.4 The PDF File Name Tab

Menu Item	Default Setting	Description
PDF File Name	/	Selects the name of PDF files. **N/A**: refers to no information.

39.9.5 The Other Tab

Menu Item	Default Setting	Description
Second Mark (Printer)	On	Selects whether to show second marks on the report output by the printer.
Arrhy Setting (Recorder)	Off	Selects whether to include arrhythmia thresholds and QRS thresholds in the report output by the recorder.

39.10 The Unit Settings

Menu Item	Default Setting	Description
Height Unit	cm	Selects measurement unit for each parameter.
Weight Unit	kg	
ST Unit	mV	
Hb Unit	g/dl	
tcpCO2/tcpO2 Unit	mmHg	
CVP Unit	cmH2O	
ICP Unit	mmHg	
CO2 Unit	mmHg	
O2 Unit	%	
Temp Unit	℃	
Pressure Unit	mmHg	
SVR Unit	DS/cm^5	

39.11 The Time Settings

Section	Menu Item	Default Setting	Description
Nighttime	From	22:00	Selects the nighttime for heart rate statistics.
	To	06:00	
Auto Daylight Saving Time		Off	**On**: auto starts the daylight saving time.

39.12 The Other Settings

Menu Item	Default Setting	Description
Barometric Pressure	760 mmHg	For the mainstream CO2 module and RM module, enter the value of barometric pressure to which the patient monitor is exposed to. Be sure to set the barometric pressure properly. Improper settings will result in erroneous measurements.
Notch Frequency	50 Hz	Selects notch filter frequency according to the power line frequency of your country.
Mouse Sensitivity	5	/
Clear CMS IP at startup	On	/
SpO_2 Tone	Mode 1	Selects the SpO_2 tone mode. The monitor adjusts the QRS tone (pitch tone) according to the SpO2 values. The same SpO2 tone mode shall be used for the same monitors in a single area.
Language	/	/
Parameters On/Off Config Influenced	On	Selects whether the settings of parameter switches are influenced by configuration
Parameters On/Off Protected	Off	Selects whether setting parameter switches is password protected.

Menu Item		Default Setting	Description
Parameters On/Off		/	Selects what parameter s can be monitored.
Parameter Output Setup	Baud Rate	Off	Configures DIAP protocol parameters to realize communications between the monitor and third party devices.
	Parity Mode	None	
	Data Bits	8	
	Stop Bits	1	

39.13 The Authorization Setup Settings

Section	Menu Item	Default Setting	Description
/	Retention Time	20 sec	Selects timeout period of the MLDAP password for accessing the Maintenance menu, alarm settings and arrhythmia settings. If there is no operation after the specified timeout period is reached, you need to re-enter the password.
Maintenance	User Maintenance	Local Password	Selects the password for accessing the monitor's **Maintenance** menu. • **Local Password**: the monitor's password for accessing the **Maintenance** menu is required. • **User Password:** the user name and password saved in the MLDAP server are required.
	Modify Local Password	/	Changes the monitor's password for accessing the **Maintenance** menu.
Others	Alarm Setup	No Password	Selects the password for changing alarm settings. • **No Password**: changing alarm settings is not password protected. • **Local Password**: changing alarm switch, alarm limit, and alarm priority is password protected. The monitor's password for changing alarm settings is required. • **User Password**: changing alarm switch, alarm limit, and alarm priority is password protected. The user name and password saved in the MLDAP server are required.
	Arrhythmia	No Password	selects the password for changing arrhythmia settings. • **No Password**: changing arrhythmia settings is not password protected. • **Local Password**: changing arrhythmia switch, alarm priority, and arrhythmia threshold is password protected. The monitor's password for changing arrhythmia settings is required. • **User Password**: changing arrhythmia switch, alarm priority, and arrhythmia threshold is password protected. The user name and password saved in the MLDAP server are required.
	Modify Local Password	/	Changes the monitor's password for accessing alarm settings and arrhythmia settings.

Section	Menu Item	Default Setting	Description
Remote Screen	Remote Screen	Enable	Selects the password for starting remote screens. • **Disable**: you cannot start remote screens for this monitor. • **Enable**: starting remote screens is not password protected. • **Local Password**: starting remote screens is password protected. The monitor's password for remote screens is required. • **User Password**: starting remote screens is password protected. The user name and password saved in the MLDAP server are required.
	Modify Local Password	/	Changes the monitor's password for starting remote screens.

39.14 The Version Settings

Tab	Default Setting	Description
Version	/	Displays system software version, module hardware and software version, and firmware version.

39.15 The Battery Information Settings

Tab	Default Setting	Description
Remaining Battery Capacity	/	Displays battery information.
Battery Voltage	/	
Battery Chip Temperature	/	

39.16 The Scanner Settings

39.16.1 The 2D Barcode Tab (for the Mindray Custom 2D Barcode Reader)

Tab	Default Setting	Description
2D Barcode	/	Establishes the relationship between the monitor data and barcode data for selectable patient demographics. For example, the monitor has an option of **Ped** for patient category. In your hospital barcode, the text may read as **Pediatric**. You need to input **Pediatric** for the field **Ped** to establish their relationship.

39.16.2 The 1D Barcode Tab

Menu Item	Default Setting	Description
Content Fill to	Patient ID	/

39.16.3 The Scanner Information Tab

Menu Item	Default Setting	Description
Scanner Type	2D Scanner	• **1D Scanner**: select this option when you are using a 1D scanner or a 2D scanner other than the Mindray custom 2D scanner. • **2D Scanner**: select this option when you are using the Mindray custom scanner.
Data Encoding Type	UTF8	When you set **Scanner Type** to **2D Scanner**, default settings are applied to **Data Encoding Type** and **DataParseMode**. You do not need to change these settings.
Data Parse Mode	Local Parse Mode	

39.16.4 The Identify Scanner Tab (for the non-Mindray Custom 2D Barcode Reader)

Tab	Default Setting	Description
Identify Scanner	/	When you are using barcode readers other than HS-1R or HS-1M, you should select the barcode reader from the USB device list, so that the monitor can identify the barcode reader.

39.16.5 The Field Tab (for the Mindray Custom 2D Barcode Reader)

Menu Item	Default Setting	Description
Patient ID/First Name/Last Name/Patient Category/Gender/DOB	Selected	Selects desired patient information to be output by the barcode reader.
Visit Number/Room No/Bed No/Age/ Department/Custom Field 1 - 4	Unselected	

39.17 The Network Setup Settings

39.17.1 The Network Type Tab

Menu Item	Default Setting	Description
Monitor	Auto	Selects what kind of network your monitor will use. **Auto**: the monitor automatically identify your network type.

39.17.2 The LAN1 IP Tab

Menu Item	Default Setting	Description
Obtain IP Address Automatically	Selected	Automatically gets the IP address.
Use the Following Address	Unselected	**IP address**, **Subnet mask**, and **Gateway** are required.
IP Address	0.0.0.0	
Subnet Mask	0.0.0.0	
Gateway	0.0.0.0	
Obtain DNS address automatically	Selected	Automatically gets the DNS address

Menu Item	Default Setting	Description
Using the Following DNS Address	Unselected	IP addresses of **Preferred DNS server** and **Alternate DNS server** are required.
Preferred DNS Server	0.0.0.0	
Alternate DNS Server	0.0.0.0	

39.17.3 The WLAN Tab

Menu Item		Default Setting	Description
SSID		/	/
Security		WEP OFF	Selects the security method.
Password		/	/
WLAN Setup	WLAN Band	Auto	**Auto**: automatically identifies the WLAN band.
	Auth Server Type	ACS	Selects the type of authentication server.
	BGN Channel	All	Selects the type of B, G, and N channels.
	AN Channel	All	Selects the type of A and N channels.
Certification Management	Local	/	**Delete**: delete the selected certifications.
	USB Drive	/	Select certifications you want to import from the USB memory, and then select **Import**: import the desired certifications from the USB memory.
Network Test		/	Tests whether the wireless network is properly connected.

39.17.4 The WLAN IP Tab

Menu Item	Default Setting	Description
Obtain IP Address Automatically	On	Selects whether to enable the function of automatically getting the IP address.
Use the Following Address	Off	Select whether inputting the **IP address**, **Subnet mask**, and **Gateway** is required.
IP Address	0.0.0.0	
Subnet Mask	0.0.0.0	
Gateway	0.0.0.0	
Obtain DNS address automatically	On	Selects whether to enable the function of automatically getting the DNS address.
Using the Following DNS Address	Off	Select whether inputting the IP address of **Preferred DNS server** and **Alternate DNS server** is required.
Preferred DNS Server	0.0.0.0	
Alternate DNS Server	0.0.0.0	

39.17.5 The Central Station Setup Tab

Menu Item	Default Setting	Function
Select CMS	On	Selects whether to enable the CMS selection function for your monitor.

Menu Item	Default Setting	Function
Add Central Station	/	Inputs the name, department, and server address of the CMS. You can add up to 30 CMSs for your monitor.

39.17.6 The Device Discover Tab

Multicast helps device discovery between monitors and between monitors and CMS. Devices in the same multicast group can be mutually discovered.

Menu Item	Default Setting	Description
Multicast TTL	1	/
Multicast Address	225.0.0.8	
Master Server Address	0.0.0.0	/
Master Server IP Address	0.0.0.0	
Connected Status	Disconnected	

39.17.7 The QoS Tab

Menu Item	Default Setting	Description
QoS Level For Realime Monitoring	0	Selects the service quality of network connection for realtime monitoring, for example parameter measurements and waveforms, alarms, and so on
QoS Level For Others	0	Selects the service quality of network connection for non-realtime monitoring, for example history data, printing, and as on.

39.17.8 The ADT Tab

The ADT (admit-discharge-transfer) gateway is normally deployed in the eGateway. You can obtain patient information from the hospital ADT server through the ADT gateway.

Menu Item	Default Setting	Description
Server Address	192.168.0.100	Input the host name or IP address of the ADT gateway.
IP Address	192.168.0.100	
Port	3502	Input the port of the ADT gateway.
ADT Query	Off	Selects whether patient information can be loaded to the monitor from the ADT server.
Network Test	/	Tests whether the ADT server is properly connected.

39.17.9 The HL7 Configuration Tab

You can send the realtime data, waveforms, and alarms from the monitor to the hospital servers via HL7 protocol. This page also display the server connection status.

Section	Menu Item	Default Setting	Description
Data+Waveforms	Server Address	/	Inputs the name or IP address for the server receiving the realtime data and waveform.
	Destination IP	0.0.0.0	
	Port	0	/
	Send Data	Off	
	Data Interval	30 sec	
	Send Waveforms	Off	
Alarms	Server Address	/	Inputs the name or IP address for the server receiving the alarm data.
	Destination IP	0.0.0.0	
	Port	0	/
	Send Alarm	Off	

39.17.10 The Information Security Tab

Menu Item	Default Setting	Description
Encryption Connection Type	Only Private Encryption	• **Only Private Encryption**: Mindray private encryption is used to encrypt the transmitted data. You cannot connect devices supporting SSL (secure sockets layer) encryption. • **SSL Encryption Priority**: for devices supporting SSL encryption, SSL encryption is used when connecting the devices. For devices not supporting SSL encryption, private encryption is used when connecting the devices.
Broadcast Patient Demographics	On	**On:** when viewing other patients, device location and patient information of remote devices are displayed in the remote device list. • **Off**: patient information does not display in the remote device list.

39.17.11 The MLDAP Tab

Menu Item	Default Setting	Description
Server Address	/	Inputs the name or IP address for the MLDAP server.
IP Address	0.0.0.0	
Port	0	/
Network Test	/	Tests whether the monitor is properly connected with the MLDAP server.

39.18 The Wireless Module Settings

Menu Item	Default Setting	Description
Communication Mode	MPAN First	• **MPAN First**: if Bluetooth is available, the TM80 is paired with the monitor via Bluetooth. If Bluetooth is not available, the TM80 is paired with the monitor via Wi-Fi. • **Wi-Fi Only**: the TM80 is always paired with the monitor via Wi-Fi. • **Auto**: the TM80 is paired with the monitor via Wi-Fi by default for the first time. If the current communication is disconnected, another communication mode is selected automatically.

40 Battery

40.1 Battery Introduction

This monitor is designed to operation battery power when the mains power is not available. The monitor uses mains power as primary power source. In case of mains power failure, the monitor automatically runs on the battery power.

NOTE

- **If the mains power fails and the monitor runs on the battery power, the display brightness automatically lowers to the dimmest. You can manually adjust the display brightness as required.**

40.2 Battery Safety Information

WARNING

- **Keep batteries out of children's reach.**
- **Use only specified battery. Use of a different battery may present a risk of fire or explosion.**
- **Keep the batteries in their original package until you are ready to use them.**
- **Do not expose batteries to liquid.**
- **Do not crush, drop or puncture the battery. Mechanical abuse can lead to internal damage and internal short circuits. If a battery has been dropped or banged against a hard surface, whether damage is externally visible or not, remove the battery from use and dispose of it properly.**
- **If the battery shows signs of damage or signs of leakage, replace it immediately.**
- **Batteries should be charged only in this monitor.**
- **Extremely high ambient temperature may cause battery overheat protection, resulting in monitor shutdown.**
- **The lithium-ion battery has a service life of two years (for N22/N19) or three years (for N17/N15/N12/N12C). Replace your battery when it reaches the end of its service life. Failure to replace the battery may cause serious damage to your equipment from battery overheating.**
- **Do not open batteries, heat batteries above 60 °C, incinerate batteries, or short battery terminals. They may ignite, explode, leak or heat up, causing personal injury.**
- **Lithium batteries replaced by inadequately trained personnel could result in a hazard (such as excessive temperatures, fire or explosion).**

CAUTION

- **Remove the battery before shipping the monitor or if it will not be used for an extended period of time.**
- **When the monitor runs on battery power, the monitor may automatically shutdown due to high power consumption if too many external modules are connected.**
- **Use only the AC mains to power the monitor when the iView system is in use.**

40.3 Installing or Replacing the Battery

No battery is installed when the monitor leaves the factory.

For N22/N19, the battery must only be installed or replaced by service personnel trained and authorized by Mindray. To install or replace the battery, contact your service personnel.

For N12/N12C, to install the battery, follow this procedure:

1. Turn off the monitor. Disconnect the power cable and other cables.
2. Place the monitor on the worktable with monitor face down.
3. Open the battery door as indicated by Figure 1 below.
4. Turn the latch aside.
5. Insert the battery into the battery compartment with the battery terminal inwards. Turn the latch back to the middle as indicated by Figure 2 below. To replace the battery, remove the old battery and insert a new one.
6. Close the battery door.

Figure 1

Figure 2

For N17/N15, to install the battery, follow this procedure:

1. Turn off the monitor. Disconnect the power cable and other cables.
2. Place the monitor on the worktable with monitor face down.
3. Pull up the battery door to open the battery compartment as indicated by Figure 1 below.
4. Insert the battery into the battery compartment. Push the battery downwards till the battery terminal is plugged into the battery connector as indicated by Figure 2 below. To replace the battery, remove the old battery and insert a new one.
5. Close the battery door.

Figure 1

Figure 2

40.4 Battery Indications

The battery LED, on-screen battery power indicator and related alarm messages indicate the battery status.

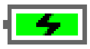
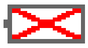
40.4.1 Battery LED

The battery LED indications are as follows:

- Green: the battery is fully charged.
- Yellow: the battery is being charged.
- Green and flashing: the monitor runs on battery power.
- Off: no battery is installed, or the battery malfunctions, or the AC mains is not connected when the monitor is powered off.

40.4.2 Battery Power Indicators

The on-screen power indicator indicates the battery status as follows:

-  indicates that the battery works correctly. The green portion represents the remaining charge.
-  indicates that the battery power is low and needs to be charged.
-  indicates that the battery is almost depleted and needs to be charged immediately. Otherwise, the monitor will soon automatically shut down.
-  indicates that the battery is being charged.
-  indicates that no battery is installed or the battery fails.

40.4.3 Battery-related Alarms

The capacity of the battery is limited. When the battery is low, the monitor presents the **Low Battery** alarm, the alarm lamp flashes, and the monitor produces an alarm sound.

If the battery is almost depleted, the monitor presents the **Critically Low Battery** alarm. In this case, immediately connect the AC mains to power the monitor and charge the battery. Otherwise, the monitor will automatically shut down soon.

For N22/N19, if the battery is aged, the **Battery Service Required** alarm is presented each time the monitor is turned on, indicating that the battery reaches its lifetime.

For more information on battery-related alarms, see *D Alarm Messages*.

40.5 Charging the Battery

The battery is recharged automatically when the monitor is connected to AC mains power.

40.6 Maintaining the Battery

40.6.1 Conditioning the Battery

The performance of batteries deteriorates over time. You should condition the batteries every three months.

If the battery is not conditioned for a prolonged time, its charge indication may not be accurate and you may wrongly evaluate the remaining battery runtime.

To condition a battery, follow this procedure:

1. Disconnect the monitor from the patient and stop all monitoring and measuring procedures.
2. Allow the battery to be charged uninterruptedly till it is fully charged.
3. Allow the monitor to run on the battery until the battery is completely depleted and the monitor automatically shuts down.
4. Fully charge the battery again for use or charge it to 40 – 60% for storage.

NOTE

- **Do not use the monitor to monitor the patient during battery conditioning.**
- **Do not interrupt battery conditioning.**

40.6.2 Checking Battery Performance

The performance of a rechargeable battery deteriorates over time. You should check the battery performance every three months or if you doubt that the battery may fail.

See steps 1 to 3 of *40.6.1 Conditioning the Battery* to check battery performance. The operating time of the batteries reflects their performance directly. If the operating time of a battery is noticeably shorter than that stated in the specifications, the battery may reach its service life or malfunction.If the battery performance meets the requirement, fully charge the battery again for use or charge it to 40 – 60% for storage.

NOTE

- **Battery operating time depends on equipment configuration and operation. For example, high display brightness or measuring NIBP repeatedly will shorten the battery operating time.**

40.7 Storing Batteries

When storing batteries, make sure that the battery terminals do not come into contact with metallic objects. If batteries are stored for an extended period of time, place the batteries in a cool place with a partial charge of 40% to 60% capacity.

Condition the stored batteries every three months. For more information, see *40.6.1 Conditioning the Battery*.

NOTE

- **Remove the battery from the equipment if the equipment is not used for a prolonged time (for example, several weeks). Otherwise the battery may overdischarge.**
- **Storing batteries at high temperature for an extended period of time will significantly shorten their life expectancy.**
- **The battery storage temperature is between -5 °C and 35 °C. Storing batteries in a cool place can slow the aging process. Ideally the batteries should be stored at 15 °C.**

40.8 Recycling Batteries

Discard a battery in the following situations:

- The battery has visual signs of damage.
- The battery fails.
- The battery is aged and its runtime significantly less than the specification.
- The battery service life is reached.

Properly dispose of batteries according to local regulations.

WARNING

- **Do not open batteries, heat batteries above 60 °C, incinerate batteries, or short the battery terminals. They may ignite, explode, leak or heat up, causing personal injury.**

This page intentionally left blank.

41 Care and Cleaning

41.1 Care and Cleaning Introduction

In this chapter we only describe cleaning and disinfection of the monitor, modules, satellite module rack (SMR) and certain accessories. For the cleaning and disinfection of other reusable accessories, refer to their instructions for use.

41.2 Care and Cleaning Safety Information

WARNING

- **Use only Mindray approved cleaners, disinfectants and methods listed in this chapter to clean or disinfect your equipment or accessories. Warranty does not cover damage caused by unapproved substances or methods.**
- **Do not mix disinfecting solutions, as hazardous gases may result.**
- **We make no claims regarding the efficacy of the listed chemicals or methods as a means for controlling infection. For the method to control infection, consult your hospital's infection control officer or epidemiologist.**
- **Be sure to turn off the system and disconnect all power cables from the outlets before cleaning the equipment.**
- **The responsible hospital or institution shall carry out all cleaning and disinfection procedures specified in this chapter.**

CAUTION

- **Never immerse any part of the equipment or accessories in liquids or allow liquid to enter the interior.**
- **Any contact of cleaners or disinfectants with connectors or metal parts may cause corrosion.**
- **Do not pour or spray any liquid directly on the equipment or accessories or permit fluid to seep into connections or openings.**
- **If you spill liquid on the equipment or accessories, disconnect the power supply, dry the equipment, and contact your service personnel.**
- **Never use abrasive materials (such as steel wool or silver polish), or erosive cleaners (such as acetone or acetone-based cleaners).**
- **Dilute and use the cleaners or disinfectants according to the manufacturer's instructions.**
- **Check the equipment after cleaning and disinfecting. If there is any sign of damage, remove it from use.**

41.3 Cleaning the Monitor/Module/SMR

Clean your equipment on a regular basis. Before cleaning the equipment, consult your hospital's regulations for cleaning the equipment.

To clean the equipment, follow this procedure:

1. Dampen a soft lint-free cloth with water or ethanol (70%).
2. Wring excess liquid from the cloth.
3. Wipe the display screen.
4. Wipe the external surface of the monitor, modules, or SMR with the damp cloth, avoiding the connectors and metal parts.

5. Dry the surface with a clean cloth. Allow the equipment air dry in a ventilated and cool place.

CAUTION

- **During the cleaning procedure, disable the touch operation by switching off the monitor or locking the touchscreen.**
- **Any contact of cleaners or disinfectants with connectors or metal parts may cause corrosion.**

41.4 Disinfecting the Monitor/Module/SMR

Disinfect the equipment as required in your hospital's servicing schedule. Cleaning the equipment before disinfecting is recommended. Always dilute and use disinfectants according to the manufacturer's instructions. The following table lists approved disinfectants:

Product Name	Product Type	Manufacturer
Alpet® D2 Surface Sanitizing Wipes	Wipes	BEST SANITIZERS INC™.
CIDEX® OPA	Liquid	Gilag GmbH International Advanced Sterilization products
Clorox Dispatch® Hospital Cleaner Disinfectant Towels with Bleach	Wipes	Clorox professional products company
Clorox Healthcare® Bleach Germicidal Wipes	Wipes	Clorox professional products company
Clorox Healthcare® Hydrogen Peroxide Cleaner Disinfectant Wipes	Wipes	Clorox professional products company
Diversey Oxivir® TB Wipes	Wipes	Diversey Inc
Metrex CaviCide1™	Liquid, spray	METERX® RESEARCH
Metrex CaviWipes™	Wipes	METERX® RESEARCH
PDI Sani-Cloth® AF3 Germicidal Disposable Wipe	Wipes	PDI Inc.
PDI Sani-Cloth® Bleach Germicidal Disposable Wipe	Wipes	PDI Inc.
PDI Sani-Cloth® HB Germicidal Disposable Wipe	Wipes	PDI Inc.
PDI Sani-Cloth® Plus Germicidal Disposable Cloth	Wipes	PDI Inc.
PDI Super Sani-Cloth® Germicidal Disposable Wipe	Wipes	PDI Inc.
VIRAGUARD® Hospital Surface Disinfectant Towelettle	Wipes	VERIDIEN corporation
Virex® II 256 (1:256)	Liquid	Diversey Inc
Virex® TB	Liquid, spray	Diversey Inc
JIAN ZHI SU Disinfectant Tablets	Tablet	Beijing ChangJiangMai Medical Science Technology Co. Ltd
JIAN ZHI SU Surface Disinfectant Spray	Liquid, spray	Beijing ChangJiangMai Medical Science Technology Co. Ltd

Product Name	Product Type	Manufacturer
JIAN ZHI SU Disinfectant, Double-chain Quaternary Ammonium	Liquid	Beijing ChangJiangMai Medical Science Technology Co. Ltd
DIAN'ERKANG Surface Wipes	Wipes	Shanghai Likang Disinfectant Hi-Tech Co., Ltd
DIAN'ERKANG Surface Disinfectant	Liquid	Shanghai Likang Disinfectant Hi-Tech Co., Ltd
DIAN'ERKANG Disinfectant Spray	Liquid, spray	Shanghai Likang Disinfectant Hi-Tech Co., Ltd
Clinell® Universal Wipes	Wipes	GAMA Healthcare Ltd
Clinell ® Sporicidal Wipes	Wipes	GAMA Healthcare Ltd
Tristel Duo™	Liquid, foam	Tristel solutions Limited
Tristel Jet	Liquid, spray	Tristel solutions Limited
Tristel Fuse For Surfaces, 196ppm	Liquid	Tristel solutions Limited
Surfanios Premium, 0.25%	Liquid	ANIOS LABORATORIES
Surfa 'safe	Liquid, spray	ANIOS LABORATORIES
Wip' Anios premium	Wipes	ANIOS LABORATORIES
Aniosurf ND premium, 0.25%	Liquid	ANIOS LABORATORIES
Mikrobac® Tissues	Wipes	BODE Chemie GmbH
Cleanisept® Wipes	Wipes	Dr. Schumacher GmbH
mikrozid® PAA Wipes	Wipes	Schülke & Mayr GmbH
mikrozid® Sensentive Wipes	Wipes	Schülke & Mayr GmbH
Ecolab Incidin® OxyWipe S	Wipes	Ecolab Deutschland GmbH
Glutaraldehyde, 2%	Liquid	/
*Ethanol, 70%	Liquid	/
*Isopropanol, 70%	Liquid	/
*Sodium hypochlorite bleach, 0.5%	Liquid	/
*Hydrogen peroxide, 3%	Liquid	/
*Rely+On™ Virkon® High Level surface Disinfectant, 1%	Powder	Antec International Ltd
*1-Propanol, 50%	Liquid	/
*Descosept® forte	Liquid	Dr. Schumacher GmbH
*Descosept® AF	Liquid	Dr. Schumacher GmbH
*Dismozon® plus, 0.4%	Powder	BODE Chemie GmbH
*mikrozid® AF Wipes	Wipes	Schülke & Mayr GmbH

Product Name	Product Type	Manufacturer
*Terralin® Liquid	Liquid	Schülke & Mayr GmbH
*Perform® Classic Concentrate OXY, 0.5%	Powder	Schülke & Mayr GmbH

NOTE

- **For equipment with the symbol , all the listed cleaners and disinfectants are available for use. For equipment without this symbol, only the cleaners and disinfectants marked with "*" are available for use.**

41.5 Cleaning and Disinfecting the Accessories

For the NIBP air hose, Mindray SpO_2 cable, Masimo SpO_2 cable, Nellcor SpO_2 cable and NMT accessories, you should clean and disinfect them using the cleaners and disinfectants and methods listed in this section. For other accessories, you should consult the instructions delivered with the accessories.

CAUTION

- **Fluids entering the NIBP air hose can damage the equipment. When cleaning or disinfecting the NIBP air hose, prevent liquid from entering the hose.**
- **Periodically inspect the NIBP air hose and connector for signs of wear or deterioration after cleaning or disinfecting the NIBP air hose. Replace the NIBP air hose if you detect a leak. Dispose of damaged NIBP air hose according to local laws for disposal of hospital waster.**
- **Never immerse or soak the accessories in any liquid.**
- **Never clean or disinfect the connectors and metal parts.**
- **Use only Mindray approved cleaners and disinfectants and methods listed in this section to clean or disinfect the accessories. Warranty does not cover damage caused by unapproved substances or methods.**
- **To avoid long term damage, the accessories should be disinfected only when necessary as determined by your hospital's policy.**

41.5.1 Cleaning the Accessories

You should clean the accessories (NIBP air hose, Mindray SpO_2 cable,Masimo SpO_2 cable, Nellcor SpO_2 cable and NMT accessories) on a regular basis. Before cleaning the accessories, consult your hospital's regulations for cleaning the accessories.

To clean the accessories (NIBP air hose, Mindray SpO_2 cable, Masimo SpO_2 cable, Nellcor SpO_2 cable and NMT accessories), follow this procedure:

1. Clean the accessories with a soft cloth moistened with water or ethanol (70%).
2. Wipe off all the cleaner residue with a dry cloth.
3. Allow the accessories to air dry.

41.5.2 Disinfecting the Accessories

We recommend that the accessories (NIBP air hose, Mindray SpO_2 cable, Masimo SpO_2 cable, Nellcor SpO_2 cable and NMT accessories) should be disinfected only when necessary as determined by your hospital's policy. Cleaning the accessories before disinfecting is recommended.

41.5.2.1 Disinfectants for the NIBP Air Hose

The following table lists approved disinfectants for the NIBP air hoses:

Product Name	Product Type	Manufacturer
Alpet® D2 Surface Sanitizing Wipes	Wipes	BEST SANITIZERS INC™.
CIDEX® OPA	Liquid	Gilag GmbH International Advanced Sterilization products
Clorox Dispatch® Hospital Cleaner Disinfectant Towels with Bleach	Wipes	Clorox professional products company
Metrex CaviCide1™	Liquid, spray	METERX® RESEARCH
Metrex CaviWipes™	Wipes	METERX® RESEARCH
PDI Sani-Cloth® AF3 Germicidal Disposable Wipe	Wipes	PDI Inc.
PDI Sani-Cloth® Plus Germicidal Disposable Wipe	Wipes	PDI Inc.
PDI Super Sani-Cloth® Germicidal Disposable Wipe	Wipes	PDI Inc.
VIRAGUARD® Hospital Surface Disinfectant Towelettle	Wipes	VERIDIEN corporation
Virex® TB	Liquid, spray	Diversey Inc
Clinell® Universal Wipes	Wipes	GAMA Healthcare Ltd
Surfa 'safe	Liquid, spray	ANIOS LABORATORIES
Aniosurf ND premium, 0.25%	Liquid	ANIOS LABORATORIES
mikrozid® Tissues	Wipes	Schülke & Mayr GmbH
Glutaraldehyde, 2%	Liquid	/
Ethanol, 70%	Liquid	/
Isopropanol, 70%	Liquid	/
Rely+On™ Virkon® High Level surface Disinfectant, 1%	Powder	Antec International Ltd
1-Propanol, 50%	Liquid	/

41.5.2.2 Disinfectants for the SpO_2 Cable

The following table lists approved disinfectants for the Mindray and Nellcor SpO_2 cables:

Product Name	Product Type	Manufacturer
CIDEX® OPA	Liquid	Gilag GmbH International Advanced Sterilization products
Clorox Dispatch® Hospital Cleaner Disinfectant Towels with Bleach	Wipes	Clorox professional products company
Clorox Healthcare® Bleach Germicidal Wipes	Wipes	Clorox professional products company
Clorox Healthcare® Hydrogen Peroxide Cleaner Disinfectant Wipes	Wipes	Clorox professional products company
Diversey Oxivir® TB Wipes	Wipes	Diversey Inc
PDI Super Sani-Cloth® Germicidal Disposable Wipe	Wipes	PDI Inc.
VIRAGUARD® Hospital Surface Disinfectant Towelettle	Wipes	VERIDIEN corporation
Virex® TB	Liquid, spray	Diversey Inc
Glutaraldehyde, 2%	Liquid	/
Ethanol, 70%	Liquid	/
Isopropanol, 70%	Liquid	/
Sodium hypochlorite bleach, 0.5%	Liquid	/
Hydrogen peroxide, 3%	Liquid	/
Rely+On™ Virkon® High Level surface Disinfectant, 1%	Powder	Antec International Ltd
1-Propanol, 50%	Liquid	/

The following table lists approved Masimo SpO_2 cable cleaning and disinfecting agents:

Product Name	Product Type	Active Ingredients
Isopropanol	Liquid	Isopropanol 70%

41.5.2.3 Disinfectants for the NMT Accessory

The following table lists approved disinfectants for the NMT accessories:

Product Name	Product Type	Manufacturer
Alpet® D2 Surface Sanitizing Wipes	Wipes	BEST SANITIZERS INC™.
CIDEX® OPA	Liquid	Gilag GmbH International Advanced Sterilization products
Clorox Dispatch® Hospital Cleaner Disinfectant Towels with Bleach	Wipes	Clorox professional products company
Clorox Healthcare® Bleach Germicidal Wipes	Wipes	Clorox professional products company

Product Name	Product Type	Manufacturer
Clorox Healthcare® Hydrogen Peroxide Cleaner Disinfectant Wipes	Wipes	Clorox professional products company
Diversey Oxivir® TB Wipes	Wipes	Diversey Inc
Metrex CaviCide1™	Liquid, spray	METERX® RESEARCH
Metrex CaviWipes™	Wipes	METERX® RESEARCH
PDI Sani-Cloth® AF3 Germicidal Disposable Wipe	Wipes	PDI Inc.
PDI Sani-Cloth® Bleach Germicidal Disposable Wipe	Wipes	PDI Inc.
PDI Sani-Cloth® Plus Germicidal Disposable Wipe	Wipes	PDI Inc.
PDI Super Sani-Cloth® Germicidal Disposable Wipe	Wipes	PDI Inc.
VIRAGUARD® Hospital Surface Disinfectant Towelettle	Wipes	VERIDIEN corporation
Virex® TB	Liquid, spray	Diversey Inc
Clinell® Universal Wipes	Wipes	GAMA Healthcare Ltd
Surfa 'safe	Liquid, spray	ANIOS LABORATORIES
Aniosurf ND premium, 0.25%	Liquid	ANIOS LABORATORIES
mikrozid® Tissues	Wipes	Schülke & Mayr GmbH
Glutaraldehyde, 2%	Liquid	/
Ethanol, 70%	Liquid	/
Isopropanol, 70%	Liquid	/
Sodium hypochlorite bleach, 0.5%	Liquid	/
Hydrogen peroxide, 3%	Liquid	/
Rely+On™ Virkon® High Level surface Disinfectant, 1%	Powder	Antec International Ltd
1-Propanol, 50%	Liquid	/

41.6 Sterilization

Sterilization is not recommended for this monitor, related products, accessories, or supplies unless otherwise indicated in the Instructions for Use that accompany the products, accessories or supplies.

41.7 Cleaning the Thermal Print Head

Dirty print head deteriorates printing quality. Check the printout to ensure the printing is legible and dark. Light printing may indicate a dirty print head.

To clean the thermal print head, follow this procedure:

1. Take measures against the static electricity, such as the wrist strap.
2. Remove the recorder module from the module rack.
3. Open the recorder door and remove the recording paper.

4. Gently wipe the print head with cotton swabs dampened with ethanol to remove the dust and foreign particles.
5. Wipe off excess moisture with dry cotton swabs.
6. Allow the print head air dry.
7. Reload the recording paper and close the recorder door.

CAUTION

- **Do not use anything that may destroy the thermal element.**
- **Do not add unnecessary force to the thermal head.**
- **The thermal print head gets hot when recording. Do not clean the print head immediately after recording.**

41.8 Impact of Improper Cleaning

Using cleaners other than those recommended may have the following impact:

- Product discoloration
- Metal part corrosion
- Brittle and breaking wires, connectors, and equipment housing
- Reduced cable and leadwire life
- Overall system performance degradation
- Equipment malfunction or failure

42 Maintenance

42.1 Maintenance Introduction

Regular maintenance is essential to ensure that the equipment functions properly. This chapter contains information on periodic testing and maintenance.

42.2 Maintenance Safety Information

WARNING

- **Failure on the part of the responsible individual hospital or institution using this equipment to implement a recommended maintenance schedule may cause undue equipment failure and possible health hazards.**
- **No modification of this equipment is allowed.**
- **This equipment contains no user serviceable parts.**
- **The safety checks or maintenance involving any disassembly of the equipment should be performed by professional service personnel. Otherwise, undue equipment failure and possible health hazards could result.**
- **Do not open batteries, heat batteries to above 60 °C, incinerate batteries, or short the battery terminals. Batteries may ignite, explode, leak or heat up, causing personal injury.**
- **The service personnel must be properly qualified and thoroughly familiar with the operation of the equipment.**

CAUTION

- **The equipment and accessories shall not be served or maintained while in use with a patient.**
- **If you discover a problem with any of the equipment, contact your service personnel or Mindray.**
- **Use and store the equipment within the specified temperature, humidity, and altitude ranges.**
- **When disposing of the packaging material, be sure to observe the applicable waste control regulations and keep it out of children's reach.**
- **At the end of its service life, the equipment, as well as its accessories, must be disposed of in compliance with the guidelines regulating the disposal of such products. If you have any questions concerning disposal of the equipment, please contact Mindray.**

NOTE

- **If needed, contact the manufacture for circuit diagrams, component part lists, descriptions, calibration instructions, or other information concerning the repair of the equipment.**

42.3 Maintenance and Testing Schedule

Follow the maintenance and testing schedule or local regulations to perform testing and maintenance. Make sure to clean and disinfect the equipment before taking any tests and maintenance

The following table lists the maintenance and testing schedule:

<table>
<tr><th colspan="2">Test/Maintenance Item</th><th>Recommended Frequency</th></tr>
<tr><td colspan="3">Performance Tests</td></tr>
<tr><td colspan="2">Visual inspection</td><td>Every day, before first use.</td></tr>
<tr><td colspan="2">Measurement module performance test and calibration</td><td>1. If you suspect that the measurement values are incorrect.
2. Follow any repairs or replacement of relevant module.
3. Once a year for CO2 and AG tests.
4. Once every two years for other parameter module performance tests.</td></tr>
<tr><td colspan="2">Analog output test</td><td>If you suspect that the analog output function does not work properly.</td></tr>
<tr><td colspan="2">Defibrillation synchronization test</td><td>If you suspect that the defibrillation synchronization function does not work properly.</td></tr>
<tr><td colspan="2">Nurse call test</td><td>If you suspect that the nurse call function does not work properly.</td></tr>
<tr><td colspan="3">Electrical Safety Tests</td></tr>
<tr><td colspan="2">Electrical safety tests</td><td>Once every two years.</td></tr>
<tr><td colspan="3">Other Tests</td></tr>
<tr><td colspan="2">Power-on test</td><td>Before use.</td></tr>
<tr><td colspan="2">NMT sensor check</td><td>Once a year.</td></tr>
<tr><td colspan="2">Recorder check</td><td>1. When the recorder is used for the first time.
2.Follow any repair or replacement of the recorder.</td></tr>
<tr><td colspan="2">Network printer tests</td><td>1. When first installed.
2.Followany repair or replacement of the printer.</td></tr>
<tr><td colspan="2">Device integration check</td><td>1. When first installed.
2. Follow any repair or replacement of the external device.</td></tr>
<tr><td rowspan="2">Battery check</td><td>Functionality test</td><td>1. When first installed.
2. When battery is replaced.</td></tr>
<tr><td>Performance test</td><td>Every three months or if the battery runtime reduced significantly.</td></tr>
</table>

42.4 Testing Methods and Procedures

Except the following maintenance tasks, all other test and maintenance tasks should be performed by Mindray-qualified service personnel only.

- Regular check, including visual inspection and power-on test
- NMT sensor check
- Printer and recorder tests
- Battery check

If your monitor needs a safety test and performance test, contact the service personnel.

42.4.1 Performing Visual Inspection

Visually inspect the equipment before its first used every day. If you find any signs of damage, remove your monitor from use and contact the service personnel.

Verify that the equipment meets the following requirements:

- Environment and power supply specifications are met.
- The monitor housing and display screen are free from cracks or other damages
- The power cord is not damaged and the insulation is in good condition.
- Connectors, plugs, and cables are not damaged and kinked.
- Power cord and patient cables are securely connected with the equipment and modules.

42.4.2 Performing Power-on Test

The monitor automatically performs a selftest at startup. Check the following items for the power-on test:

- The equipment powers on properly.
- The alarm system works properly.
- The monitor displays properly.

42.4.3 Checking the NMT Sensor

NMT sensor check is required once a year or when you doubt the measured values.

To calibrate the NMT sensor,

1. Select the **Main Menu** quick key → from the **System** column select **Maintenance** → input the required password → select .
2. Select the **Module** tab → **NMT** tab.
3. Follow the on-screen instructions to check the NMT sensor in four ways.

If sensor check completes successfully, the message “Test passed. The function of NMT sensor is OK” is presented. If any of the four steps fails, check if the sensor is placed correctly as instructed and perform the sensor check again. Replace the sensor or contact your service personnel if you cannot pass the sensor check.

NOTE

- **Stop NMT measurement or calibration before starting NMT sensor check.**
- **Take care to handle the NMT sensor, avoiding forcefully striking the sensor.**

42.4.4 Testing the Recorder

To test the recorder, follow this procedure:

1. Start a recording task to print waveforms and reports.
2. Check that the recorder functions correctly.
3. Check that the printout is clear without missing dots.

42.4.5 Testing the Network Printer

To check the printer, follow this procedure:

1. Start a printing task to print waveforms and reports.
2. Check that the printer is properly connected and functions correctly.
3. Check that the printout is clear without missing dots.

42.4.6 Checking the Battery

For information on battery check, see *40.6.2 Checking Battery Performance*.

42.5 Disposing of the Monitor

Dispose of the monitor and its accessories when its service life is reached. Follow local regulations regarding the disposal of such product.

WARNING

- **For disposal of parts and accessories, where not otherwise specified, follow local regulations regarding disposal of hospital waste.**

43 Accessories

The accessories listed in this chapter comply with the requirements of IEC 60601-1-2 when in use with the patient monitor. The accessory material that contacts the patients has undertaken the bio-compatibility test and is verified to be in compliance with ISO 10993-1. For details about the accessories, refer to the instructions for use provided with the accessory.

WARNING

- **Use accessories specified in this chapter. Using other accessories may cause damage to the monitor or not meet the claimed specifications.**
- **Single use accessories are not designed to be reused. Reuse may cause a risk of contamination and affect the measurement accuracy.**

CAUTION

- **The accessories may not meet the performance specifications if stored or used outside the specified temperature and humidity ranges. If accessory performance is degraded due to aging or environmental conditions, contact your service personnel.**
- **Check the accessories and their packages for any sign of damage. Do not use them if any damage is detected.**
- **Use the accessories before the expiry date if their expiry date is indicated.**
- **The disposable accessories shall be disposed of according to hospital's regulations.**

43.1 ECG Accessories

43.1.1 ECG Electrodes

Model	PN	Description	Applicable patient
31499224	0010-10-12304	Electrode Kendall, 10 pcs/package	Adult
2245-50	9000-10-07469	Electrode 3M, 50 pcs/package	Pediatric
1050NPSMKittycat	0681-00-0098-01	NEO Pre-wired Electrode radio Opaque	Neonate
1051NPSMKittycat	0681-00-0098-02	NEO Pre-wired Electrode radio Transluent	Neonate
SF06	040-002711-00	Electrode, 5 pcs/package	Adult
SF07	040-002833-00	Electrode, Intco	Pediatric, neonate
H124SG	900E-10-04880	Electrode, Kendall, 50 pcs/package	Neonate

43.1.2 12-Pin Trunk Cables

Model	PN	Description	Applicable patient
EV6201	0010-30-42719 009-004728-00	ECG cable,12-pin, 3/5-lead, defibrillation-proof AHA/IEC	Adult, pediatric
EV6202	0010-30-42720	ECG cable,12-pin, 3-lead, defibrillation-proof, AHA/IEC	Neonate, infant

Model	PN	Description	Applicable patient
EV6203	0010-30-42721	ECG cable, 12-lead, defibrillation-proof, AHA	Adult
EV6204	0010-30-42722	ECG cable, 12-lead, defibrillation-proof, IEC	Adult
EV6211	0010-30-42723	ECG cable, 12-pin, 3/5-lead, ESU-proof, AHA/IEC	Adult, pediatric
EV6212	0010-30-42724	ECG cable, 12-pin, 3-lead, ESU-proof, AHA/IEC	Neonate, infant
EV6222	040-000754-00	ECG cable, 12-pin, 3-lead, defibrillation-proof, DIN connector	Neonate
EV6206	009-005266-00	ECG cable, defibrillation-proof, 3.1 m, T/N series	Adult, pediatric
EV6216	009-005268-00	ECG cable, ESU-proof, 3.1 m, T/N series	Adult, pediatric
EV6205	040-001416-00	ECG cable, 12-pin, 3/5-lead, defibrillation-proof, (DS)	Adult, pediatric
EV6213	009-003652-00	ECG cable, 12-pin, 3/5-lead, ESU-proof, (DS)	Adult, pediatric

43.1.3 3-lead ECG Leadwires

Model	PN	Description	Length	Applicable patient
EL6305A	0010-30-42896	ECG leadwires, 3-lead, AHA, clip, long	1 m	Neonate, infant
EL6306A	0010-30-42897	ECG leadwires, 3-lead, IEC, clip, long	1 m	Neonate, infant
EL6303A	0010-30-42731	ECG leadwires, 3-lead, AHA, clip, long	1 m	Adult, pediatric
EL6304A	0010-30-42732	ECG leadwires, 3-lead, IEC, clip, long	1 m	Adult, pediatric
EL6301B	0010-30-42734	ECG leadwires, 3-lead, AHA, snap, long	1 m	Adult, pediatric
EL6302B	0010-30-42733	ECG leadwires, 3-lead, IEC, snap, long	1 m	Adult, pediatric
EL6311B	040-000146-00	ECG leadwires, 3-lead, AHA, snap, long, disposable	1 m	Neonate, infant
EL6312B	040-000147-00	ECG leadwires, 3-lead, IEC, snap, long, disposable	1 m	Neonate, infant
EL6311A	040-000148-00	ECG leadwires, 3-lead, AHA, snap, long, disposable	1 m	Neonate, infant
EL6312A	040-000149-00	ECG leadwires, 3-lead, IEC, snap, long, disposable	1 m	Neonate, infant

43.1.4 5-lead ECG Leadwires

Model	PN	Description	Length	Applicable patient
EL6503A	0010-30-42729	ECG leadwires, 5-lead, AHA, clip, long	1m to 1.4m	Adult, pediatric
EL6504A	0010-30-42730	ECG leadwires, 5-lead, IEC, clip, long	1m to 1.4m	Adult, pediatric
EL6501B	0010-30-42735 009-004729-00	ECG leadwires,5-lead, AHA, snap	1m to 1.4m	Adult, pediatric
EL6502B	0010-30-42736 009-004730-00	ECG leadwires, 5-lead, IEC, snap	1m to 1.4m	Adult, pediatric

43.1.5 6-lead ECG Leadwires

Model	PN	Description	Length	Applicable patient
EY6601B	009-004794-00	ECG leadwires, 6-lead, AHA, snap, 24 inch	24 inch	Adult, pediatric
EY6602B	009-004795-00	ECG leadwires, 6-lead, AHA, snap, 36 inch	36 inch	Adult, pediatric
EY6603B	009-004796-00	ECG leadwires, 6-lead, IEC, snap, 24 inch	24 inch	Adult, pediatric
EY6604B	009-004797-00	ECG leadwires, 6-lead, IEC, snap, 36 inch	36 inch	Adult, pediatric
EY6601A	009-004798-00	ECG leadwires, 6-lead, AHA, clip, 24 inch	24 inch	Adult, pediatric
EY6602A	009-004799-00	ECG leadwires, 6-lead, AHA, clip, 36 inch	36 inch	Adult, pediatric
EY6603A	009-004800-00	ECG leadwires, 6-lead, IEC, clip, 24 inch	24 inch	Adult, pediatric
EY6604A	009-004801-00	ECG leadwires, 6-lead, IEC, clip, 36 inch	36 inch	Adult, pediatric

43.1.6 12-lead ECG Leadwires

Model	PN	Description	Length	Applicable patient
EL6801A	0010-30-42902	ECG leadwires, 12-lead, limb lead, AHA, clip	0.8 m	Adult
EL6803A	0010-30-42904	ECG leadwires, 12-lead, chest lead, AHA, clip	0.6 m	Adult
EL6802A	0010-30-42903	ECG leadwires, 12-lead, limb lead, IEC, clip	0.8 m	Adult
EL6804A	0010-30-42905	ECG leadwires, 12-lead, chest lead, IEC, clip	0.6 m	Adult
EL6801B	0010-30-42906	ECG leadwires, 12-lead, limb lead, AHA, snap	0.8 m	Adult
EL6803B	0010-30-42908	ECG leadwires, 12-lead, chest lead, AHA, snap	0.6 m	Adult
EL6802B	0010-30-42907	ECG leadwires, 12-lead, limb lead, IEC, snap	0.8 m	Adult
EL6804B	0010-30-42909	ECG leadwires, 12-lead, chest lead, IEC, snap	0.6 m	Adult

43.2 SpO_2 Accessories

Wavelength emitted by the sensors is between 600 nm and 1000 nm. The maximum photic output consumption of the sensor is less than 18 mW.

The information about the wavelength range and maximum photic output consumption can be especially useful to clinicians, for example, when photodynamic therapy is performed.

43.2.1 Extension Cables

Model	Part No.	Description	Applicable patient
562A	0010-20-42710 009-004600-00	7-pin, Mindray	All
572A	0010-20-42712	8-pin, Nellcor	All
582A	040-000332-00	8-pin, Masimo	All

Note: If you need to purchase Masimo sensors, please contact Masimo.

43.2.2 Mindray SpO_2 Sensors

Model	PN	Description	Applicable patient	Application site
512F	512F-30-28263	Reusable SpO2 sensor	Adult	Finger
512H	512H-30-79061	Reusable SpO2 sensor	Pediatric	Finger
512E	512E-30-90390	Reusable SpO2 sensor	Adult	Finger
512G	512G-30-90607	Reusable SpO2 sensor	Pediatric	Finger
518B	518B-30-72107	Reusable SpO2 sensor	Neonate	Foot
520A	009-005087-00	Disposable SpO2 sensor	Adult	Finger
520P	009-005088-00	Disposable SpO2 sensor	Pediatric	Finger
520I	009-005089-00	Disposable SpO2 sensor	Infant	Toe
520N	009-005090-00	Disposable SpO2 sensor	Neonate	Foot
521A	009-005091-00	Disposable SpO2 sensor	Adult	Finger
521P	009-005092-00	Disposable SpO2 sensor	Pediatric	Finger
521I	009-005093-00	Disposable SpO2 sensor	Infant	Toe
521N	009-005094-00	Disposable SpO2 sensor	Neonate	Foot
518C	040-000330-00	Reusable SpO2 Sensor	Neonate	
518C	115-004895-00	Disposable bandage, for 518C SpO_2 sensor	Neonate	
513A	115-033848-00	Reusable SpO2 sensor	Adult, pediatric	Ear

43.2.3 Nellcor SpO_2 Sensors

Model	PN	Description	Applicable patient	Application site
DS100A	9000-10-05161	Reusable SpO2 sensor	Adult	Finger
OXI-P/I	9000-10-07308	Reusable SpO2 sensor	Pediatric, infant	Finger
OXI-A/N	9000-10-07336	Reusable SpO2 sensor	Adult, neonate	Finger, foot
MAXAI	0010-10-12202	Disposable SpO2 sensor	Adult (>30 kg)	Finger
MAXPI	0010-10-12203	Disposable SpO2 sensor	Pediatric (10 - 50Kg)	Finger
MAXII	0010-10-12204	Disposable SpO2 sensor	Infant (3 - 20Kg)	Toe
MAXNI	0010-10-12205	Disposable SpO2 sensor	Neonate (<3 kg), adult (>40 kg)	Foot Finger

43.3 Temp Accessories

43.3.1 Temp Cable

Model	Part No.	Description	Applicable patient
MR420B	040-001235-00	2-pin extension cable	All

43.3.2 Temp Probes

Model	Part No.	Description	Applicable patient
MR401B	0011-30-37392	Reusable temperature probe, esophageal	Adult
MR402B	0011-30-37394	Reusable temperature probe, esophageal	Pediatric, infant
MR403B	0011-30-37393	Reusable temperature probe, skin	Adult
MR404B	0011-30-37395	Reusable temperature probe, skin	Pediatric, infant
MR411	040-003292-00	Disposable temperature probe, esophageal/rectal, general	Adult, pediatric
MR412	040-003293-00	Disposable temperature probe, skin	All

43.3.3 Tympanic Temperature Accessories

Model	Part No.	Description	Applicable patient
/	100-000200-00	Genius™ 2 Tympanic Probe Covers	Adult, pediatric, infant

43.4 NIBP Accessories

43.4.1 NIBP Hoses

Model	Part No.	Description	Applicable patient
CM1901	6200-30-11560	Reusable NIBP hose	Neonate
CM1903	6200-30-09688	Reusable NIBP hose	Adult, pediatric

43.4.2 Cuffs

Model	Part No.	Description	Limb Circumference (cm)	Bladder Width (cm)	Applicable patient
CM1200	115-002480-00	Reusable cuff	7 - 13	3.8	Small infant
CM1201	0010-30-12157	Reusable cuff	10 - 19	7.2	Infant
CM1202	0010-30-12158	Reusable cuff	18 - 26	9.8	Pediatric
CM1203	0010-30-12159	Reusable cuff	24 - 35	13.1	Adult
CM1204	0010-30-12160	Reusable cuff	33 - 47	16.5	Large adult
CM1205	0010-30-12161	Reusable cuff	46 - 66	20.5	Adult thigh

Model	Part No.	Description	Limb Circumference (cm)	Bladder Width (cm)	Applicable patient
CM1300	040-000968-00	Reusable cuff, bladderless	7 - 13	3.8	Small infant
CM1301	040-000973-00	Reusable cuff, bladderless	10 - 19	7.2	Infant
CM1302	040-000978-00	Reusable cuff, bladderless	18 - 26	9.8	Pediatric
CM1303	040-000983-00	Reusable cuff, bladderless	24 - 35	13.1	Adult
CM1304	040-000988-00	Reusable cuff, bladderless	33 - 47	16.5	Large adult
CM1305	040-000993-00	Reusable cuff, bladderless	46 - 66	20.5	Adult thigh
CM1306	115-015930-00	Reusable cuff, bladderless	24 - 35	13.1	Adult
CM1307	115-015931-00	Reusable cuff, bladderless	33 - 47	16.5	Large adult
CM1501	001B-30-70697	NIBP cuff, single patient use, 10 pcs/box	10 to 19	7.2	Infant
CM1502	001B-30-70698	NIBP cuff, single patient use, 10 pcs/box	18 to 26	9.8	Pediatric
CM1503	001B-30-70699	NIBP cuff, single patient use, 10 pcs/box	25 to 35	13.1	Adult
CM1504	001B-30-70700	NIBP cuff, single patient use, 10 pcs/box	33 to 47	16.5	Adult
CM1505	001B-30-70701	NIBP cuff, single patient use, 10 pcs/box	46 to 66	20.5	Adult thigh
CM1506	115-016969-00	NIBP cuff, single patient use, 10 pcs/box	25 to 35	13.1	Adult
CM1507	115-016970-00	NIBP cuff, single patient use, 10 pcs/box	33 to 47	16.5	Adult
CM1500A	001B-30-70692	NIBP cuff, single patient use, size 1, 20 pcs/box	3.1 to 5.7	2.2	Neonate
CM1500B	001B-30-70693	NIBP cuff, single patient use, size 2, 20 pcs/box	4.3 to 8.0	2.9	Neonate
CM1500C	001B-30-70694	NIBP cuff, single patient use, size 3, 20 pcs/box	5.8 to 10.9	3.8	Neonate
CM1500D	001B-30-70695	NIBP cuff, single patient use, size 4, 20 pcs/box	7.1 to 13.1	4.8	Neonate
CM1500E	001B-30-70696	NIBP cuff, single patient use, size 5, 20 pcs/box	8 to 15	5.4	Neonate

43.5 IBP Accessories

43.5.1 IBP Accessories

Model	Part No.	Description	Applicable patient
IM2202	001C-30-70757	12-pin IBP cable, Argon	/
DT-4812	6000-10-02107	IBP transducer, disposable, Argon	Adult, pediatric, neonate
682275	0010-10-12156	Transducer/Manifold Mount, Argon	/
IM2201	001C-30-70759	12 Pin IBP cable, ICU Medical	/
42584	0010-10-42638	IBP transducer, disposable, ICU Medical	/
42602	M90-000133---	Steady Rest for IBP Transducer and Clamp, ICU Medical	/
42394	M90-000134---	Steady Rest for IBP Transducer and Clamp, ICU Medical	/
IM2211	0010-21-12179	12 Pin IBP cable, for Edwards, reusable	Adult, pediatric, neonate
IM2206	115-017849-00	12 Pin IBP cable, for Utah, reusable	Adult, pediatric, neonate
IM2207	0010-21-43082	12 Pin IBP Cable, for Memscap,SP844 82031 transducer, reusable	Adult, pediatric, neonate
IM2213	0010-30-43055	IBP adapter cable (12-pin to 6-pin)	All

43.5.2 ICP Accessories

Model	Part No.	Description	Applicable patient
82-6653	040-002336-00	ICP sensor kit, disposable	/
CP12601	009-005460-00	12-pin ICP cable	/

43.6 C.O. Accessories

Model	Part No.	Description	Applicable patient
CO7702	0010-30-42743	12-pin C.O. cable	/
131HF7	6000-10-02183	Dilution hose, Edwards	/
SP4042	6000-10-02079	Disposable TI sensor, BD	/
SP5045	6000-10-02080	Disposable TI sensor housing, BD	/
MX387	6000-10-02081	12 cc control syringe W/1 cc stop W/ rotator, disposable, Medex	/

43.7 $ScvO_2$ Accessories

Model	Part No.	Description	Applicable patient
PC3030	115-008191-00	8-pin ScvO2 module and cable, reusable	/
PV2022-37	040-000919-00	CeVOX probe, 37 cm, disposable	/
PV2022-35	040-000920-00	CeVOX probe, 35 cm, disposable	/

43.8 PiCCO Accessories

Model	Part No.	Description	Applicable patient
CO7701	040-000816-00	12-pin PiCCO cable	/
PC80105	040-000817-00	2Pin TI sensor cable	/
PV2015L20N	040-000921-00	Arterial thermodilution catheter, disposable	Adult
PV2013L07N	040-000922-00	Arterial thermodilution catheter, disposable	Pediatric
IM2203	040-000815-00	12-pin IBP Y cable, reusable	/
IM2212	040-002827-00	12-pin AP&CVP cable, reusable	/
IM2211	0010-21-12179	Edward: IBP Truwave Reusable Cable	/
IM2201	001C-30-70759	12 Pin IBP cable (for ICU Medical)	/
IM2202	001C-30-70757	12 Pin IBP cable (for BD)	/
/	040-002903-00	PiCCO monitoring plate	/
PV8215	040-002899-00	PiCCO monitoring kits, disposable	/
PV8115	040-000918-00	PiCCO monitoring kits, disposable	/

43.9 ICG Accessories

Model	Part No.	Description	Applicable patient
N1201-5	100-000148-00	ICG sensor, disposable	/
N1301-3	100-000149-00	ICG patient cable, normal	/

43.10 CO_2 Accessories

43.10.1 Sidestream CO_2 Accessories

Model	Part No.	Description	Applicable patient
4000	M02A-10-25937	Nasal CO2 sample cannula, disposable	Adult
4100	M02A-10-25938	Nasal CO2 sample cannula, disposable	Pediatric
4200	M02B-10-64509	Nasal CO2 sample cannula, disposable	Neonate
60-15200-00	9200-10-10533	Airway sampling line, disposable	Adult, pediatric
60-15300-00	9200-10-10555	Airway sampling line, disposable	Neonate
60-14100-00	9000-10-07486	Airway adapter, straight, disposable	/
040-001187-00	040-001187-00	Airway adapter, disposable	Neonate
60-14200-00	9000-10-07487	Airway adapter, elbow, disposable	/
100-000080-00	100-000080-00	Watertrap, DRYLINE II, reusable	Adult, pediatric
100-000081-00	100-000081-00	Watertrap, DRYLINE II, reusable	Neonate

43.10.2 Microstream CO_2 Accessories

Model	Part No.	Description	Applicable patient
XS04620	0010-10-42560	Disposable airway sampling line	Adult, pediatric
XS04624	0010-10-42561	Disposable airway sampling line, humidified	Adult, pediatric
006324	0010-10-42562	Disposable airway sampling line, humidified	Neonate
007768	0010-10-42563	Disposable airway sampling line, long	Adult, pediatric
007737	0010-10-42564	Disposable airway sampling line, long, humidified	Adult, pediatric
007738	0010-10-42565	Disposable airway sampling line, long, humidified	Neonate
009818	0010-10-42566	Disposable nasal sampling line	Adult
007266	0010-10-42567	Disposable nasal sampling line	Pediatric
009822	0010-10-42568	Disposable nasal sampling line, plus O_2	Adult
007269	0010-10-42569	Disposable nasal sampling line, plus O_2	Pediatric
009826	0010-10-42570	Disposable nasal sampling line, long, plus O_2	Adult
007743	0010-10-42571	Disposable nasal sampling line, long, plus O_2	Pediatric
008177	0010-10-42572	Disposable nasal sampling line, humidified	Adult
008178	0010-10-42573	Disposable nasal sampling line, humidified	Pediatric
008179	0010-10-42574	Disposable nasal sampling line, humidified	Neonate
008180	0010-10-42575	Disposable nasal sampling line, humidified, plus O_2	Adult
008181	0010-10-42576	Disposable nasal sampling line, humidified, plus O_2	Pediatric
008174	0010-10-42577	Disposable nasal sampling line	Adult
008175	0010-10-42578	Disposable nasal sampling line	Pediatric

43.10.3 Mainstream CO_2 Accessories

Model	Part No.	Description	Applicable patient
6063	0010-10-42662	Airway adapter, disposable	Adult, pediatric
6421	0010-10-42663	Airway adapter, disposable, with mouthpiece	Adult, pediatric
6312	0010-10-42664	Airway adapter, disposable	Pediatric, neonate
7007	0010-10-42665	Airway adapter, reusable	Adult, pediatric
7053	0010-10-42666	Airway adapter, reusable	Neonate
9960LGE	0010-10-42669	Mask, large	Adult
9960STD	0010-10-42670	Mask, standard	Adult
9960PED	0010-10-42671	Mask	Pediatric
6934	0010-10-42667	Cable management straps	/
8751	0010-10-42668	Sensor holding clips	/
1036698	6800-30-50760	CO2 sensor	/

43.11 AG Accessories

Model	Part No.	Description	Applicable patient
60-15200-00	9200-10-10533	Airway sampling line, disposable	Adult, pediatric
60-15300-00	9200-10-10555	Airway sampling line, disposable	Neonate
60-14100-00	9000-10-07486	Airway adaptor, straight, disposable	/
040-001187-00	040-001187-00	Airway adapter, disposable	Neonate
60-14200-00	9000-10-07487	Airway adaptor, elbow, disposable	/
100-000080-00	100-000080-00	Watertrap, DRYLINE II, reusable	Adult, pediatric
100-000081-00	100-000081-00	Watertrap, DRYLINE II, reusable	Neonate

43.12 RM Accessories

Model	Part No.	Description	Applicable patient
040-001947-00	040-001947-00	Flow sensor, 1.8 m	Adult, pediatric
040-001949-00	040-001949-00	Flow sensor, 3.3 m	Adult, pediatric
040-001948-00	040-001948-00	Flow sensor, 1.8 m	Neonate
040-001950-00	040-001950-00	Flow sensor, 3.3 m	Neonate

43.13 EEG Accessories

Model	Part No.	Description	Applicable patient
B8830085010	040-001594-00	EEG patient cable	/
B9721104003	040-001598-00	Cup electrode	Adult, pediatric
B9721105004	040-001602-00	Cup electrode	Pediatric
B9600085001	040-001596-00	Needle electrode, 10pcs/box, disposable	Adult, pediatric
B9690009100	040-001595-00	Skin prep gel	/
E9690028100	040-001597-00	Conductive gel	/

43.14 BIS Accessories

Model	Part No.	Description	Applicable patient
186-0195-MR	6800-30-50761	BIS Cable	/
186-0224-MR	115-005707-00	BISx4 Cable	/
186-0106	0010-10-42672	BISx sensor, Quatro	Adult
186-0200	0010-10-42673	BISx sensor, Quatro	Pediatric
186-0212	040-000392-00	BISx4 sensor, Bilateral	Adult

43.15 NMT Accessories (For Mindray NMT Module)

Model	Part No.	Description	Applicable patient
NM13101	040-001462-00	NMT cable	Adult, pediatric
NM13401	040-001463-00	NMT sensor cable	Adult, pediatric
NM13701	040-001464-00	NMT stimulation cable	Adult, pediatric
NM13901	040-002258-00	NMT sensor securing strap, 20 pcs/box, disposable	Adult, pediatric
NM13902	049-001606-00	NMT sensor securing strap, reusable	Adult, pediatric

43.16 rSO_2 Accessories

Model	Part No.	Description	Applicable patient
RSC-1	100-000164-00	Reusable sensor cable, channel 1, INVOS 5100C	/
RSC-2	100-000165-00	Reusable sensor cable, channel 2, INVOS 5100C	/
SAFB-SM	100-000168-00	Disposable SomaSensor (>40 kg)	Adult
SPFB	100-000169-00	isposable SomaSensor (<40 kg)	Pediatric
SNN	100-000181-00	Disposable OxyAlert NIRSensor (<5 kg), somatic, with sensor cable	Neonate
CNN	100-000180-00	Disposable OxyAlert NIRSensor (<5 kg), cerebral, with sensor cable	Neonate
CNN/SNN	100-000182-00	Disposable OxyAlert NIRSensor (<5 kg), somatic/cerebral, with sensor cable	Neonate
5100C-PA	100-000173-00	Preamplifier, channel 1 & 2, INVOS 5100C	/

43.17 BeneLink Accessories

Part No.	Description
115-007277-00	ID Adapter
009-001767-00	Serial port adapting cable, type A
009-001768-00	Serial port adapting cable, type B
009-001769-00	Serial port adapting cable, type C
009-002943-00	Serial port adapting cable, type D
009-004613-00	Serial port adapting cable, type E
009-008485-00	Serial port adapting cable, type F
047-004857-00	ID adapter label
047-004859-00	Network line label
009-001770-00	RJ45 connecting cable

43.18 Mount and Mounting Accessories

Part No.	Description
0010-30-11972	Clamp assembly kit
034-000452-00	7"/17.8 cm channel for φ38 mm post
034-000457-00	GCX M series pivot arm, 12"
034-000458-00	GCX M series articulating arm, 12" x 12"
042-014101-00	Plug-in box sleeve support
043-002629-00	21" Keyboard Tray
043-006060-00	Plug-in box cable hook
045-003254-00	TDS cross clamp with 9" up pole
115-032656-00	Mounting post, 6"
115-032657-00	Mounting post, 9"
115-033715-00	Handle (with encoder, for N22/N19)
115-033716-00	Handle (no encoder, for N22/N19)
115-033882-00	SMR bracket kit (lock hook)
115-033884-00	Keyboard kit for anesthetic machine
115-033911-00	SMR cable management mounting kit
115-033913-00	SMR lock hook mounting kit
115-035995-00	SMR clamp mounting kit
115-037737-00	SMR mounting kit, basic version
115-045621-00	SMR integrated mount accessory kit

The following installation accessories are for N17/N15/N12/N12C only.

Part No.	Description
045-000891-00	Tray Kit of wall mounting
045-000893-00	Rolling Stand
045-000915-00	T5 rolling stand
045-000924-00	iPM/iMEC rolling stand
045-000953-00	Trolley tray kit
045-000955-00	Trolley tray kit
045-001189-00	Value stand (MR)
045-001190-00	Transport stand (MR)
045-003297-00	Mount Transition Plate
045-003240-00	M Series 12" arm with Transition Plate
045-003253-00	GCX VHM Series arm with Transition Plate
045-003255-00	N12 roll stands(With iPM/iMEC adapter)
115-045865-00	Bedrail Hook (M3X16)

The following installation accessories are for N22/N19 only.

Part No.	Description
034-000455-00	GCX VHM arm with 8" horizontal extension
034-000456-00	GCX VHM arm
034-000454-00	GCX M series arm, 16", with 6" riser
034-000464-00	Desktop mounting bracket
045-001976-00	Rotatory assembly kit for display
045-002138-00	Desktop seat
045-002198-00	Dock install to bracket package
115-033880-00	Adapting plate kit
115-033871-00	Keyboard kit for wall or tower

43.19 Miscellaneous Accessories

Part No.	Description
0000-10-10903	Power cord, H05VV-F3X1.5mmVolex, 1.8 m, India
0010-10-42667	Cable management strap, 5 pcs/pack
009-000259-00	CCO/SvO_2 connecting cable
009-001075-00	Power cord, 250 V, 10 A, 3 m, Brazil
009-001791-00	Power cord, 250 V, 16 A, 3 m, South Africa
009-002636-00	Power cord, 10 A, 1.5 m, Australia standard
009-003648-00	Cable protecting tube
009-003903-00	Accessory management tape
009-005000-00	External DC power cord
009-005103-00	Signal wire, from the monitor to the display
009-005115-00	Video cable, 2.3 m (for N22/N19)
009-005117-00	Video cable, 10 m (for N22/N19)
009-005118-00	USB cable, 2.3 m
009-005120-00	USB cable, 10 m
009-005121-00	SMR cable, 2m
009-005122-00	SMR cable, 10m
009-009766-00	SMR cable, 20m
009-005123-00	T1 docking station cable
009-005391-00	MPM analog output external cable
009-006439-00	Video cable, 1.6 m (for N22/N19)
009-006593-00	Cable connecting the monitor and the T1 docking station, 2 m
009-007190-00	Power cord, 3 m, India
009-007191-00	Power cord, 1.8 m, Switzerland
009-006594-00	Cable connecting the monitor and the T1 docking station, 10 m
009-007740-00	Video cable, 5 m (for N22/N19)

Part No.	Description
009-008237-00	USB cable, 5 m
022-000008-00	Lithium-ion battery, LI23S002A (for N17/N15/N12/N12C)
022-000013-00	Alkaline battery, 1.5V, AAA
022-000248-00	Lithium-ion battery, LI23S003A (for N22/N19)
022-000250-00	Power adapter, 100-250VAC,12V/5A (for N22/N19)
023-000247-00	USB keyboard
023-000248-00	USB mouse
023-000524-00	Wireless keyboard and mouse suite
023-000525-00	Wired keyboard and mouse suite
023-001076-00	HP LaserJet Pro M202dw, black and white, double-sided printing
023-001139-00	HP LaserJet Enterprise M605, black and white, USB 2.0
023-001158-00	Barcode reader, LI4278, Motorola
023-001286-00	2D Barcode reader, HS-1M, JADAK
023-001288-00	2D Barcode reader, HS-1R, JADAK
023-001393-00	Remote controller
023-001788-00	External display, 21.5-inch
023-001523-00	HP LaserJet Printer
044-000764-00	Display handle
048-006620-00	Luggage (for N22/N19)
1000-21-00122	Grounding cable
100-000198-00	GeniusTM 2 tethered thermometer
100-000201-00	GeniusTM 2 tethered thermometer base
115-004693-00	Vacant module (for N22/N19)
115-029872-00	Satellite module rack (SMR)
115-030320-00	Clinical Scoring Custom CD
115-031385-00	iView assembly (for N22/N19)
115-031466-00	Encoder kit (for N22/N19)
115-031500-00	Display assembly, 22" (for N22)
115-031502-00	Display assembly, 19" (for N19)
115-050298-00	Display rear housing (for N22/N19)
509B-10-05996	Power cord, 10 A, 250 V, 1.6 m, China
DA8K-10-14452	Power cord, USA
8000-21-10361	Nurse call cable
A30-000001---	Recording paper, 50 mm*20 m
DA8K-10-14453	Power cord, UK
DA8K-10-14454	Power cord, Europe

43.20 External Modules

Module	Model	Comments
MPM module	MPM-1	Integrates 5-lead ECG, RESP, Mindray SpO_2, TEMP, NIBP, IBP
MPM module	MPM-3	Integrates 5-lead ECG, RESP, Nellcor SpO_2, TEMP, NIBP, IBP
MPM module	MPM-7	Integrates 5-lead ECG, RESP, Mindray SpO_2, TEMP, NIBP
MPM module	MPM-9	Integrates 5-lead ECG, RESP, Nellcor SpO_2, TEMP, NIBP
MPM module	MPM-13	Integrates 12-lead ECG, RESP, Mindray SpO_2, TEMP, NIBP, IBP, analog output
MPM module	MPM-14	Integrates 12-lead ECG, RESP, Nellcor SpO_2, TEMP, NIBP, IBP, analog output
SpO_2 module	SpO2-1	Supports SpO2 monitoring, Mindray SpO_2
SpO_2 module	SpO2-2	Supports SpO2 monitoring, Nellcor SpO_2
Temp module	Temp	Supports temperature monitoring
C.O. module	C.O.	Supports C.O. monitoring
IBP module	IBP	Supports IBP monitoring
BIS module	BIS	Supports BIS monitoring
ICG module	ICG	Supports ICG monitoring, Medis ICG
CCO/SvO_2 module	CCO/SvO2	Connects Edwards Vigilance II®, Vigileo™, or EV1000 monitor, supports CCO and SvO2 monitoring
PiCCO module	PiCCO	Supports CCO monitoring and other hemodynamic parameters
$ScvO_2$ module	$ScvO_2$	Supports ScvO2 monitoring
EEG module	EEG	Supports EEG monitoring
NMT module	NMT	Supports NMT monitoring
rSO_2 module	rSO_2	Supports rSO_2 monitoring
Microstream CO_2 module	CO2-1	Supports CO2 monitoring
Mainstream CO_2 module	CO2-2	Supports CO2 monitoring
Sidestream CO_2 module	CO2-3	Supports CO2 monitoring
Sidestream CO_2 module	CO2-4	Supports CO2 monitoring, integrates O2 (paramagnetic) monitoring
RM module	RM	Supports RM monitoring
AG module	AG-1	Supports AG monitoring
AG module	AG-2	Supports AG monitoring, integrates O_2 (paramagnetic) and BIS monitoring
AG module	AG-3	Supports AG monitoring, integrates O_2 (paramagnetic) monitoring
AG module	AG-4	Supports AG monitoring, integrates BIS monitoring
Tympanic Temp adapting module	Tympanic Temp	Connects the Genius tympanic thermometer to the monitor
BeneLink module	BeneLink	Connects external devices
Recorder module	/	Supports recording

This page intentionally left blank.

A Product Specifications

A.1 Monitor Safety Specifications

The monitor is classified, according to IEC 60601-1:

Degree of protection against electrical shock	Type CF defibrillation proof for ECG, Resp, TEMP, IBP, SpO_2, C.O., PiCCO, NIBP, EEG, and NMT Type BF defibrillation proof for Tympanic Temp, $ScvO_2$, CO_2, ICG, BIS, AG, RM, and rSO_2
Type of protection against electrical shock	Class I
Degree of protection against harmful ingress of water	IPX1
Degree of safety of application in the presence of flammable anesthetic mixture with air or with oxygen or nitrous oxide	The equipment is not suitable for use in the presence of a flammable anesthetic mixture with air or with oxygen or nitrous oxide
Mode of operation	Continuous

A.2 Physical Specifications

A.2.1 BeneVision N22/N19

Item	Maximum Weight (kg)	W × H × D (mm)	Comments
N19 monitor (main unit and primary display installed together)	10.30	509 × 423 × 115 (display horizontally installed) 584 × 348 × 115 (display vertically installed)	Including the battery, iView module, Wi-Fi module, display with the handle and navigation knob. Excluding SMR, modules, and accessories.
N22 monitor (main unit and primary display installed together)	11.50	566 × 458 × 115 (display horizontally installed) 641 × 383 × 115 (display vertically installed)	Including the battery, iview module, Wi-Fi module, display with the handle and navigation knob. Excluding SMR, modules, and accessories.
Main unit	3.40	268 × 268 × 68	Including the battery.
Display, 19 inch	6.20	509 × 348 × 48	Excluding the handle.
Display, 22 inch	7.40	566 × 383 × 48	Excluding the handle.

A.2.2 BeneVision N17/N15/N12/N12C

Item	Maximum Weight (kg)	W × H × D (mm)	Comments
N17	7.3	466×355×210	Standard configuration, excluding modules, recorder, battery and accessories.
N15	5.4	396×313×193	
N12/12C	4.1	313×290×161	

A.2.3 SMR and Modules

Item	Maximum Weight (kg)	W × H × D (mm)	Comments
Satellite module rack (SMR)	2.30	403 × 221 × 145	Including the handle and cable hooks.
MPM module	0.63	136.5 × 80.5 × 102	/
SpO_2 module	0.29	136.5 × 40 × 102	Mindray SpO_2
SpO_2 module	0.29	136.5 × 40 × 102	Nellcor SpO_2
Temp module	0.25	136.5 × 40 × 102	/
C.O. module	0.25	136.5 × 40 × 102	/
IBP module	0.26	136.5 × 40 × 102	/
BIS module	0.26	136.5 × 40 × 102	/
ICG module	0.30	136.5 × 40 × 102	Medis ICG
CCO/SvO_2 module	0.26	136.5 × 40 × 102	/
PiCCO module	0.30	136.5 × 40 × 102	/
$ScvO_2$ module	0.26	136.5 × 40 × 102	/
EEG module	0.28	136.5 × 40 × 102	/
NMT module	0.29	136.5 × 40 × 102	/
rSO_2 module	0.30	136.5 × 40 × 102	/
Mainstream CO_2 module	0.26	136.5 × 40 × 102	/
Microstream CO_2 module	0.38	136.5 × 40 × 102	/
Sidestream CO_2 module	0.54	136.5 × 40 × 102	/
Sidestream CO_2 module	0.63	136.5 × 40 × 102	With build-in O_2 module
RM	0.38	136.5 × 40 × 102	/
AG	1.03	136.5 × 80.5 × 102	Without built-in O_2 module and BIS module
AG	1.15	136.5 × 80.5 × 102	With built-in O_2 module and BIS module
AG	1.03	136.5 × 80.5 × 102	With built-in O_2 module
AG	1.06	136.5 × 80.5 × 102	With built-in BIS module
Tympanic Temp adapting module	0.25	136.5 × 80.5 × 102	/
BeneLink	0.35	136.5 × 40 × 102	/
Recorder	0.40	136.5 × 80.5 × 102	/

A.3 Environmental Specifications

WARNING

- **The monitor may not meet the performance specifications if stored or used outside the specified temperature and humidity ranges. If the performance of the equipment is degraded due to aging or environmental conditions, contact your service personnel.**
- **When the monitor and related products have differing environmental specifications, the effective range for the combined products is that range which is common to the specifications for all products.**

NOTE

- **The environmental specification of unspecified parameter modules are the same as those of the main unit.**

Components	Item	Operating Condition	Storage Condition
Main Unit	Temperature (ºC)	0 to 40 (0 to 35 for N17 configured with iView module)	-20 to 60
	Relative humidity (noncondensing) (%)	15 to 95	10 to 95
	Barometric (mmHg)	427.5 to 805.5	120 to 805.5
Microstream CO_2 module	Temperature (ºC)	0 to 40	-20 to 60
	Relative humidity (noncondensing) (%)	15 to 95	10 to 95
	Barometric (mmHg)	430 to 790	430 to 790
Sidestream CO_2 module	Temperature (ºC)	5 to 40	-20 to 60
	Relative humidity (noncondensing) (%)	15 to 95	10 to 95
	Barometric (mmHg)	430 to 790	430 to 790
Mainstream CO_2 module	Temperature (ºC)	0 to 40	-20 to 60
	Relative humidity (noncondensing) (%)	10 to 90	10 to 90
	Barometric (mmHg)	427.5 to 805.5	400 to 805.5
AG module	Temperature (ºC)	10 to 40	-20 to 60
	Relative humidity (noncondensing) (%)	15 to 95	10 to 95
	Barometric (mmHg)	525 to 805.5	525 to 805.5
RM module	Temperature (ºC)	5 to 40	-20 to 60
	Relative humidity (noncondensing) (%)	15 to 95	10 to 95
	Barometric (mmHg)	427.5 to 805.5	120 to 805.5
ICG module	Temperature (ºC)	10 to 40	0 to 50
	Relative humidity (noncondensing) (%)	15 to 95	15 to 95
	Barometric (mmHg)	427.5 to 805.5	120 to 805.5

Components	Item	Operating Condition	Storage Condition
PiCCO module	Temperature (ºC)	10 to 40	-20 to 60
	Relative humidity (noncondensing) (%)	15 to 75	10 to 90
	Barometric (mmHg)	427.5 to 805.5	120 to 805.5
$ScvO_2$ module	Temperature (ºC)	10 to 40	-20 to 60
	Relative humidity (noncondensing) (%)	15 to 75	10 to 90
	Barometric (mmHg)	427.5 to 805.5	120 to 805.5
rSO_2 module	Temperature (ºC)	16 to 32	-20 to 70
	Relative humidity (noncondensing) (%)	20 to 80	10 to 95
	Barometric (mmHg)	522 to 805.5	435.7 to 822

A.4 Power Supply Specifications

A.4.1 External Power Supply Specifications

Line voltage	100 to 240 VAC (±10%)
Input current	N22/N19: 2.8 to 1.6 A N17/N15/N12/N12C: 2.0 to 0.9 A
Frequency	50/60 Hz (± 3 Hz)

A.4.2 Battery Specifications

A.4.2.1 N22/N19 Battery Specifications

Battery type	Rechargeable lithium-Ion battery
Voltage	11.3 VDC
Capacity	5600 mAh
Run time	At least 1 hour when the monitor is powered by a new fully-charged battery at 25 ºC±5 ºC and works continuously at the following conditions: • The monitor is configured with a 12-lead ECG, Resp, SpO_2, 4-channel IBP, 2-channel Temp, CO_2, C.O. • NIBP module set at an interval of 15 minutes. • Wi-Fi is enabled. • The screen brightness is set to the factory default. Shutdown delay: at least 15 minutes after the low battery alarm first occurs
Charge time	For a new battery: 5 hours to 90% when the monitor is off. 9 hours to 90% when the monitor is on.

A.4.2.2 N17/N15/N12/N12C Battery Specifications

Battery type	Rechargeable lithium-Ion battery
Voltage	11.1 VDC
Capacity	4500 mAh
Run time	At least 2 hour for N17/N15 At least 4 hour for N12/N12C when the monitor is powered by a new fully-charged battery at 25 ºC±5 ºC with 5-lead ECG and SpO2 cable connected, auto NIBP measurements at an interval of 15 minutes, and screen brightness set to 1. Shutdown delay: at least 15 minutes after the low battery alarm first occurs
Charge time	No more than 4.5 hours to 90% when the monitor is off No more than 10 hours to 90% when the monitor is on

A.5 Display Specifications

Screen type	Medical-grade color TFT LCD
Screen Size (diagonal)	N22: 22 inches N19: 19 inches N17: 18.5 inches N15: 15.6 inches N12/N12C: 12.1 inches
Resolution	N22/N19: 1680 x 1050 pixels N17/N15: 1920 x1080 pixels N12/N12C: 1280 x 800 pixels

A.6 Touchscreen Specifications

Screen type	Capacitive, multi-point touch

A.7 Recorder Specifications

Method	Thermal dot array
Horizontal resolution	16 dots/mm (25 mm/s paper speed)
Vertical resolution	8 dots/mm
Paper width	50 mm
Paper length	20 m
Paper speed	25 mm/s, 50 mm/s Accuracy: ±5%
Number of waveform channels	A maximum of 3

A.8 LEDs

Alarm lamp	1 (three color-coded: red, yellow, and cyan)
Power-on LED	1 (green)
AC power LED	1 (green)
Battery LED	1 (two color-coded: yellow and green)

A.9 Audio Indicator

Speaker	Give alarm tones (45 to 85 dB), reminder tones, key tones, QRS tones; support PITCH TONE and multi-level tone modulation; alarm tones comply with IEC 60601-1-8.

A.10 Monitor Interface Specifications

A.10.1 Interface Specifications of the N22/N19 Main Unit

AC power input	1
Network connector (LAN1, LAN2, LAN3)	3, standard RJ45 connectors (one on the iView module), 100 Base-TX, IEEE 802.3
Serial bus connector (MSB)	6
USB connector	4, USB 2.0, on the iView module
Satellite module rack (SMR) connector	3
Video output connector (VP1, VP2)	2, VP1 connects the secondary display. VP2 connects the display for iView system.
Nurse call connector (NC)	1, standard BNC
Equipotential grounding terminal	1

A.10.2 Interface Specifications of the N22/N19 Separate Primary Display

Serial bus connector (MSB)	3
Serial bus hub connector (SBH)	1
Signal input connector (SIG1)	1
DC-in connector	1
Video output connector (VP1)	1

A.10.3 Interface Specifications of the N22/N19 Integrated Primary Display

Serial bus connector (MSB)	1

A.10.4 Interface Specifications of the N22/N19 Secondary Display

Serial bus connector (MSB)	3
Serial bus hub connector (SBH)	1
Signal input connector (SIG1)	1
DC-in connector	1
Video output connector (VP1)	1

A.10.5 Interface Specifications of the N17/N15/N12/N12C

AC power input	1
Network connector	N17: 2, standard RJ45 connectors (one on the iView module) N15/N12/N12C: 1, standard RJ45 connector
USB connector	N15/N12/N12C: 4, USB 2.0 N17: 8, USB 2.0, 4 on the iView module
Satellite module rack (SMR)Dock connector	1 (For N17/N15, it connects the SMR, N1 Dock, or T1 Dock. For N12/N12C, it connects the N1 Dock or T1 Dock)
Video output connector	N17: 2 (one for the iView system) N15/N12/N12C: 1
Nurse call connector	1, standard BNC
Equipotential grounding terminal	1

A.11 Signal Outputs Specifications

Auxiliary Output	
Standard	Meets the requirements of IEC 60601-1 for short-circuit protection and leakage current
ECG Analog Output	
Bandwidth (-3dB; reference frequency: 10Hz)	Diagnostic mode: 0.05 to 150 Hz Monitor mode: 0.5 to 40 Hz Surgical mode: 1 to 20 Hz ST mode: 0.05 to 40 Hz
Maximum QRS delay	25 ms (in diagnostic mode, and non-paced)
Gain (reference frequency 10Hz)	1V/mV (±5%)
Pace enhancement	Signal amplitude: V_{oh}≥2.5V Pulse width: 10ms±5% Signal rising and falling time: ≤100μs
IBP Analog Output	
Bandwidth (-3dB; reference frequency:1Hz)	0 to 40 Hz
Maximum transmission delay	30 ms
Gain (reference frequency 1 Hz)	1 V/100 mmHg, ±5%
Nurse Call Signal	
Amplitude	High level: 3.5 to 5 V, ±5%, providing a minimum of 10 mA output current; Low level: < 0.5 V, receiving a minimum of 5 mA input current.
Rising and falling time	≤1 ms
Defib Sync Pulse	
Output impedance	≤100 ohm
Maximum time delay	35 ms (R-wave peak to leading edge of pulse)
Amplitude	High level: 3.5 to 5 V, ±5%, providing a maximum of 10 mA output current; Low level: < 0.5 V, receiving a maximum of 5 mA input current.
Pulse width	100 ms ±10%
maximum rising and falling time	1 ms
Alarm output	

Alarm delay time from the monitor to remote equipment	The alarm delay time from the monitor to remote equipment is ≤2 seconds, measured at the monitor signal output connector.
Alarm signal sound pressure level range	45 db(A) to 85 db(A) within a range of one meter

A.12 Data Storage

Trends	A minimum of 120 hours' trend data with the resolution no less than 1 minute.
Events	1000 events, including parameter alarms, arrhythmia events, technical alarms, and so on
NIBP measurements	1000 sets
Interpretation of resting 12-lead ECG results	20 sets
Full-disclosure waveforms	48 hours at maximum. The specific storage time depends on the waveforms stored and the number of stored waveforms. 48 hours (8 G storage card, for N22/N19)
ST view	A maximum of 120 hours' ST segment waveforms. One group of ST segment waveforms is stored every one minutes.
OxyCRG view	48 hours. Trend data is stored one dot per second and the waveform stored is a compressed waveform.

A.13 Wi-Fi Specifications

A.13.1 Wi-Fi Technical Specifications

Protocol	IEEE 802.11a/b/g/n	
Modulation mode	DSSS and OFDM	
Operating frequency	IEEE 802.11b/g/n (at 2.4G)	IEEE 802.11a/n (at 5G)
	ETSI: 2.4 GHz to 2.483 GHz FCC: 2.4 GHz to 2.483 GHz MIC: 2.4 GHz to 2.495GHz KC: 2.4 GHz to 2.483 GHz	ETSI: 5.15 GHz to 5.35 GHz, 5.47 GHz to 5.725 GHz FCC: 5.15 GHz to 5.35 GHz, 5.725 GHz to 5.82 GHz MIC: 5.15GHz to 5.35 GHz KC: 5.15 GHz to 5.35 GHz, 5.47 GHz to 5.725 GHz, 5.725 GHz to 5.82 GHz
Channel spacing	IEEE 802.11b/g: 5 MHz IEEE 802.11n (at 2.4 G): 5 MHz IEEE802.11a: 20 MHz IEEE802.11n (at 5 G): 20 MHz	
Wireless baud rate	IEEE 802.11b: 1 Mbps to 11 Mbps IEEE 802.11g: 6 Mbps to 54 Mbps IEEE 802.11n: 6.5 Mbps to 72.2 Mbps IEEE 802.11a: 6 Mbps to 54 Mbps	
Output power	<20dBm (CE requirement, detection mode: RMS) <30dBm (FCC requirement: detection mode: peak power)	
Operating mode	Infrastructure	
Data security	Standards: WPA-PSK, WPA2-PSK, WPA-Enterprise,WPA2-Enterprise EAP method: EAP-FAST. EAP-TLS, EAP-TTLS, PEAP-GTC, PEAP- MSCHAPv2, PEAP-TLS, EAP-LEAP Encryption: TKIP, AES	

A.13.2 Wi-Fi Performance Specifications

WARNING

- **Do perform all network functions of data communication within an enclosed network.**

A.13.2.1 System capacity and resistance to wireless interference

Meets the following requirements:

- All the monitors do not encounter communication loss.
- The total delay of data transmission from the monitor to the CMS: ≤ 2 seconds.
- The delay for monitor-related settings configured at the CMS to be effective: ≤ 2 seconds.
- The total delay of data transmission from one monitor to the other: ≤ 2 seconds.
- The delay for the monitor to reset alarms of another to be effective: ≤ 2 seconds.
- The total delay of data transmission from the TM80 to the monitor: ≤ 2 seconds.

Testing conditions are as follows:

- Number of the monitors supported by a single AP: ≤ 12 (for N22/N19) or ≤ 16 (for N17/N15/N12/N12C).
- Each monitor can communicate with the CMS.
- Two monitors are used to view other monitors.
- Five monitors are connected to TM80s.
- Only one monitor can transmit history data.
- The weakest strength of the AP signal where the monitor is located is not less than -65 dBm.
- The distance between the interfering devices and the monitor is greater than 20 cm. A Wi-Fi interference (no greater than -85 dBm) in the same channel and a Wi-Fi interference (no greater than -50 dBm) in an adjacent-channel are presented synchronously. The interfering devices include, but are not limited to, 2.4 G wireless devices, cellular mobile networks, microwave ovens, interphones, cordless phones, and ESU equipment. The interfering devices do not include Wi-Fi devices.

A.13.2.2 Wi-Fi network stability

The ratio of the communication data loss on the CMS from any monitor does not exceed 0.1% over a 24-hour period (for N17/N15/N12/N12C, 12 of the 16 monitors connected to the network roam for 30 times).

Testing conditions are as follows:

- Number of the monitors supported by a single AP: ≤ 12 (for N22/N19) or ≤ 16 (for N17/N15/N12/N12C).
- Each monitor can communicate with the CMS.
- Two monitors are used to view other monitors.
- Five monitors are connected to TM80s.
- Only one monitor can transmit history data.
- The weakest strength of the AP signal where the monitor is located cannot be less than -65 dBm.

A.13.2.3 Distinct vision distance

The distinct vision distance between the monitor and the AP is no less than to 50 meters.

A.14 MPAN Specifications

A.14.1 MPAN Technical Specifications

Modulation mode	GFSK
Operating frequency	2402 MHz to 2480 MHz
Channel spacing	2MHz
Wireless baud rate	1 Mbps
Output power	≤2.5mW
Data security	Private protocol

A.14.2 MPAN Performance Specifications

A.14.2.1 System capacity and resistance to wireless interference

Meets the following requirements:

- The distinct vision distance between the monitor and the BP10 or the TM80: ≥ 5 m.
- Bluetooth communication does not interrupt.
- The total delay of data transmission from the TM80 or BP10 to the monitor: < 2 s.

Testing conditions are as follows:

- Five pairs of monitors and telemetry devices (TM80 or BP10) can communicate in a 10 m^2 space.
- The monitors communicating with the CMS via Wi-Fi.
- The distance between the interfering devices and the monitor is greater than 20 cm. The interfering devices include but are not limited to: Bluetooth devices, remote controllers, microwave ovens, interphones, network devices, cordless phones, and ESU equipment.

A.14.2.2 Bluetooth network stability

Meets the following requirements:

- The distinct vision distance between the monitor and the BP10 or the TM80: ≥ 5 m.
- The data loss percentage of bluetooth communication over a 24-hour period: < 0.1%.

Testing conditions are as follows:

- Five pairs of monitors and telemetry devices (TM80 or BP10) can communicate in a 10 m^2 space.
- The monitors communicating with the CMS via Wi-Fi.

A.15 Measurement Specifications

The adjustable range of alarm limits is the same with the measurement range of signals unless otherwise specified.

A.15.1 ECG Specifications

ECG		
Standards	Meet standards of IEC 60601-2-27 and IEC 60601-2-25	
Lead set	3-lead: I, II, III 5-lead: I, II, III, aVR, aVL, aVF, V 6-lead: I, II, III, aVR, aVL, aVF, Va, Vb 12-lead: I, II, III, aVR, aVL, aVF, V1 to V6	
ECG standard	AHA, IEC	
Display sensitivity	1.25 mm/mV (×0.125), 2.5 mm/mV (×0.25), 5 mm/mV (×0.5), 10 mm/mV (×1), 20 mm/mV (×2), 40 mm/mV (×4), Auto, less than 5% error	
Sweep speed	6.25 mm/s, 12.5 mm/s, 25 mm/s, 50 mm/s, less than 5% error	
Bandwidth (-3dB)	Diagnostic mode: Monitor mode: Surgical mode: ST mode: High Freq Cut-off (for 12-lead ECG analysis)	0.05 to 150 Hz 0.5 to 40 Hz 1 to 20 Hz 0.05 to 40 Hz 350 Hz, 150 Hz, 35 Hz, or 20 Hz, selectable
Common mode rejection ratio	Diagnostic mode: Monitor mode: Surgical mode: ST mode:	>90 dB >105 dB (with notch filter on) >105 dB (with notch filter on) >105 dB (with notch filter on)
Notch filter	50/60 Hz Monitor, surgical, and ST mode: notch filter turns on automatically Diagnostic mode and High Freq Cut-off: notch filter is turned on/off manually	
Differential input impedance	≥5 MΩ	
Input signal range	±8 mV (peak-to-peak value)	
Accuracy of signal reproduction	Use A and D methods based on IEC 60601-2-25 to determine frequency response.	
Electrode offset potential tolerance	±500 mV	
Lead-off detection current	Measuring electrode: <0.1 μA Drive electrode: <1 μA	
Input offset current	≤0.1 μA, (drive lead≤1μA)	
Defibrillation protection	Enduring 5000V (360 J) charge without data loss or corruption Baseline recovery time: <5 s (after defibrillation) Polarization recovery time: <10 s Defibrillation energy absorption: ≤10% (100Ω load)	
Patient leakage current	<10 uA	
Calibration signal	1mV (peak-to-peak value) ±5%	
ESU protection	Cut mode: 300 W Coagulate mode: 100 W Recovery time: ≤10 s In compliance with the requirements in clause 202.6.2.101 of IEC 60601-2-27	
Pace Pulse		

Pace pulse markers	Pace pulses meeting the following conditions are labelled with a PACE marker: Amplitude: ±2 to ±700 mV Width: 0.1 to 2 ms Rise time: 10 to 100 μs (no greater than 10% of pulse width) No overshoot
Pace pulse rejection	When tested in accordance with the IEC 60601-2-27: 201.12.1.101.13, the heart rate meter rejects all pulses meeting the following conditions. Amplitude: ±2 to ±700 mV Width: 0.1 to 2 ms Rise time: 10 to 100 μs (no greater than 10% of pulse width) No overshoot

HR	
Measurement range	Neonate: 15 to 350 bpm Pediatric: 15 to 350 bpm Adult: 15 to 300 bpm
Resolution	1 bpm
Accuracy	±1 bpm or ±1%, whichever is greater.
Sensitivity	200 μV (lead II)
HR averaging method	In compliance with the requirements in Clause 201.7.9.2.9.101 b) 3) of IEC 60601-2-27, the following method is used: If the last 3 consecutive RR intervals are greater than 1200 ms, the 4 most recent RR intervals are averaged to compute the HR. Otherwise, heart rate is computed by subtracting the maximum and minimum ones from the most recent 12 RR intervals and then averaging them. The HR value displayed on the monitor screen is updated no more than one second.
Response to irregular rhythm	In compliance with the requirements in Clause 201.7.9.2.9.101 b) 4) of IEC 60601-2-27, the heart rate after 20 seconds of stabilization is displayed as follows: Ventricular bigeminy (waveform A1): 80±1 bpm Slow alternating ventricular bigeminy (waveform A2): 60±1 bpm Rapid alternating ventricular bigeminy (waveform A3): 120±1 bpm Bidirectional systoles (waveform A4): 90±2 bpm
Response time to heart rate change	Meets the requirements of IEC 60601-2-27: Clause 201.7.9.2.9.101 b) 5). From 80 to 120 bpm: less than 11 s From 80 to 40 bpm: less than 11 s
Time to alarm for tachycardia	Meets the requirements in Clause 201.7.9.2.9.101 b) 6) of IEC 60601-2-27. Waveform B1h-range: <11 s B1-range: <11 s B1d-range: <11 s B2h-range: <11 s B2-range: <11 s B2d-range: <11 s
Tall T-wave rejection capability	When the test is performed based on Clause 201.12.1.101.17 of IEC 60601-2-27, the heart rate calculation is not affected for QRS of 1 mV amplitude and 100 ms duration, T-wave duration of 180 ms and amplitude lower than 1.2 mV, and QT interval of 350 ms.
Arrhythmia Analysis Classifications	Asystole, V-Fib/V-Tac, V-tac, Vent-. Brady, Extreme Tachy, Extreme Brady, Vent Rhythm, PVCs/min, Pauses/min, Couplet, Bigeminy, Trigeminy, R on T, Run PVCs, PVC, Tachy, Brady, Missed Beat, Pacer Not Paceing, Pacer Not Capture, Multiform PVC, Nonsus. V-Tac, Pause, Irr. Rhythm., A-Fib

ST Segment Analysis		
Measurement range	-2.0 to 2.0 mV RTI	
Accuracy	-0.8 to 0.8 mV: Beyond this range:	±0.02 mV or ±10%, whichever is greater. Not specified.
Resolution	0.01mV	
QT/QTc Analysis		
Measurement range	QT: 200 to 800 ms QTc: 200 to800 ms QT-HR: 15 to 150 bpm for adult, 15 to 180 bpm for pediatric and neonate	
Accuracy	QT: ±30 ms	
Resolution	QT: 4 ms QTc: 1 ms	
12-lead ECG Interpretation		
Sampling rate	1000 samples/s (A/D) 500 samples/s (ECG algorithm)	
Amplitude quantisation	24 bits	

Alarm limit	Range	Step
HR High	HR≤40bpm: (low limit + 2 bpm) to 40 bpm HR > 40 bpm: (low limit + 5 bpm) to 295 bpm	HR≤40bpm: 1 bpm HR > 40 bpm: 5 bpm
HR Low	HR≤40bpm: 16 bpm to (low limit - 2 bpm) HR > 40 bpm: 40 bpm to (low limit - 5 bpm)	
ST High	(low limit + 0.2 mV) to 2.0 mV (ST alarm mode: Absolute) 0 mV to 2.0 mV (ST alarm mode: Relative)	0.05 mV
ST Low	-2.0 mV to (high limit - 0.2 mV) (ST alarm mode: Absolute) -2.0 mV to 0 mV (ST alarm mode: Relative)	
QTc High	200 to 800 ms	10 ms
ΔQTc High	30 to 200 ms	

A.15.2 Resp Specifications

Technique	Trans-thoracic impedance
Lead	Options are lead I, II and Auto.
Respiration excitation waveform	<300 μA RMS, 62.8 kHz (±10%)
Minimum respiration impedance threshold	0.3Ω
Baseline impedance range	200 to 2500Ω (using an ECG cable with 1kΩ resistance)
Differential input impedance	>2.5 MΩ
Bandwidth	0.2 to 2.5 Hz (-3 dB)
Sweep speed	3mm/s, 6.25 mm/s, 12.5 mm/s, 25 mm/s or 50 mm/s, less than 10% error
Respiration Rate	
Measurement range	0 to 200 rpm

Resolution	1 rpm	
Accuracy	0 to 120 rpm: ±1 rpm 121 to 200 rpm: ±2 rpm	
Apnea alarm time	10 s, 15 s, 20 s, 25 s, 30 s, 35 s, 40 s	
Alarm limit	**Range (rpm)**	**Step (rpm)**
RR High	Adult, pediatric: RR≤20 (low limit + 2) to 20 RR>20 (low limit + 5) to 100 Neonate: RR≤20 (low limit + 2) to 20 RR>20 (low limit + 5) to 150	RR≤20: 1 RR>20: 5
RR Low	RR≤20: 0 to (high limit - 2) RR>20: 20 to (high limit - 5)	

A.15.3 SpO_2 Specifications

Alarm limit	Range (%)	Step (%)
SpO_2 High	(low limit + 2) to 100	1
SpO_2 Low	Mindray/Masimo: (Desat+1) to (high limit - 2) Nellcor: (Desat+1) or 20 (whichever is greater) to (high limit - 2)	
SpO_2 Desat Low	0 to (high limit - 2)	
ΔSpO_2 High	0 to 50	

Mindray SpO_2 Module

Standards	Meet standards of ISO 80601-2-61		
*Measurement accuracy verification: The SpO_2 accuracy has been verified in human experiments by comparing with arterial blood sample reference measured with a CO-oximeter. Pulse oximeter measurement are statistically distributed and about two-thirds of the measurements are expected to come within the specified accuracy range compared to CO-oximeter measurements.			
Measurement range	0 to 100%		
Resolution	1%		
Response time	< 30 s (normal perfusion, no disturbance, SpO_2 value sudden changes from 70% to 100%)		
Accuracy	70 to 100%: ±2% (adult/pediatric mode) 70 to 100%: ±3% (neonate mode) 0% to 69%: Not specified.		
* One percent was added to the accuracies for neonatal sensors to account for accuracy variation due to properties of fetal hemoglobin. Studies were performed to validate the accuracy of Pulse Oximeter with neonatal SpO_2 sensors by contrast with a CO-Oximeter. Some neonates aged from 1 day to 30 days with a gestation age of 22 weeks to full term were involved in this study. The statistical analysis of data of this study shows the accuracy (Arms) is within the stated accuracy specification. Please see the following table.			
Sensor type	**Totally neonates**	**Data**	**Arms**
518B	97 (51 male & 46 female)	200 pairs	2.38%
520N	122 (65 male & 57 female)	200 pairs	2.88%
The Pulse Oximeter with neonatal SpO_2 sensors was also validated on adult subjects.			
Refreshing rate	≤1 s		

Sensitivity	High, Medium, Low
PI	
Measurement range	0.05 to 20%
Resolution	PI<10.0: 0.01 PI≥10.0: 0.1
CQI	
Display range	0 to 100
Refreshing rate	1 s
Rate	
Display range	20 to 300
Accuracy range	40 to 160
Accuracy	±3
Refreshing rate	1 s

Nellcor SpO_2 Module

Measurement range	0 to 100%
Resolution	1%
Refreshing rate	≤1 s
Response time	≤30 s (normal perfusion, no disturbance, SpO2 value sudden change from 70% to 100%)
Accuracy	70 to 100%: ±2% (adult/pediatric) 70 to 100%: ±3% (neonate) 0% to 69%: Not specified.
When the SpO_2 sensor is applied for neonatal patients as indicated, the specified accuracy range is increased by ±1%, to compensate for the theoretical effect on oximeter measurements of fetal hemoglobin in neonatal blood.	

Masimo SpO_2 Module

Standards	meets the requirements of ISO 80601-2-61: 2011
Measurement range	1 to 100%
Resolution	1%
Response time	≤20 s (normal perfusion, no disturbance, SpO2 value sudden changes from 70% to 100%)
Accuracy[1]	70 to 100%: ±2% (measured without motion in adult/pediatric mode) 70 to 100%: ±3% (measured without motion in neonate mode) 70 to 100%: ±3% (measured with motion) 1% to 69%: Not specified.
Refresh rate	≤ 1 s
SpO2 averaging time	2-4 s, 4-6 s, 8 s, 10 s, 12 s, 14 s, 16 s
Low perfusion conditions	Pulse amplitude: >0.02% Light penetration: >5%
Low perfusion SpO2 accuracy[2]	±2%
PI measurement range	0.02 to 20%

[1] The Masimo pulse oximeter with sensors have been validated for no motion accuracy in human blood studies on healthy adult volunteers in induced hypoxia studies in the range of 70% to 100% SpO2 against a laboratory co-oximeter and ECG monitor. This variation equals plus or minus one standard deviation. Plus or minus one standard deviation encompasses 68% of the population. One percent was added to the accuracies for neonatal sensors to account for accuracy variation due to properties of fetal hemoglobin.

The Masimo pulse oximeter with sensors has been validated for motion accuracy in human blood studies on healthy adult volunteers in induced hypoxia studies while performing rubbing and tapping motions at 2 to 4 Hz. At an amplitude of 1 to 2 cm and non-repetitive motion between 1 to 5 Hz. At an amplitude of 2 to 3 cm in induced hypoxia studies in the range of 70% to 100% SpO2 against a laboratory co-oximeter and ECG monitor. This variation equals plus or minus one standard deviation. Plus or minus one standard deviation encompasses 68% of the population.

[2] The Masimo pulse oximeter has been validated for low perfusion accuracy in bench top testing against a Biotek Index 2 simulator and Masimo's simulator with signal strengths of greater than 0.02% and a % transmission of greater than 5% for saturations ranging from 70 to 100%. This variation equals plus or minus one standard deviation. Plus or minus one standard deviation encompasses 68% of the population.

A.15.4 PR Specifications

Alarm limit	Range	Step
PR High	PR≤40bpm: (low limit + 2 bpm) to 40 bpm PR > 40 bpm: (low limit + 5 bpm) to 295 bpm	PR≤40: 1 PR>40: 5
PR Low	PR≤40bpm: 16 bpm to (high limit - 2 bpm) PR > 40 bpm: 40 bpm to (high limit - 5 bpm)	

PR from Mindray SpO_2 Module

Measurement range	20 to 300 bpm
Resolution	1 bpm
Response time	<30 s (normal perfusion, no disturbance, PR value sudden changes from 25 to 220bpm)
Accuracy	±3 bpm
Refreshing rate	≤1 s
Sensitivity	High, Medium, Low

PR from Masimo SpO_2

Measurement range	25 to 240 bpm
Resolution	1 bpm
Response time	≤20 s (with normal perfusion, no disturbance, and a PR value transition from 25 to 220 bpm)
Accuracy	±3 bpm (measured without motion) ±5 bpm (measured with motion)
Refresh rate	≤1 s
Sensitivity	High, Medium, Low

PR from Nellcor SpO_2 Module

Measurement range	20 to 300 bpm
Resolution	1 bpm
Response time	≤30 s (normal perfusion, no disturbance, PR value sudden change from 25 to 250 bpm)
Accuracy	20 to 250 bpm: ±3 bpm 251 to 300 bpm, not specified
Refreshing rate	≤1 s

PR from IBP Module

Measurement range	25 to 350 bpm
Resolution	1 bpm
Accuracy	±1 bpm or ±1%, whichever is greater

A.15.5 Temp Specifications

A.15.5.1 Temp Specifications from the MPM Module and Temp module

Standard	Meet the standard of ISO 80601-2-56	
Technique	Thermal resistance	
Operating mode	Direct mode	
Measurement range	0 to 50 °C (32 to 122 °F)	
Resolution	0.1°C	
Accuracy	±0.1 °C or ±0.2 °F (excluding probe error)	
Refreshing rate	≤1 s	
Minimum time for accurate measurement	Body surface: <100 s Body cavity: <80 s	
Alarm limit	**Range**	**Step**
Txx High (xx refers to temperature site)	(low limit +1.0) to 50.0 °C (low limit +2.) to 122.0 °F	0.1 °C 0.1 °F
Txx Low (xx refers to temperature site)	0.1 to (high limit - 1.0) °C 32.2 to (high limit - 2.0) °F	
ΔT High	0.1 to 50.0 °C 0.2 to 90.0 °F	

A.15.6 Temp Specifications from Genius^{TM}2 Tympanic Thermometer

Measurement range	33 to 42 °C (91.4 °F to 107.6 °F)	
Resolution	0.1°C or 0.1 °F	
Calibrated accuracy	±0.1 °C with ambient temperature 25 °C, target temperature 36.7 to 38.9 °C ±0.2 °C with ambient temperature 16 °C, target temperature 33 to 42 °C)	
Ambient temperature range	16 to 33 °C (60.8 °F to 91.4 °F)	
Response time	<2 s	
Alarm limit	**Range**	**Step**
TempIF High	(low limit +1.0) to 41.9 °C	0.1 °C
TempIF Low	33.1 to (high limit - 1.0) °C	

A.15.7 NIBP Specifications

Standard	Meet standard of ISO 80601-2-30
Technique	Oscillometry
Mode of operation	Manual, Auto, STAT, Sequence
Auto mode repetition intervals	1, 2, 2.5, 3, 5, 10, 15, 20, 30, 60, 90, 120, 180, 240 or 480 min
STAT mode cycle time	5 min
Max measurement time	Adult, pediatric: 180 s Neonate: 90 s
Heart rate range	30 to 300 bpm

Measurement ranges (mmHg)		Adult	Pediatric	Neonate
	Systolic:	25 to 290	25 to 240	25 to 140
	Diastolic:	10 to 250	10 to 200	10 to 115
	Mean:	15 to 260	15 to 215	15 to 125

Accuracy	Max mean error: ±5 mmHg Max standard deviation: 8 mmHg
Resolution	1mmHg
Initial cuff inflation pressure range (mmHg)	Adult: 80 to 280 Pediatric: 80 to 210 Neonate: 60 to 140
Default initial cuff inflation pressure (mmHg)	Adult: 160 Pediatric: 140 Neonate: 90
Software overpressure protection	Adult: 297±3 mmHg Pediatric: 297±3 mmHg Neonate: 147±3 mmHg
Static pressure measurement range	0 mmHg to 300 mmHg
Static pressure measurement accuracy	±3 mmHg
PR	
Measurement range	30 to300 bpm
Resolution	1 bpm
Accuracy	±3bpm or ±3%, whichever is greater

Alarm limit	**Range (mmHg)**	**Step (mmHg)**
NIBP-S High	Adult: (low limit + 5) to 285 Pediatric: (low limit + 5) to 235 Neonate: (low limit + 5) to 135	NIBP ≤ 50: 1 NIBP > 50: 5
NIBP-S Low	26 to (high limit - 5)	
NIBP-M High	Adult: (low limit + 5) to 255 Pediatric: (low limit + 5) to 210 Neonate: (low limit + 5) to 120	
NIBP-M Low	16 to (high limit - 5)	
NIBP-D High	Adult: (low limit + 5) to 245 Pediatric: (low limit + 5) to 195 Neonate: (low limit + 5) to 110	
NIBP-D Low	11 to (high limit - 5)	

NIBP-S Extreme High	Adult: (NIBP-S high limit + 5) to 290 Pediatric: (NIBP-S high limit +5) to 240 Neonate: (NIBP-S high limit +5) to 140	NIBP ≤ 50: 1 NIBP > 50: 5
NIBP-S Extreme Low	25 to (NIBP-S low limit - 5)	
NIBP-M Extreme High	Adult: (NIBP-M high limit + 5) to 260 Pediatric: (NIBP-M high limit + 5) to 215 Neonate: (NIBP-M high limit + 5) to 125	
NIBP-M Extreme Low	15 to (NIBP-M low limit - 5)	
NIBP-D Extreme High	Adult: (NIBP-D high limit + 5) to 250 Pediatric: (NIBP-D high limit + 5) to 200 Neonate: (NIBP-D high limit + 5) to 115	
NIBP-D Extreme Low	10 to (NIBP-D low limit - 5)	

*Measurement accuracy verification: In adult and pediatric modes, the blood pressure measurements measured with this device are in compliance with the Standard for Non-invasive sphygmomanometers (ISO 81060-2)in terms of mean error and standard deviation by comparing with intra-arterial or auscultatory measurements (depending on the configuration) in a typical patient population. For auscultatory reference, the 5th Korotkoff sound was used to determine the diastolic pressure.

In neonatal mode, the blood pressure measurements measured with this device are in compliance with the American National Standard for Non-invasive sphygmomanometers (ISO 81060-2) in terms of mean error and standard deviation by comparing with intra-arterial measurements (depending on the configuration) in a typical patient population.

A.15.8 IBP Specifications

Standard	Meet the standard of IEC 60601-2-34.	
Technique	Direct invasive measurement	
IBP		
Measurement range	-50 to 360 mmHg	
Resolution	1 mmHg	
Accuracy	±2% or ±1 mmHg, whichever is greater (excluding sensor error)	
Refreshing rate	≤1 s	
PPV		
Measurement range	0% ~ 50%	
Pressure transducer		
Excitement voltage	5 VDC, ±2%	
Sensitivity	5 μV/V/mmHg	
Zero adjustment range	±200 mmHg	
Impedance range	300 to 3000Ω	
Volume displacement	<0.04 mm^3 /100 mmHg	
Alarm limit	**Range (mmHg)**	**Step (mmHg)**
Sys High Mean High Dia High	IBP ≤ 50: (low limit + 2) to 50 IBP > 50: (low limit + 5) to 360	IBP ≤ 50: 1 IBP > 50: 5
Sys Low Mean Low Dia Low	IBP ≤ 50: -50 to (high limit - 2) IBP > 50: 50 to (high limit - 5)	
Art-S Extreme High Art-M Extreme High Art-D Extreme High	High limit to 360	IBP ≤ 50: 1 IBP > 50: 5
Art-S Extreme Low Art-M Extreme Low Art-D Extreme Low	-50 to low limit	

A.15.9 C.O. Specifications

Measurement method	Thermodilution method	
Measurement range	C.O.: TB: TI:	0.1 to 20 L/min 23 to 43 °C 0 to 27 °C
Resolution	C.O.: TB, TI:	0.1 L/min 0.1 °C
Accuracy	C.O.: TB, TI:	±5% or ±0.1 L /min, whichever is greater ±0.1 °C (without sensor)
Repeatability	C.O.:	±2% or ±0.1 L/min, whichever is greater
Alarm range	TB:	23 to 43 °C

Alarm limit	Range	Step
TB High	(low limit + 1) to 43 °C (low limit + 2) to 109.4 °F	0.1 °C 0.1 °F
TB Low	23 to (high limit - 1) °C 73.4 to (high limit - 2) °F	

A.15.10 ScvO2/SvO2 Specifications

A.15.10.1 $ScvO_2$/SvO_2 Specifications from Vigilance II, Vigileo, and EV1000 monitor

Operating mode	Interfaces with Edwards Vigilance II, Vigileo, or EV1000 monitor
Measured parameter	Consistent with SvO_2/$ScvO_2$-related parameters outputted by Vigilance II, Vigileo, and EV1000 monitor
Parameter alarm	SvO_2, $ScvO_2$
Signal Output	
Standard	Meets the requirements of IEC 60601-1 for short-circuit protection and leakage current
Output impedance	≤1000Ω
Isolation voltage	1500 VAC
SpO_2 Analog Signal Output	
Output voltage	0 to 10V (0 to 100%)
Output voltage error	±5%

Alarm Limit	Range(%)	Step (%)
SvO_2 /$ScvO_2$High	$ScvO_2$<60%: (Low limit + 5%) to 60% $ScvO_2$≥60%: (Low limit + 1%) to 99%	ScvO2<60%: 5% ScvO2≥60%: 1%
SvO_2 /$ScvO_2$ Low	$ScvO_2$<60%: 0 to (High limit - 5%) $ScvO_2$≥60%: 60% to (Low limit - 1%)	

A.15.10.2 $ScvO_2$ Specifications from the $ScvO_2$ Module

Measured parameters	Measurement range	Measurement accuracy

$ScvO_2$	0 to 99%	50% to 80%: ±3% Other ranges: Not specified.
Alarm Limit	**Range**	**Step**
$ScvO_2$ High	$ScvO_2$<60%: (Low limit + 5%) to 60% $ScvO_2$≥60%: (Low limit + 1%) to 99%	$ScvO_2$<60%: 5% $ScvO_2$≥60%: 1%
$ScvO_2$ Low	$ScvO_2$<60%: 0 to (High limit - 5%) $ScvO_2$≥60%: 60% to (High limit - 1%)	

A.15.11 CCO Specifications

A.15.11.1 CCO Specifications from Vigilance II, Vigileo, and EV1000 monitor

Operating mode	Interfaces with Edwards Vigilance II, Vigileo, or EV1000 monitor
Measured parameter	Consistent with CCO-related parameters outputted by Vigilance II, Vigileo, and EV1000 monitor
Parameter alarm	CCO, CCI
Signal Outputs	
Standard	Meets the requirements of IEC 60601-1 for short-circuit protection and leakage current
Output impedance	≤1000Ω
Isolation voltage	1500 VAC
ECG Analog Output	
Bandwidth (-3dB; reference frequency: 10Hz)	ST mode: 0.05~40Hz Diagnostic mode: 0.05~150Hz Monitor mode: 0.5~40Hz Surgical mode: 1~20Hz
Sensitivity	2V/mV ±5%
MAP Analog Signal Output	
Output voltage	DC 0 to 5V (0 to 500mmHg)
Output voltage error	±5%
CVP Analog Signal Output	
Output voltage	DC 0 to 5V (0 to 100mmHg)
Output voltage error	±5%

Alarm Limit	Range	Step
CCO High	(Low limit + 0.1) to 25 L/min	0.1 L/min
CCO Low	0.3 to (high limit - 0.1)L/min	
CCI High	(Low limit + 0.1) to 15 L/min/m^2	0.1 L/min/m^2
CCI Low	0.1 to (high limit - 0.1)L/min/m^2	

A.15.11.2 CCO Specifications from the PiCCO Module

Measured parameters	Measurement range	Coefficient of variation
CCO	0.25 l/min to 25.0 l/min	≤2%
C.O.	0.25 l/min to 25.0 l/min	≤2%
GEDV	40ml to 4800 ml	≤3%
SV	1ml to 250 ml	≤2%
EVLW	10ml to 5000 ml	≤6%
ITBV	50ml to 6000 ml	≤3%
Measured parameters	**Measurement range**	**Measurement Accuracy**
TB	25°C to 45°C	±0.1°C (excluding probe error)
TI	0°C to 30°C	±0.1°C (excluding probe error))
pArt	-50 to 300 mmHg	±2% or ±1mmHg, whichever is greater (excluding sensor error)
pCvp	-50 to 300 mmHg	±2% or ±1mmHg, whichever is greater (excluding sensor error)
Alarm Limit	**Range**	**Step**
CCO/C.O. High	(Low limit+0.1 L/min) to 25.0 L/min	0.1 L/min
CCO/C.O. Low	0.3 L/min to (High limit - 0.1 L/min)	
CCI/C.I. High	(Low limit + 0.1 L/min/m^2) to 15.0 L/min/m^2	0.1 L/min/m^2
CCI/C.I. Low	0.1 L/min/m^2 to (High limit - 0.1 L/min/m^2)	
pArt-M/pArt-D/pArt-S High	pArt≤50: (Low limit + 2 mmHg) to 50 mmHg pArt>50: (Low limit + 5 mmHg) to 300 mmHg	pArt≤50: 1mmHg pArt>50: 5mmHg
pArt-M/pArt-D/pArt-S Low	pArt≤50: -50 mmHg to (High limit - 2mmHg) pArt>50: 50 mmHg to (High limit - 5mmHg)	
pCVP-M High	pCVP≤50: (Low limit + 2 mmHg) to 50 mmHg pCVP>50: (Low limit + 5 mmHg) to 300 mmHg	pArt≤50: 1mmHg pArt>50: 5mmHg
pCVP-M Low	pCVP≤50: -50 mmHg to (High limit - 2mmHg) pCVP>50: 50 mmHg to (High limit - 5mmHg)	

* Coefficient of variation is measured using synthetic and/or database wave forms (laboratory testing). Coefficient of variation= SD/mean error.

A.15.12 ICG Specifications

Technique	Thoracic electrical bioimpedance (TEB)	
Measurement range	SV: 5 to 250 ml HR: 44 to 185 bpm C.O.: 1.0 to 15 L/min	
Accuracy	SV: Not specified. HR: ±2 bpm C.O.: Not specified	
Alarm limit	**Range**	**Step**
C.I. High	(low limit + 1.0) to 15.0 L/min/m^2	0.1 L/min/m2
C.I. Low	1.4 to (high limit - 1.0)L/min/m^2	
TFC High	(low limit + 1) to 125/kΩ	1 /kΩ
TFC Low	19 to (high limit - 1)/kΩ	

A.15.13 CO_2 Specifications

Measurement mode	Sidestream, microstream, mainstream	
Technique	Infrared absorption	
Apnea time	10 s, 15 s, 20 s, 25 s, 30 s, 35 s, 40 s	
Alarm limit	**Range**	**Step**
$EtCO_2$ High	(low limit + 2) to 99 mmHg	1 mmHg
$EtCO_2$ Low	1 to (high limit - 2)mmHg	
$FiCO_2$ High	1 to 99 mmHg	
EtO_2 High	(low limit + 2%) to 100%	1%
EtO_2 Low	0% to (high limit - 2)%	
FiO_2 High	(low limit + 2%) to 100%	
FiO_2 Low	18% to (high limit - 2)%	

Sidestream CO_2 Module

Standard	Meet the standard of ISO 80601-2-55	
CO_2 Measurement range	0 to 150 mmHg	
CO_2 absolute accuracy*	Full accuracy mode:	
	0 to 40 mmHg:	± 2 mmHg
	41 to 76 mmHg:	±5% of reading
	77 to 99 mmHg:	±10% of reading
	100 to150mmHg:	±(3mmHg + 8% of reading)
	>150mmHg:	unspecified
	ISO accuracy mode: add ±2mmHg to the full accuracy mode	
Inaccuracy specifications are affected by the breath rate and I:E. The $EtCO_2$ accuracy is within specification for breath rate ≤ 60 rpm and I/E ratio ≤ 1:1, or breath rate ≤ 30 rpm and I/E ratio ≤ 2:1.		
CO_2 resolution	1 mmHg	
O_2 measurement range	0 to 100%	

O_2 absolute accuracy	0≤O_2 concentration≤25%: ±1% 25<O_2 concentration≤80%: ±2% 80<O_2 concentration≤100%: ±3%
O_2 resolution	1%
Accuracy drift	Meet the requirement for measurement accuracy within 6 hours
Sample flowrate	For sidestream CO_2 module with O_2 monitoring function: Connected a DRYLINE II watertrap for adult and pediatric patient: 120 ml/min Connected a DRYLINE II watertrap for neonatal patient: 90 ml/min Connected a DRYLINE II watertrap for adult and pediatric patient and using with RM module: 150 ml/min For sidestream CO_2 module without O_2 monitoring function: Connected a DRYLINE II watertrap for adult and pediatric patient: 120 ml/min Connected a DRYLINE II watertrap for neonatal patient: 90 ml/min or 70 ml/min
Sample flowrate tolerance	±15% or ±15 ml/min, whichever is greater.
Start-up time	Maximum: 90 s Typically: 20 s
Response time	For CO_2 measurement (without O_2 measurement): Measured with a DRYLINE II neonatal watertrap and a 2.5-meter neonatal sampling line: ≤5.0 s @ 70 ml/min ≤4.5 s @ 90 ml/min Measured with a DRYLINE II adult watertrap and a 2.5-meter adult sampling line: ≤5.0 s @ 120 ml/min For CO_2 measurement (with O_2 measurement): Measured with a DRYLINE II neonatal watertrap and a 2.5-meter neonatal sampling line: ≤4.5 s@90 ml/min. Measured with a DRYLINE II adult watertrap and a 2.5-meter adult sampling line: ≤5 s@120 ml/min Measured with a DRYLINE II adult watertrap and a 2.5-meter adult sampling line (using with the RM module): ≤4.5 s@150 ml/min For O_2 measurements: Measured with a DRYLINE II neonatal watertrap and a 2.5-meter neonatal sampling line: ≤4.5 s @ 90 ml/min Measured with a DRYLINE II adult watertrap and a 2.5-meter adult sampling line: ≤5 s@120 ml/min Measured with a DRYLINE II adult watertrap and a 2.5-meter adult sampling line (using with the RM module): ≤4.5 s@150 ml/min

Rise time	For CO_2 measurement (without O_2 measurement): Measured with a DRYLINE II neonatal watertrap and a 2.5-meter neonatal sampling line: ≤250 ms@70 ml/min. ≤250 ms@90 ml/min. Measured with a DRYLINE II adult watertrap and a 2.5-meter adult sampling line: ≤300 ms@120 ml/min For CO_2 measurement (with O_2 measurement): Measured with a DRYLINE II neonatal watertrap and a 2.5-meter neonatal sampling line: ≤250 ms@90 ml/min. Measured with a DRYLINE II adult watertrap and a 2.5-meter adult sampling line: ≤300 ms@120 ml/min Measured with a DRYLINE II adult watertrap and a 2.5-meter adult sampling line (using with the RM module): ≤240 ms@150 ml/min For O_2 measurements: Measured with a DRYLINE II neonatal watertrap and a 2.5-meter neonatal sampling line: ≤800 ms@90 ml/min. Measured with a DRYLINE II adult watertrap and a 2.5-meter adult sampling line: ≤750 ms@120 ml/min Measured with a DRYLINE II adult watertrap and a 2.5-meter adult sampling line (using with the RM module): ≤650 ms@150 ml/min	
awRR measurement range	0 to 150 rpm	
awRR measurement precision	≤60 rpm: ±1 61 to 150 rpm: ±2	
awRR resolution	1 rpm	
Data sample rate	50 Hz	
Effect of interference gases on CO_2 measurements		
Gas	**Concentration (%)**	**Quantitative effect***
O_2	≤100	±1 mmHg
N_2O	≤60	
Hal	≤4	
Sev	≤5	
Iso	≤5	
Enf	≤5	
Des	≤15	±2 mmHg
*: means an extra error should be added in case of gas interference when CO_2 measurements are performed between 0 to 40mmHg.		
Effect of interference gases on O_2 measurements		
Gas	**Quantitative effect**	
CO_2	0.2%	
N_2O	0.2%	
Hal, Des, Sev, Iso, Enf	1%	

Microstream CO_2 Module

Standard	Meet the standard of ISO 80601-2-55	
CO2 Measurement range	0 to 99 mmHg	
Accuracy*	0 to 38 mmHg: 39 to 99 mmHg:	±2 mmHg ±5% of the reading (0.08% increased in error for every 1 mmHg if the reading is more than 38 mmHg)
Accuracy drift	Meet the requirement for measurement accuracy within 6 hours	
* Accuracy applies for respiration rate up to 80 rpm. For respiration rate above 80 rpm and EtCO2 exceeding 18 mmHg, the accuracy is 4 mmHg or ±12% of the reading, whichever is greater. For respiration rate above 60 rpm, the above accuracy can be achieved by using the FilterLine H Set for Infant/Neonatal (Model: 006324). In the presence of interfering gases, the above accuracy is maintained to within 4%.		
Resolution	1 mmHg	
Sample flow rate	50 ml/min	
Sample flowrate tolerance	-7.5/+15 ml/min	
Initialization time	30 s (typical) 180 s (maximum)	
Response time	2.9 s (typical) (The response time is the sum of the rise time and the delay time when using a FilterLine of standard length) Rise time: <190 ms (10% to 90%) Delay time: 2.7 s (typical)	
awRR measurement range	0 to 150 rpm	
awRR measurement accuracy	0 to 70 rpm: 71 to 120 rpm: 121 to 150 rpm:	±1 rpm ±2 rpm ±3 rpm
awRR resolution	1 rpm	
Data sample rate	40 Hz	

Mainstream CO_2 Module

Standard	Meet the standard of ISO 80601-2-55
CO_2 Measurement range	0 to 150 mmHg
Accuracy	0 to 40 mmHg: ±2 mmHg 41 to 70 mmHg: ±5% of the reading 71 to 100 mmHg: ±8% of the reading 101 to 150 mmHg: ±10% of the reading
Accuracy drift	Meet the requirement for measurement accuracy within 6 hours
Resolution	1 mmHg
Rise time	<60 ms
Data sample rate	100 Hz
awRR measurement range	0 to 150 rpm
awRR measurement accuracy	±1 rpm
awRR resolution	1 rpm

A.15.14 AG Specifications

Standard	Meet the standard of ISO 80601-2-55
Technique	Infrared absorption, paramagnetic properties for O_2 monitoring
Warm-up time	Iso accuracy mode: 45 s Full accuracy mode: 10 min
Sample flow rate	Adult, pediatric: 200 ml/min Neonate: 120 ml/min Accuracy: ±10 ml/min or ±10%, whichever is greater
Measurement range	CO_2: 0 to 30% O_2: 0 to 100% N_2O: 0 to 100% Des: 0 to 30% Sev: 0 to 30% Enf: 0 to 30% Iso: 0 to 30% Hal: 0 to 30% awRR: 2 to 100 rpm
Resolution	CO_2: 0.1 % O_2: 1% N_2O: 1% Des: 0.1 % Sev: 0.1 % Enf: 0.1 % Iso: 0.1 % Hal: 0.1 % awRR: 1 rpm
Iso accuracy	As full accuracy specifications, but derated as follows: Add $\pm 0.3\%_{ABS}$ to accuracy for CO_2 Add $\pm 8\%_{REL}$ to accuracy for all anesthetic gases N_2O accuracy is $\pm(8\%_{REL}+2\%_{ABS})$

Full accuracy	Gases	Range (%REL)1	Accuracy (%ABS)
	CO_2	$0 \le CO_2 \le 1$ $1 < CO_2 \le 5$ $5 < CO_2 \le 7$ $7 < CO_2 \le 10$ $CO_2 > 10$	±0.1 ±0.2 ±0.3 ±0.5 Not specified
	N2O	$0 \le NO_2 \le 20$ $20 < CO_2 \le 100$	±2 ±3
	O_2	$0 \le O_2 \le 25$ $25 < CO_2 \le 80$ $80 < CO_2 \le 100$	±1 ±2 ±3
	Des	0≤Dev≤1 1≤Dev≤5 5≤Dev≤10 10≤Dev≤15 15≤Dev≤18 Dev>18	±0.15 ±0.2 ±0.4 ±0.6 ±1 Not specified
	Sev	0≤Sev≤1 1≤Sev≤5 5≤Sev≤8 Sev>8	±0.15 ±0.2 ±0.4 Not specified
	Enf, Iso, Hal	0≤Enf/Iso/Hal≤1 1≤Enf/Iso/Hal≤5 Enf/Iso/Hal>5	±0.15 ±0.2 Not specified
awRR accuracy	2 to 60 rpm >60 rpm		±1 rpm Not specified
Note[1]: The highest GAS LEVEL for a single halogenated anaesthetic gas in a gas mixture that is concealed when the anaesthetic concentration falls is 0.15/0.3% (Full/ISO accuracy).			
Accuracy drift	Meet the requirement for measurement accuracy within 6 hours		
Apnea alarm time	10 s, 15 s, 20 s, 25 s, 30 s, 35 s, 40 s		
Refreshing rate	≤1 s		
Rise time (10% ~ 90%)	Gas sample flow rate 120ml/min, using a DRYLINE II neonatal watertrap and sampling line (2.5m): CO_2 N_2O Hal, Iso, Sev, Des Enf O_2	 ≤250 ms ≤250 ms ≤300 ms ≤350 ms ≤600 ms	
	Gas sample flow rate 200ml/min, using the adult DRYLINE II water trap and sampling line (2.5m): CO_2 N_2O O_2 Hal, Iso, Sev, Des Enf	 ≤250 ms ≤250 ms ≤500 ms ≤300 ms ≤350 ms	
Delay time	<4 s		

Response time	Measured with a DRYLINE II neonatal watertrap and a 2.5-meter neonatal sampling line: 120 ml/min: CO_2: ≤4 s N_2O: ≤4.2 s O_2: ≤4 s Hal, Iso, Sev, Des, Enf: ≤4.4 s				
	Measured with a DRYLINE II adult watertrap and a 2.5-meter adult sampling line: 200 ml/min: CO_2: ≤4.2s N_2O: ≤4.3s Hal, Iso, Sev, Des, Enf: ≤4.5s O_2: ≤4s				
Anesthetic agent limit	Primary anesthetic agent In full accuracy mode: 0.15%,				
	Secondary anesthetic agent: In full accuracy mode: 5% of primary agent if primary agent is greater than 10%, 0.3% if primary agent is less than or equal to 10%.				
Data sample rate	25 Hz				
Inaccuracy specifications are affected by the breath rate and I:E change. The end-tidal gas reading is within specification for breath rate below 15BPM and I:E ratio smaller than 1:1 relative to the gas readings without breath; Add ±6%REL to inaccuracy for HAL and O_2 for breath rate larger than 15 BPM; Add ±6%REL to inaccuracy for all gases for breath rate larger than 30 BPM (inaccuracy for HAL and O_2 are unspecified in this case); inaccuracy is unspecified for breath rate larger than 60 BPM.					
Effect of interference gases on AG measurements					
Gas	**Concentration(%)**	**Quantitative effect(%ABS)3)**			
		CO_2	**N_2O**	**Agent 1)**	**O_2**
CO_2	/	/	0.1	0	0.2
N_2O	/	0.1	/	0.1	0.2
Agent 1) 2)	/	0.1	0.1	0.1	1
Xenon	<100%	0.1	0	0	0.5
Helium	<50%	0.1	0	0	0.5
Ethanol	<0.1%	0	0	0	0.5
Acetone	<1%	0.1	0.1	0	0.5
Methane	<1%	0.1	0	0	0.5
Saturated Isopropanol vapour	/	0.1	0	0	0.5
Metered dose inhaler propellants,	/	Unspecified	Unspecified	Unspecified	Unspecified
O_2	/	0.2	0.2	1.0	/
1) Agent represents one of Des, Iso, Enf, Sev, and Hal. 2) Multiple agent interference on CO_2, N_2O and O_2 is typically the same as single agent interference. 3) For CO_2, N_2O and Agents, maximum interference from each gas at concentrations within specified accuracy ranges for each gas. The total interference of all gases is never larger than 5%REL.					
Alarm limit	**Range**			**Step**	

$EtCO_2$ High	(low limit + 2) to 99 mmHg	1 mmHg
$EtCO_2$ Low	1 to (high limit - 2)mmHg	
$FiCO_2$ High	0 to 99 mmHg	
$FiCO_2$ Low	1to (high limit - 2)mmHg	
EtO_2 High	(low limit + 2%) to 100%	1%
EtO_2 Low	0% to (high limit - 2)%	
FiO_2 High	(low limit + 2%) to 100%	
FiO_2 Low	18% to (high limit - 2)%	
EtN_2O High	(low limit + 2) to 100%	1%
EtN_2O Low	0 to (high limit - 2)%	
FiN_2O High	(low limit + 2) to 100%	
FiN_2O Low	0 to (high limit - 2)%	
EtHal/Enf/Iso High	(low limit + 0.2) to 5.0%	0.1%
EtHal/Enf/Iso Low	0 to (high limit - 0.2)%	
FiHal/Enf/Iso High	(low limit + 0.2) to 5.0%	
FiHal/Enf/Iso Low	0 to (high limit - 0.2)%	
EtSev High	(low limit + 0.2) to 8.0%	0.1%
EtSev Low	0 to (high limit - 0.2)%	
FiSev High	(low limit + 0.2) to 8.0%	
FiSev Low	0 to (high limit - 0.2)%	
EtDes High	(low limit + 0.2) to 18.0%	0.1%
EtDes Low	0 to (high limit - 0.2)%	
FiDes High	(low limit + 0.2) to 18.0%	
FiDes Low	0 to (high limit - 0.2)%	

A.15.15 RM Specifications

Technique	Diff-Pressure flow measurement technology	
Flow		
Measurement range	Adult/pediatric: Neonate:	± (2 to 120) L/min ± (0.5 to 30) L/min
Accuracy	Adult/pediatric: Neonate:	1.2 L/min or ±10% of the reading, whichever is greater 0.5 L/min or ±10% of the reading, whichever is greater
Resolution	0.1 L/min	
Paw		
Measurement range	-20 to 120 cmH_2O	
Accuracy	±3%×reading	
Resolution	0.1 cmH_2O	
MVe/MVi		
Measurement range	Adult/Pediatric: Infant:	2 to 60 L/min 0.5 to 15 L/min
Resolution	0.01 L/min if airflow is less than 10 L/min, 0.1 L/min if airflow is equal to or more than 10 L/min	
Accuracy	±10% × reading	
TVe/TVi		
Measurement range	Adult/Pediatric: Infant:	100 to 1500 ml 20 to 500 ml
Resolution	1 ml	
Accuracy	Adult/pediatric: Infant:	±10% or 15 ml, whichever is greater ±10% or 6 ml, whichever is greater
awRR		
Measurement range	4 to 120 rpm	
Resolution	1rpm	
Accuracy	4 to 99 rpm 100 to 120 rpm	±1 rpm ±2 rpm

Calculated Parameters	**Measurement range**	**Measurement accuracy**
I:E	4:1 to 1:8	Not specified.
FEV1.0%	0 to 100%	Not specified.
Pmean	0 to 120 cmH_2O	±10%
PEEP	0 to 120 cmH_2O	Not specified.
PEF	2 to 120 L/min	±10%
PIF	2 to 120 L/min	±10%
PIP	0 to 120 cmH_2O	±10%

Pplat	0 to 120 cmH_2O	Not specified.
Compl	0 to 200 ml/cmH_2O	
RSBI	0 to 4095 rpm/L	
NIF	-20 to 0 cmH_2O	
WOB	0 to 10J/L	
RAW	0 to 100 $cmH_2O/(L/s)$	Not specified

Specifications of parameters monitored when using with the mainstream CO_2 module

Parameter	Measurement range	Measurement accuracy
VCO_2	0 to 200 ml	±15% or ±15 ml, whichever is greater

Parameters	Resolution	Parameters	Resolution	Parameters	Resolution
VCO_2	1 mL	$MVCO_2$	1 mL/min	$FeCO_2$	0.1%vol
$SlopeCO_2$	0.01%vol/L	Vtalv	1 mL	MValv	0.01 L/min
Vdaw	1 mL	Vdaw/Vt	1%	Vdalv	1 mL
Vdalv/Vt	1%	Vdphy	1 mL	Vd/Vt	1%

Specifications of parameters monitored when using with the sidestream CO_2 module or AG module configured with the paramagnetic oxygen sensor

Parameter	Measurement range	Measurement accuracy
VCO_2	0 to 200 ml	±15% or ±15 ml, whichever is greater
VO_2	0 to 200 ml	±15% or ±15 ml, whichever is greater

Parameter	Resolution	Parameters	Resolution	Parameters	Resolution
VCO_2	1 mL	$MVCO_2$	1 mL/min	VO_2	1 mL
MVO_2	1 mL/min	EE	1 kCal/day	RQ	0.01

Alarm limit	Range	Step
PEEP High	PEEP≤50 cmH_2O: (low limit + 1) to 50 cmH_2O PEEP>50 cmH_2O: (low limit + 5) to 120 cmH_2O	PEEP≤50 cmH_2O: 1 cmH_2O PEEP>50 cmH_2O: 5 cmH_2O
PEEP Low	PEEP≤50 cmH_2O: 0 to (high limit - 1) cmH_2O PEEP>50 cmH_2O: 50 to (high limit - 5) cmH_2O	
PIP High	PIP≤50 cmH_2O: (low limit + 1) to 50 cmH_2O PIP>50 cmH_2O: (low limit + 5) to 120 cmH_2O	PIP≤50 cmH_2O: 1 cmH_2O PIP>50 cmH_2O: 5 cmH_2O
PIP Low	PIP≤50 cmH_2O: 1 to (high limit - 1) cmH_2O PIP>50 cmH_2O: 50 to (high limit - 5) cmH_2O	
MVe High	Mve≤10 L/min:(low limit + 0.5 L/min) to 10.0 L/min Mve>10 L/min: (low limit + 2 L/min) to 60.0 L/min	Mve≤10 L/min: 0.5 L/min Mve>10 L/min: 2 L/min
MVe Low	Mve≤10 L/min: 0.5 L/min to (high limit - 0.5 L/min) Mve>10 L/min: 10 L/min to (high limit - 2 L/min)	

A.15.16 EEG Specifications

Standard	Meet the standard of IEC 60601-2-26
Channels and Leads	Four-channel bipolar mode: 9 Leads Four-channel referential mode: 6 Leads
Analog Bandwidth	0.5 to 110 Hz
Input Signal Range	± 2 mVac
Measurement Bandwidth	0.5 to 110 Hz
Max. Input DC Offset	± 500 mV DC
Common Mode Rejection Ratio	≥100 dB @50 Hz
Noise	≤0.5 μV rms (0.5 to 70 Hz)
Input Differential Impedance	≥15 M Ω @10 Hz
Electrode Impedance	Range: 1 to 90 kΩ, Accuracy: ±1 kΩ, or ±10%, whichever is greater
Sampling Frequency	1024 Hz
Low Filter Frequencies	0.16 Hz, 0.5 Hz, 1.0 Hz, and 2.0 Hz
High Filter Frequencies	15 Hz, 30 Hz, 50 Hz, and 70 Hz

Measured Parameters	**Measurement range**	**Resolution**
SEF, MF, PPF	0.5 to 30 Hz	0.5 Hz
TP	40 to 100 dB	1 dB
SR	0 to 100%	1%
EMG	0 to 100 dB	1 dB
Delta, Theta, Alpha, Beta	0 to 100% (±1%)	1%

A.15.17 BIS Specifications

Standard	Meet the standard of IEC 60601-2-26	
Technique	Bispectral index	
Measured parameters	EEG BIS, BIS L, BIS R: 0 to 100	
Calculated parameters	SQI, SQI L, SQI R: 0 to 100% EMG, EMG L, EMG R: 0 to 100 dB SR, SR L, SR R: 0 to 100% SEF, SEF L, SEF R: 0.5 to 30.0 Hz TP, TP L, TP R: 40 to 100 dB BC, BC L, BC R: 0 to 30 sBIS L, sBIS R: 0 to 10.0 sEMG L, sEMG R: 0 to 10.0 ASYM: 0 to 100%	
Sweep speed	6.25 mm/s, 12.5 mm/s, 25 mm/s or 50 mm/s, ±10% error	
Input impedance	>5 MΩ	
Noise (RTI)	<0.3 µV (0.25 to 50 Hz)	
Input signal range	±1 mV	
EEG bandwidth	0.25 to 100 Hz	
Patient leakage current	<10 µA	
Alarm limit	**Range**	**Step**
BIS High	(low limit + 5) to 100	5
BIS Low	0 to (high limit - 5)	

A.15.18 NMT Specifications (from Mindray NMT module)

Standard	Meet the standard of IEC 60601-2-10	
Stimulation output	Pulse width	100, 200, or 300 µs; monophasic rectangle pulse Accuracy: ±10%
	Current range	0 to 60 mA in increments of 5 mA Accuracy: ± 5% or ±2 mA, whichever is greater
	Max. skin impedance	3 kΩ @ 60 mA, 5 kΩ @ 40 mA
	Max. output voltage	300 V
ST mode	ST-Ratio	0 to 200%
	Measurement interval	Manual, 1 s, 10 s, 20 s
TOF mode	TOF-Count	0 to 4
	TOF-Ratio	5% to 160%
	Measurement interval	Manual, 12s, 15s, 20s, 30s, 1min, 5min, 15min, 30min, 60min
PTC mode	PTC	0 to 20
	Measurement interval	Manual

DBS mode	Measurement interval	Manual, 15s, 20s, 30s, 1min, 5min, 15min, 30min, 60min
	DBS-Count	0 to 2
	DBS-Ratio	5% to 160%
NMT message	**Threshold**	
Block Recovery	Off, 1, 2, 3, 4, 5%, 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90%, 100%	

A.15.19 rSO_2 Specifications

Measurement range	15% to 95%

B EMC and Radio Regulatory Compliance

B.1 EMC

The device meets the requirements of IEC 60601-1-2: 2014.

WARNING

- **Use of accessories, transducers and cables other than those specified or provided by the manufacturer of this equipment could result in increased electromagnetic emissions or decreased electromagnetic immunity of this equipment and result in improper operation.**
- **The non-ME EQUIPMENT (e.g. ITE) that is a part of an ME SYSTEM may be disrupted by the electromagnetic interference of nearby equipment. It may be necessary to take mitigation measures, such as re-orienting or relocating the non-ME EQUIPMENT or shielding the location.**
- **Use of this equipment adjacent to or stacked with other equipment should be avoided because it could result in improper operation. If such use is necessary, this equipment and the other equipment should be observed to verify that they are operating normally.**
- **This device is intended for use in professional healthcare facility environment only. If it is used in special environment, such as magnetic resonance imaging environment, the equipment/system may be disrupted by the operation of nearby equipment.**
- **Portable RF communications equipment (including peripherals such as antenna cables and external antennas) should be used no closer than 30 cm (12 inches) to any part of the this device, including cables specified by the manufacturer. Otherwise, degradation of the performance of this equipment could result.**

Guidance and Declaration - Electromagnetic Emissions		
The device is intended for use in the electromagnetic environment specified below. The customer or the user of the device should assure that it is used in such an environment.		
Emission tests	**Compliance**	**Electromagnetic environment - guidance**
Conducted and radiated RF EMISSIONS CISPR 11	Group 1	The device uses RF energy only for its internal function. Therefore, its RF emissions are very low and are not likely to cause any interference in nearby electronic equipment.
Conducted and radiated RF EMISSIONS CISPR 11	Class A	The device is suitable for use in all establishments other than domestic and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes
Harmonic distortion EMISSIONS IEC61000-3-2	Class A	
Voltage Fluctuations/Flicker EMISSIONS IEC 61000-3-3	Complies	

If the system is operated within the electromagnetic environment listed in Table Guidance and Declaration − Electromagnetic Immunity, the system will remain safe and provide the following essential performance:

- Operating mode
- Accuracy
- Function
- Accessories identification
- Data stored
- Alarm
- Detect for connection

NOTE

- **If the essential performance is lost or degraded, it may be necessary to take mitigation measures, such as re-orienting or relocating the ME EQUIPMENT or ME SYSTEM or shielding the location or stopping using the monitor and contact the service personnel.**
- **The device needs special precautions regarding EMC and needs to be installed and put into service according to the EMC information provided below.**
- **Other devices may interfere with this device even though they meet the requirements of CISPR.**
- **When the inputted signal is below the minimum amplitude provided in technical specifications, erroneous measurements could result.**
- **The EMISSIONS characteristics of this device make it suitable for use in industrial areas and hospitals (CISPR 11 class A). If it is used in a residential environment (for which CISPR 11 class B is normally required) this device might not offer adequate protection to radio-frequency communication services. The user might need to take mitigation measures, such as relocating or re-orienting the device.**

Guidance and Declaration - Electromagnetic Immunity			
The device is intended for use in the electromagnetic environment specified below. The customer or the user of the device should assure that it is used in such an environment.			
Immunity test	**IEC60601 test level**	**Compliance level**	**Electromagnetic environment - guidance**
Electrostatic discharge (ESD) IEC 61000-4-2	±8 kV contact ±15 kV air	±8 kV contact ±15 kV air	Floors should be wood, concrete or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30%.
Electrical fast transient/burst IEC 61000-4-4	±2 kV for power supply lines ±1 kV for input/ output lines	±2 kV for power supply lines ±1 kV for input/ output lines	Mains power quality should be that of a typical commercial or hospital environment.
Surge IEC 61000-4-5	±1 kV line(s) to line(s) ±2 kV line(s) to earth	±1 kV line(s) to line(s) ±2 kV line(s) to earth	
Voltage dips and voltage interruptions IEC 61000-4-11	0 % U_T for 0.5 cycle: at 0°, 45°, 90°, 135°, 180°, 225°, 270° and 315° 0 % U_T for 1 cycle and 70 % U_T for 25/30 cycles: at 0° 0 % U_T for 250/300 cycle	0 % U_T for 0.5 cycle: at 0°, 45°, 90°, 135°, 180°, 225°, 270° and 315° 0 % U_T for 1 cycle and 70 % U_T for 25/30 cycles: at 0° 0 % U_T for 250/300 cycle	Mains power quality should be that of a typical commercial or hospital environment. If the user of our product requires continued operation during power mains interruptions, it is recommended that our product be powered from an uninterruptible power supply or a battery.
RATED power frequency magnetic fields IEC 61000-4-8	30 A/m 50 Hz/60 Hz	30 A/m 50 Hz/60 Hz	Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment.
Note: U_T is the AC mains voltage prior to application of the test level.			

Guidance and Declaration - Electromagnetic Immunity			
The device is intended for use in the specified electromagnetic environment. The customer or the user of the device should assure that it is used in such an environment as described below.			
Immunity test	**IEC60601 test level**	**Compliance level**	**Electromagnetic environment - guidance**

Guidance and Declaration - Electromagnetic Immunity			
Conducted disturbances induced by RF fields IEC61000-4-6	3 Vrms 150 kHz to 80 MHz 80% AM at 1 kHz	3Vrms	Portable and mobile RF communications equipment should be used no closer to any part of the system, including cables, than the recommended separation distance calculated from the equation appropriate for the frequency of the transmitter. Recommended separation distances: $d = 1.2\sqrt{P}$
	6 Vrms in ISM bands between 0.15 MHz and 80 MHz 80 % AM at 1 kHz	6 Vrms	
Radiated RF EM fields IEC61000-4-3	3 V/m 80 MHz to 2,7 GHz 80 % AM at 1 kHz	3V/m	Recommended separation distances: 80 MHz to 800 MHz: $d = 1.2\sqrt{P}$ 800MHz - 2.7GHz: $d = 2.3\sqrt{P}$ Where, P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer and d is the recommended separation distance in meters (m)[b]. Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey[a] should be less than the compliance level in each frequency range[b]. Interference may occur in the vicinity of equipment marked with the following symbol: 
Proximity fields from RF wireless communications equipment IEC61000-4-3	27 V/m 385 MHz	27 V/m	/
	28 V/m 810 MHz, 870 MHz, 930 MHz, 1720 MHz, 1845 MHz, 1970 MHz, 2450 MHz (pulse modulation)	28 V/m	
	28V/m 450 MHz (FM modulation)	28 V/m	
	9V /m 710 MHz, 745 MHz, 780 MHz, 5240 MHz, 5500 MHz, 5785 MHz	9 V/m	
Note 1: At 80 MHz to 800 MHz, the separation distance for the higher frequency range applies. **Note 2:** These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.			
[a]: Field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcast and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the **ME EQUIPMENT or ME SYSTEM** is used exceeds the applicable RF compliance level above, the **ME EQUIPMENT or ME SYSTEM** should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as re-orienting or relocating the **ME EQUIPMENT or ME SYSTEM**. [b]: Over the frequency range 150 kHz to 80 MHz, field strengths should be less than 3V/m.			

WARNING

- **The device is configured with a wireless network connector to receive wireless signal. Other devices may interfere with this device even though they meet the requirements of CISPR.**

Recommended separation distances between portable and mobile RF communications equipment and the device			
The device is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The customer or the user of the device can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the device as recommended below, according to the maximum output power of the communications equipment.			
Rated maximum output power of transmitter (W)	**Separation distance in meters (m) according to frequency of the transmitter**		
	150 kHz to 80 MHz $d = 1.2\sqrt{P}$	80 MHz to 800 MHz $d = 1.2\sqrt{P}$	800 MHz to 2.7 GHz $d = 2.3\sqrt{P}$
0.01	0.12	0.12	0.23
0.1	0.38	0.38	0.73
1	1.20	1.20	2.30
10	3.80	3.80	7.30
100	12.00	12.00	23.00
For transmitters rated at a maximum output power not listed above, the recommended separation distance d in metres (m) can be estimated using the equation applicable to the frequency of the transmitter, where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer. **Note 1:** At 80 MHz and 800 MHz, the separation distance for the higher frequency range applies. **Note 2:** These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.			

B.2 Radio Regulatory Compliance

RF parameters (Panlink2 module)

Type of Radio	Bluetooth Low Energy 4.0
Operating Frequency	2402 MHz to 2480 MHz
Modulation Mode	GFSK
Output Power	≤2.5mW

RF parameters (MSD45N module)

Type of Radio	IEEE 802.11b/g/n (2.4G)	IEEE 802.11a/n (5G)
Operating Frequency	ETSI: 2.4 GHz to 2.483 GHz FCC: 2.4 GHz to 2.483 GHz MIC: 2.4 GHz to 2.495GHz KC: 2.4 GHz to 2.483 GHz	ETSI: 5.15 GHz to 5.35 GHz, 5.47 GHz to 5.725 GHz FCC: 5.15 GHz to 5.35 GHz, 5.725 GHz to 5.82 GHz MIC: 5.15GHz to 5.35 GHz KC: 5.15 GHz to 5.35 GHz, 5.47 GHz to 5.725 GHz, 5.725 GHz to 5.82 GHz
Modulation Mode	DSSS and OFDM	OFDM
Output Power	< 30 dBm (peak power) < 20 dBm (average power)	

The radio device used in this product is in compliance with the essential requirements and other relevant provisions of Directive 2014/53/EU.

This device complies with part 15 of the FCC Rules and with RSS-210 of Industry Canada. Operation is subject to the condition that this device does not cause harmful interference.

This device must accept any interference received, including interference that may cause undesired operation.

WARNING

- **Changes or modifications not expressly approved by the party responsible compliance could void the user's authority to operate the equipment.**

This page intentionally left blank.

C Default Settings

C.1 Parameters Default Settings

C.1.1 ECG, Arrhythmia, ST and QT Default Settings

C.1.1.1 ECG Default Settings

Item		Default Setting
HR/PR	Alarm switch	On
	High limit	Adult: 120 bpm Pediatric: 160 bpm Neonate: 200 bpm
	Low limit	Adult: 50 bpm Pediatric: 75 bpm Neonate: 100 bpm
	Priority	Med
	Alarm Outputs	Off
Extreme Tachy	Alarm switch	On
	High limit	Adult: 160 bpm Pediatric: 180 bpm Neonate: 220 bpm
	Priority	High
	Alarm Outputs	Off
Extreme Brady	Alarm switch	On
	Low limit	Adult: 35 bpm Pediatric: 50 bpm Neonate: 60 bpm
	Priority	High
	Alarm Outputs	Off
Alarm Source		Auto
ECG1		II
ECG2 (5-lead, 6-lead, 12-lead)		V, Va, V1
Va (for 6-lead only)		Va
Vb(for 6-lead only)		Vb
ECG Gain		×1
Speed		25 mm/sec
Filter		OR: Surgery CCU: Diagnostic Other departments: Monitor
High FreqCut-off (for 12-lead only)		35 Hz
Notch Filter		On

Item	Default Setting
Lead Set	Auto
D12L(for 6-lead only)	Off
Smart Lead	On
Baseline Drift Removal (for 12-lead only)	On
Waveform Layout	Standard
CrozFusion	On
CrozFusion Display	Off
QRS Volume	General, OR: 2 Other department: 0
QRS Threshold	0.16 mV
Paced	Adult: Unspecified Pediatric/neonate: No
Pacer Reject	Off

C.1.1.2 Arrhythmia Default Settings

Arrhythmia Alarm Default Settings

Item	Alarm Switch	Priority	Alarm Outputs
Asystole	On	High, unadjustable	Off
V-Fib/V-Tach	On	High, unadjustable	Off
V-Tach	On	High, unadjustable	Off
Vent Brady	On	High, unadjustable	Off
Extreme Tachy	On	High, unadjustable	Off
Extreme Brady	On	High, unadjustable	Off
R on T	CCU: On Other departments: Off	Med	Off
Run PVCs	Off	Low	Off
Couplet	Off	Prompt	Off
Multiform PVC	Off	Med	Off
PVC	Off	Prompt	Off
Bigeminy	CCU: On Other departments: Off	Med	Off
Trigeminy	CCU: On Other departments: Off	Med	Off
Tachy	Off	Med	Off
Brady	Off	Med	Off
Pacer Not Capture	Off	Prompt	Off
Pacer Not Pacing	Off	Prompt	Off
Missed Beat	Off	Prompt	Off
Nonsus V-Tach	CCU: On Other departments: Off	Med	Off

Item	Alarm Switch	Priority	Alarm Outputs
Vent Rhythm	CCU: On Other departments: Off	Med	Off
Pause	Off	Low	Off
Irr. Rhythm	Off	Prompt	Off
A-Fib	Off	Prompt	Off
PVCs/min	CCU: On Other departments: Off	Med	Off
Pauses/min	CCU: On Other departments: Off	Med	Off

Arrhythmia Threshold Default Settings

Item	Default Setting		
	Adult	Pediatric	Neonate
Asystole Delay	5 sec	5 sec	5 sec
Tachy	120 bpm	160 bpm	200 bpm
Brady	50 bpm	75 bpm	100 bpm
Extreme Tachy	160 bpm	180 bpm	220 bpm
Extreme Brady	35 bpm	50 bpm	60 bpm
Multiform PVCs Window	15 beats	15 beats	15 beats
PVCs/min	10	10	10
Pause/min	8	8	8
Pause Threshold	2.0 sec	2.0 sec	2.0 sec
AF/Irr Rhy End Time	2 min	2 min	2 min
V-Tach Rate	130 bpm	130 bpm	160 bpm
V-Brady Rate	40 bpm	40 bpm	40 bpm
V-Tach PVCs	6	6	6
V-Brady PVCs	5	5	5

C.1.1.3 ST Default Settings

Item		Default Setting
ST Alarm Mode		Absolute
ST-I, ST-II, ST-III, ST-aVR, ST-aVL, ST-aVF, ST-V1, ST-V2, ST-V3, ST-V4, ST-V5,ST-V6, ST-Va, ST-Vb (ST Alarm Mode set to **Absolute**)	Alarm switch	Off
	High limit	0.2 mV
	Low limit	-0.2 mV
	Priority	Med
	Alarm Outputs	Off

Item		Default Setting
ST Single, ST Dual (ST Alarm Mode set to **Relative**)	Alarm switch	Off
	High limit	0.1 mV
	Low limit	-0.1 mV
	Priority	Med
	Alarm Outputs	Off
ST Analysis		Off
ST Segment		Auto
Show Marker		Off
ST Point		J+60 ms
Auto Adjust		On
J		48
ISO		-80

C.1.1.4 QT Default Settings

Item		Default Setting
QTc	Alarm switch	Off
	High limit	Adult: 500 Pediatric: 480 Neonate: 460
	Priority	Med
	Alarm Outputs	Off
ΔQTc	Alarm switch	Off
	High limit	60
	Priority	Med
	Alarm Outputs	Off
QT Analysis		Off
QT Lead		All

C.1.1.5 Glasgow 12-lead ECG Algorithm Default Settings

Item	Default Setting
Filter	Diagnostic
Baseline Drift Removal	On
Tachy	100
Brady	50
Waveform Layout	Standard
Median Complex	Off
Measurements	On
Interpretation	On
Interpretation Summary	On

Item	Default Setting
Amplitude	10 mm/mV
Speed	25 mm/sec
Auto Interval	Off
12-Lead Format	3×4+1
Rhythm Lead 1	II
Rhythm Lead 2	V2
Rhythm Lead 3	V5
Format Sequence	Sequential

C.1.2 Respiration Default Settings

Item		Default Setting
RR	Alarm switch	On
	High limit	Adult: 30 Pediatric: 30 Neonate: 100
	Low limit	Adult: 8 Pediatric: 8 Neonate: 30
	Priority	Med
	Alarm Outputs	Off
Apnea	Alarm switch	On
	Priority	High, unadjustable
	Alarm Outputs	Off
Apnea Delay		Adult: 20 sec Pediatric: 20 sec Neonate: 15 sec
RR Source		Auto
Resp Lead		Adult: Auto Pediatric: Auto Neonate: II
Gain		×2
Speed		6.25 mm/s
Auto Threshold Detection		On

C.1.3 SpO_2/SpO_2b Default Settings

Item		Default Setting
SpO_2/SpO_2b	Alarm switch	On
	High limit	Adult: 100% Pediatric: 100% Neonate: 95%
	Low limit	90%
	Priority	Med
	Alarm Outputs	Off
SpO_2/SpO_2b Desat	Alarm switch	On
	Low limit	80%
	Priority	High
	Alarm Outputs	Off
ΔSpO_2	Alarm switch	On
	High limit	10%
	Priority	Med
	Alarm Outputs	Off
Satsecond (for Nellcor SpO_2)		Off
NIBP Simul		Off
Sensitivity (for Mindray SpO_2)		Medium
Display PI (for Mindray SpO_2)		On
Speed		25 mm/s
PR	Alarm switch	On
	High limit	Adult: 120 Pediatric: 160 Neonate: 200
	Low limit	Adult: 50 Pediatric: 75 Neonate: 100
	Priority	Med
	Alarm Outputs	Off
	Alarm Source	Auto
	PR Source	Auto
	QRS Volume	General, OR: 2 Other departments: 0
	Display PR	On

C.1.4 Temperature Default Settings

C.1.4.1 Temperature Default Settings for MPM and Temp Module

Item		Default Setting
TXX (XX refers to temperature site)	Alarm switch	On
	High limit	38.0 °C
	Low limit	35.0 °C
	Priority	Med
	Alarm Outputs	Off
ΔT	Alarm switch	On
	High limit	2.0 °C
	Priority	Med
	Alarm Outputs	Off

C.1.4.2 Temperature Default Settings for Genius^{TM}2 Tympanic Thermometer

Item		Default Setting
TempIF	Alarm switch	Off
	High limit	38.0 °C
	Low limit	35.0 °C
	Priority	Med
	Alarm Outputs	Off
ΔT	Alarm switch	On
	High limit	2.0 °C
	Priority	Med
	Alarm Outputs	Off

C.1.5 NIBP Default Settings

Item		Default Setting
NIBP-S	Alarm switch	On
	High limit	Adult: 160 mmHg Pediatric: 120 mmHg Neonate: 90 mmHg
	Low limit	Adult: 90 mmHg Pediatric: 70 mmHg Neonate: 40 mmHg
	Priority	Med
	Alarm Outputs	Off

Item		Default Setting
NIBP-D	Alarm switch	On
	High limit	Adult: 90 mmHg Pediatric: 70 mmHg Neonate: 60 mmHg
	Low limit	Adult: 50 mmHg Pediatric: 40 mmHg Neonate: 20 mmHg
	Priority	Med
	Alarm Outputs	Off
NIBP-M	Alarm switch	On
	High limit	Adult: 110 mmHg Pediatric: 90 mmHg Neonate: 70 mmHg
	Low limit	Adult: 60 mmHg Pediatric: 50 mmHg Neonate: 25 mmHg
	Priority	Med
	Alarm Outputs	Off
NIBP-S Extreme	Alarm switch	Off
	High limit	Adult: 175 mmHg Pediatric: 130 mmHg Neonate: 95 mmHg
	Low limit	Adult: 75 mmHg Pediatric: 60 mmHg Neonate: 35 mmHg
	Priority	High
	Alarm Outputs	Off
NIBP-D Extreme	Alarm switch	Off
	High limit	Adult: 105 mmHg Pediatric: 80 mmHg Neonate: 65 mmHg
	Low limit	Adult: 35 mmHg Pediatric: 30 mmHg Neonate: 15 mmHg
	Priority	High
	Alarm Outputs	Off
NIBP-M Extreme	Alarm switch	Off
	High limit	Adult: 125 mmHg Pediatric: 100 mmHg Neonate: 75 mmHg
	Low limit	Adult: 45 mmHg Pediatric: 40 mmHg Neonate: 20 mmHg
	Priority	High
	Alarm Outputs	Off

Item	Default Setting
Initial Pressure	Adult: 160 mmHg Pediatric: 140 mmHg Neonate: 90 mmHg
Interval	OR: 5 min NICU: 30 min Other departments: 15 min
Start Mode	Clock
NIBP End Tone	Off
Venipuncture Pressure	Auto
Display Format	Sys/Dia (Mean)
Alarm Limit Display	On
Display PR	Off

C.1.6 IBP Default Settings

Item		Default Setting
IBP-S	Alarm switch	On
	High limit	■ Art/pArt/Ao/UAP/BAP/FAP/LV/P1-P4 arterial pressure Adult: 160 mmHg Pediatric: 120 mmHg Neonate: 90 mmHg ■ PA Adult: 35 mmHg Pediatric and neonate: 60 mmHg
	Low limit	■ Art/pArt/Ao/UAP/BAP/FAP/LV/P1-P4 arterial pressure Adult: 90 mmHg Pediatric: 70 mmHg Neonate: 55 mmHg ■ PA Adult: 10 mmHg Pediatric and neonate: 24 mmHg
	Priority	Med
	Alarm Outputs	Off

Item		Default Setting
IBP-D	Alarm switch	On
	High limit	■ Art/pArt/Ao/UAP/BAP/FAP/LV/P1-P4 arterial pressure Adult: 90 mmHg Pediatric: 70 mmHg Neonate: 60 mmHg ■ PA Adult: 16 mmHg Pediatric and neonate: 4 mmHg
	Low limit	■ Art/pArt/Ao/UAP/BAP/FAP/LV/P1-P4 arterial pressure Adult: 50 mmHg Pediatric: 40 mmHg Neonate: 20 mmHg ■ PA Adult: 0 mmHg Pediatric and neonate: -4 mmHg
	Priority	Med
	Alarm Outputs	Off
IBP-M	Alarm switch	On
	High limit	■ Art/pArt/Ao/UAP/BAP/FAP/LV/P1-P4 arterial pressure Adult: 110 mmHg Pediatric: 90 mmHg Neonate: 70 mmHg ■ PA Adult: 20 mmHg Pediatric and neonate: 26 mmHg ■ CVP//pCVP/ICP/RAP/LAP/UVP/P1-P4 venous pressure Adult: 10 mmHg Pediatric and neonate: 4 mmHg
	Low limit	■ Art/pArt/Ao/UAP/BAP/FAP/LV/P1-P4 arterial pressure Adult: 70 mmHg Pediatric: 50 mmHg Neonate: 35 mmHg ■ PA Adult: 0 mmHg Pediatric and neonate: 12 mmHg ■ CVP/pCVP//ICP/RAP/LAP/UVP/P1-P4 venous pressure Adult: 0 mmHg Pediatric and neonate: 0 mmHg
	Priority	Med
	Alarm Outputs	Off

Item		Default Setting
Art-S Extreme	Alarm switch	Off
	High limit	Adult: 175 mmHg Pediatric: 130 mmHg Neonate: 95 mmHg
	Low limit	Adult: 75 mmHg Pediatric: 60 mmHg Neonate: 50 mmHg
	Priority	High
	Alarm Outputs	Off
Art-D Extreme	Alarm switch	Off
	High limit	Adult: 105 mmHg Pediatric: 80 mmHg Neonate: 65 mmHg
	Low limit	Adult: 35mmHg Pediatric: 30 mmHg Neonate: 15 mmHg
	Priority	High
	Alarm Outputs	Off
Art-M Extreme	Alarm switch	Off
	High limit	Adult: 125 mmHg Pediatric: 100 mmHg Neonate: 75 mmHg
	Low limit	Adult: 55 mmHg Pediatric: 40 mmHg Neonate: 30 mmHg
	Priority	High
	Alarm Outputs	Off
CPP	Alarm switch	On
	High limit	Adult: 130 mmHg Pediatric: 100 mmHg Neonate: 90 mmHg
	Low limit	Adult: 50 mmHg Pediatric: 40 mmHg Neonate: 30 mmHg
	Priority	Med
	Alarm Outputs	Off
Measure (for P1, P2)		All
Measure (for P3, P4)		Mean only
Sensitivity		Med
Speed		25 mm/sec

Item		Default Setting
Scale (mmHg)	CVP/pCVP/ICP/RAP/ LAP/UVP venous pressure	0-20
	Art/pArt/Ao/BAP/FAP/ LV/P1/P2 arterial pressure	0-160
	UAP/P3/P4 venous pressure	0-80
	PA	0-30
PPV Measure		Off
PPV Source		Auto
PAWP	Reference Waveform 1	II
	Reference Waveform 2	Resp
	Speed	12.5 mm/sec
	PA Scale (mmHg)	0-30
Overlapping Waveform Setup	Left Scale (mmHg)	0-160
	Right Scale (mmHg)	0-20
	CVP Scale (mmHg)	0-30
	ICP Scale (mmHg)	0-20
	PA Scale (mmHg)	0-30
	Speed	25 mm/sec
	Gridlines	Off
Display Format		Sys/Dia (Mean)
Alarm Limit Display		On
Use PA-D as PAWP		Off

C.1.7 C.O. Default Settings

Item		Default Setting
TB	Alarm switch	On
	High limit	39.0 °C
	Low limit	36.0 °C
	Priority	Med
	Alarm Outputs	Off
Comp const		0.542
Auto Start		On
Auto TI		On

C.1.8 $ScvO_2$ Default Settings

Item		Default Setting
$ScvO_2$	Alarm switch	On
	High limit	90
	Low limit	40
	Priority	Med
	Alarm Outputs	Off

C.1.9 CCO Default Settings (PiCCO)

Item		Default Setting
CCO	Alarm switch	On
	High limit	14.0
	Low limit	2.0
	Priority	Med
	Alarm Outputs	Off
CCI	Alarm switch	On
	High limit	10.0
	Low limit	1.0
	Priority	Med
	Alarm Outputs	Off
Auto pCVP		On
Auto Start		On
Injectate Volume		Adult: 15 ml Pediatric: 10 ml
Select Parameter		CCO, GEDI, ELWI, SVRI, GEF

C.1.10 ICG Default Setting

Item		Default Setting
C.I.	Alarm switch	On
	High limit	5.0
	Low limit	1.5
	Priority	Med
	Alarm Outputs	Off
TFC	Alarm switch	On
	High limit	60
	Low limit	20
	Priority	Med
	Alarm Outputs	Off

Item	Default Setting
Sweep	25 mm/sec
Select Parameter	C.I., SQI, SVI, SVRI, TFC

C.1.11 CCO Default Settings (Vigilance/Vigileo/EV1000)

Item		Default Setting
CCO	Alarm switch	On
	High limit	14.0
	Low limit	2.0
	Priority	Med
	Alarm Outputs	Off
CCI	Alarm switch	On
	High limit	10.0
	Low limit	1.0
	Priority	Med
	Alarm Outputs	Off
SVR Unit		DS/cm^5
Select Parameter		Vigilance: CCI, SVRI, EDVI, SVI, RVEF Vigileo: CCI, SVRI, SVV, SVI, RVEF EV1000: CCI, GEF, SVRI, ELWI, GEDI

C.1.12 $ScvO_2$/SvO_2 Default Settings (Vigilance/Vigileo/EV1000)

Item		Default Setting
SvO_2 /$ScvO_2$	Alarm switch	On
	High limit	90
	Low limit	40
	Priority	Med
	Alarm Outputs	Off

C.1.13 CO_2 Default Settings

C.1.13.1 General Settings

Item		Default Setting
$EtCO_2$	Alarm switch	On
	High limit	Adult and pediatric: 50 mmHg Neonate: 45 mmHg
	Low limit	Adult and pediatric: 25mmHg Neonate: 30mmHg
	Priority	Med
	Alarm Outputs	Off
$FiCO_2$	Alarm switch	On
	High limit	4 mmHg
	Priority	Med
	Alarm Outputs	Off
Apnea Delay		Adult and pediatric: 20 s Neonate: 15 s
RR Source		Auto
Speed		6.25 mm/s
Scale		50 mmHg
Waveform Type		Draw

C.1.13.2 Sidestream CO_2 Default Settings

Item		Default Setting
EtO_2	Alarm switch	On
	High limit	88%
	Low limit	18%
	Priority	Med
	Alarm Outputs	Off
FiO_2	Alarm switch	On
	High limit	Adult and pediatric: 100% Neonate: 90%
	Low limit	18%
	Priority	Med
	Alarm Outputs	Off
BTPS Compensation		Off
O_2 Compensation		OR: 100% Other departments: 21%
AG Compensation		0%
N_2O Compensation		0%
Auto Standby		60 min

Item	Default Setting
Operating Mode	Measure

C.1.13.3 Microstream CO_2 Default Settings

Item	Default Setting
BTPS Compen	Off
Maximum Hold	20 sec
Auto Standby	Off
Operating Mode	Measure

C.1.13.4 Mainstream CO_2 Default Settings

Item	Default Setting
Maximum Hold	10 sec
O_2 Compensation	Off
Balance Gas	Room Air
AG Compensation	0%
Operating Mode	Measure

C.1.14 Gas Default Settings

Item		Default Setting
$EtCO_2$	Alarm switch	On
	High limit	Adult and pediatric: 50 mmHg Neonate: 45 mmHg
	Low limit	Adult and pediatric: 25mmHg Neonate: 30mmHg
	Priority	Med
	Alarm Outputs	Off
$FiCO_2$	Alarm switch	On
	High limit	4 mmHg
	Priority	Med
	Alarm Outputs	Off
EtO_2	Alarm switch	On
	High limit	88%
	Low limit	18%
	Priority	Med
	Alarm Outputs	Off

Item		Default Setting
FiO_2	Alarm switch	On
	High limit	Adult and pediatric: 100% Neonate: 90%
	Low limit	18%
	Priority	Med
	Alarm Outputs	Off
EtN_2O	Alarm switch	On
	High limit	55%
	Low limit	0%
	Priority	Med
	Alarm Outputs	Off
FiN_2O	Alarm switch	On
	High limit	53%
	Low limit	0%
	Priority	Med
	Alarm Outputs	Off
EtAA/FiAA	Alarm switch	On
	High limit	30%
	Low limit	0.0%
	Priority	Med
	Alarm Outputs	Off
EtHal/EtEnf/EtIso	Alarm switch	On
	High limit	3.0%
	Low limit	0.0%
	Priority	Med
	Alarm Outputs	Off
FiHal/FiEnf/FiIso	Alarm switch	On
	High limit	2.0%
	Low limit	0.0%
	Priority	Med
	Alarm Outputs	Off
EtSev	Alarm switch	On
	High limit	6.0%
	Low limit	0.0%
	Priority	Med
	Alarm Outputs	Off

Item		Default Setting
FiSev	Alarm switch	On
	High limit	5.0%
	Low limit	0.0%
	Priority	Med
	Alarm Outputs	Off
EtDes	Alarm switch	On
	High limit	8.0%
	Low limit	0.0%
	Priority	Med
	Alarm Outputs	Off
FiDes	Alarm switch	On
	High limit	6.0%
	Low limit	0.0%
	Priority	Med
	Alarm Outputs	Off
Apnea Delay		Adult and pediatric: 20 sec Neonate: 15 sec
RR Source		Auto
Operating Mode		Measure
Auto Standby		Off
Speed		6.25 mm/sec
Scale		O_2: 400 mmHg CO_2: 50 mmHg N_2O: 50% Hal, Enf, and Iso: 2.5% Sev: 4.0% AA and Des: 9.0%
Waveform Type		Draw (for CO_2 only)
O_2 compensation		OR: 100% Other departments: Off

C.1.15 RM Default Settings

Item		Default Setting
PEEP	Alarm switch	On
	High limit	10
	Low limit	0
	Priority	Med
	Alarm Outputs	Off

Item		Default Setting
PIP	Alarm switch	On
	High limit	40
	Low limit	1
	Priority	Med
	Alarm Outputs	Off
MVe	Alarm switch	On
	High limit	30.0
	Low limit	2.0
	Priority	Med
	Alarm Outputs	Off
Apnea Delay		20 sec
RR Source		Auto
Atmosphere Temperature		25 °C
Relative humidity		55%
Paw Scale		40 cmH_2O
Flow Scale		60 L/min
Vol Scale		1200 ml
Speed		6.25 mm/s
Paw View		PIP, PEEP, Pmean, Pplat, RR
Flow View		PEF, PIF, Compl
Vol View		MVe, MVi, TVe, TVi

C.1.16 EEG Default Settings

Item		Default Setting
Scale		100 μV
Speed		25mm/s
Low Freq Cuf-off		0.5 Hz
High Freq Cuf-off		30 H
Notch Filter		On
Select Parameter		SR, SEF, MF, PPF, TP, EMG
Sensor Check	Montage	Montage 1
	Interval	30 min
Montage Setup	Montage Type	Bipolar Mode
EEG Expand View		**Default Setting**
EEG	EEG Channels	All
	Scale	100 μv
	Speed	25mm/s

Item		Default Setting
Trends	EEG Channels	All
	Parameters	SEF
	Trend Length	60 min
DSA	EEG Channels	All
	Parameters	SEF
	Trend Length	20 min
	Power Scale	1 - 64 dB
CSA	EEG Channels	All
	Parameters	SEF
	Trend Length	20 min
	Power Scale	1 - 64 dB
	CSA Clipping	On

C.1.17 BIS Default Settings

Item		Default Setting
BIS	Alarm switch	On
	High limit	70
	Low limit	20
	Priority	Med
	Alarm Outputs	Off
Smoothing Rate		15 sec
Display		OR: BIS Trend Other departments: EEG LT/RT
Scale		100 µv
Speed		25mm/s
Filter		On
Auto Check		On
Select Parameter		SQI, EMG, SR, SEF
BIS Expand View		**Default Setting**
EEG Waveforms		All
Parameter 1		BIS L
Parameter 2		EMG
Trend Length		60 min

C.1.18 NMT Default Settings

Item	Default Setting
Stimulation Current	Supra (60 mA)
Pulse Width	200 µs

Item	Default Setting
Block Recovery	Off
Stimulation Beep Volume	2
Interval	TOF Mode: 1 min ST Mode: 10 sec DBS Mode: 1 min
DBS Mode	3.3

C.1.19 rSO_2 Default Settings

Item		Default Setting
rSO_2-1/rSO_2-2/ rSO_2-1'/rSO_2-2'	Alarm switch	On
	High limit	90
	Low limit	40
	Priority	Med
	Alarm Outputs	Off
rSO_2-1/rSO_2-2/ rSO_2-1'/rSO_2-2' Variance	Low Limit	-20
Auto Low Limit		Off
rSO_2-1 Label		L
rSO_2-2 Label		R
rSO_2-1' Label		S1
rSO_2-2' Label		S2
AUC Mode		Below Base Percentage
Fixed Threshold		50
Percentage Below Baseline		25
Select Parameter		Baseline, Baseline Variance

C.2 Routine Default Settings

C.2.1 Alarm Default Settings

Item	Default Setting
Alarm Volume	2
High Alarm Volume	Alarm Volume + 2
Reminder Volume	2
Apnea Delay	Adult: 20 sec Pediatric: 20 sec Neonate: 15 sec
Printing Duration	20 sec

C.2.2 Review Default Settings

Item		Default Setting
Tabular Trends	Trend Group	Standard
	Interval	OR: 5 min Other departments: 30 min
Graphic Trends	Trend Group	Standard
	Zoom	8 hrs
	Trends	5
Events	Filter	Off
	Filter Setup	All On
	Beat Anno	Off
	Speed	25 mm/s
	Gain	×1
Full Disclosure	Display (Maximum: 3)	II
	Storage	II
	Duration	1 min
	Scale	×1
	Beat Anno	Off
	Speed	25 mm/sec
	Gain	×1
12-Lead ECG	Speed	25 mm/sec
	Gain	×1
	Layout	3×4+1

C.2.3 Minitrends Default Settings

Item		Default Setting
Alarm Statistics		OR: Off Other departments: On
Alarm Statistics Length		OR: 2hrs Other departments: 8 hrs
Minitrend Length		OR: 30 min Other departments: 2 hrs
Baseline (for OR department only)		On
Routine Vital		Manual
Time	(For **Routine Vital** set to **Auto**)	08:00
Interval	(For **Routine Vital** set to **Auto**)	8 hrs

C.2.4 OxyCRG Default Settings

Section	Item	Default Setting
Parameters Setup	Trend1	btbHR
	Trend2	SpO2
	Compressed	Resp
Apnea Event	Threhold (HR)	100
	Duration (HR)	0 s
	Threhold (SpO_2)	80
	Duration (SpO_2)	0 s
	Apnea	15 sec
	Event Storage Format	2 min+2 min

C.2.5 Display Default Settings

Item		Default Setting
Choose Screen		Normal Screen
Display	Screen Lock Duration	General: Permanent CCU: Permanent Other departments: 10 sec
	Brightness	5
	Brightness On Battery	1
Night Mode	Brightness	1
	Alarm Volume	2
	QRS Volume	1
	Key Volume	0
	NIBP End Tone	Off
	Stop NIBP	Off

C.2.6 Report Default Settings

C.2.6.1 Report Setup

Item		Default Setting
ECG Report	Amplitude	10 mm/mV
	Speed	25 mm/sec
	Auto Interval	Off
	12-Lead Format	3×4+1
	Rhythm Lead 1	II
	Rhythm Lead 2	V2
	Rhythm Lead 3	V5
	Format Sequence	Sequential

Item		Default Setting
Realtime Report	Speed	Auto
	Select Waveform	Current Waveforms
Tabular Trends Report	Period	Auto
	Interval	Auto
	Report Format	Parameter Oriented
	Trend Group	Standard
Graphic Trends	Period	Auto
	Trend Group	Standard

C.2.6.2 Record Setup

Item	Default Setting
Waveform 1	I
Waveform 2	II
Waveform 3	Off
IBP Overlap	Off
Recording Duration	8 sec
Interval	Off
Recorder Paper Speed	25 mm/sec

C.2.7 Calculations Default Settings

Item			Default Setting
Drug	Calculator	Weight Based	Off
		Drug Amount	mcg
		Solution Volume	ml
		Dose	mcg/min
		Concentration	mcg/ml
		Infusion Time	hr
		Infusion Rate	ml/hr
	Titration Table	Dose Type	Dose/hr
		Interval	1
Oxygenation	OxyCont Unit		ml/L
	Hb Unit		g/dl
	Pressure Unit		mmHg
Ventilation	Pressure Unit		mmHg

C.2.8 System Time Default Settings

Item	Default Setting
Date Format	yyyy-mm-dd

Item	Default Setting
24-Hour Time	On
Daylight Savings Time	Off

This page intentionally left blank.

D Alarm Messages

D.1 Physiological Alarm Messages

This section lists physiological alarms, their default priority, and the actions that can be taken when an alarm occurs.

D.1.1 General Physiological Alarm Messages

Alarm messages	Default priority	Cause and solution
XX High	Med	XX value has risen above the high alarm limit or fallen below the low alarm limit. Check the patient's condition and check if the patient category and alarm limit settings are correct.
XX Low	Med	

Note: XX represents a measurement or parameter label, such as HR, NIBP, PVCs, RR, SpO2, PR, and so on.

D.1.2 Arrhythmia Alarm Messages

Alarm message	Default priority
Asystole	High
VFib/VTac	High
Vtac	High
Vent Brady	High
Extreme Tachy	High
Extreme Brady	High
PVCs/min	Med
Pauses/min	Med
R on T	Med
Bigeminy	Med
Trigeminy	Med
Tachy	Med
Brady	Med
Multiform PVC	Med
Vent. Rhythm	Med
Nonsus. Vtac	Med
Run PVCs	Low
Pause	Low
Couplet	Prompt
PVC	Prompt
Irr Rhythm	Prompt
Pacer Not Pacing	Prompt

Alarm message	Default priority
Pacer Not Capture	Prompt
Missed Beat	Prompt
A-Fib	Prompt

Note: When arrhythmia alarms occur, check the patient's condition and the ECG connections.

D.1.3 Resp Physiological Alarm Messages

Alarm message	Default priority	Cause and solution
Resp Aritifact	High	The patient's heartbeat has interfered with his respiration. Check the patient's condition and the Resp connections.
Apnea	High	The respiration signal was so weak that the monitor cannot perform respiration analysis. Check the patient's condition, module and patient connections.

D.1.4 SpO_2 Physiological Alarm Messages

Alarm message	Default priority	Cause and solution
SpO2/SpO2b Desat	High	The SpO_2 or SpO_2b value falls below the desaturation alarm limit. Check the patient's condition and check if the alarm limit settings are correct.
ΔSpO2 High	High/Med, configurable	The ΔSpO2 value exceeds the alarm limit. Check the patient's condition.

D.1.5 PR Physiological Alarm Messages

Alarm message	Default priority	Cause and solution
No Pulse	High	The pulse signal was so weak that the monitor cannot perform pulse analysis. Check the patient's condition, SpO2 sensor and measurement site.

D.1.6 NIBP Physiological Alarm Messages

Alarm message	Default priority	Cause and solution
NIBP-S/NIBP-D/ NIBP-M Extremely High	High	The NIBP value is higher than the NIBP Extreme alarm high limit. Check the patient's condition and check if the alarm limit settings are correct.
NIBP-S/NIBP-D/ NIBP-M Extremely Low	High	The NIBP value is lower than the NIBP Extreme alarm low limit. Check the patient's condition and check if the alarm limit settings are correct.

D.1.7 IBP Physiological Alarm Messages

Alarm message	Default priority	Cause and solution
Art-S/Art-D/Art-M Extremely High	High	The Art value is higher than the Art Extreme alarm high limit. Check the patient's condition and check if the alarm limit settings are correct.
Art-S/Art-D/Art-M Extremely Low	High	The Art value is lower than the Art Extreme alarm low limit. Check the patient's condition and check if the alarm limit settings are correct.

D.1.8 CO_2 Physiological Alarm Messages

Alarm message	Default priority	Cause and solution
FiO2 Shortage	High	FiO_2 concentration is less than18%. Check the patient's condition, the ventilated O_2 content and the CO_2 connection.

D.1.9 AG Physiological Alarm Messages

Alarm message	Default priority	Cause and solution
FiO2 Shortage	High	Check the patient's condition, the ventilated O_2 content and the AG connections.
Mixed Agent and MAC≥3	Med	The mixed anaesthetic gases concentration is too high. Adjust the anaesthetic gases concentration.
Apnea	High	The respiration signal was so weak that the monitor cannot perform respiration analysis. Check the patient's condition, module and patient connections.

D.1.10 RM Physiological Alarm Messages

Alarm message	Default priority	Cause and solution
Apnea	High	The respiration signal was so weak that the monitor cannot perform respiration analysis. Check the patient's condition, module and patient connections.

D.1.11 EWS Physiological Alarm Messages

Alarm message	Default priority	Cause and solution
EWS Score > N[1]	High/Mediate	The total score exceeds the configured alarm limit. Check the patient condition.
XX[2] score is 3	Mediate	The parameter score is 3. Check the patient condition.

1. N represents a number.

2. XX represents RR, SpO2, Temp, BP-S, BP-D, BP-M, HR, EtCO2, or FiO2.

D.2 Technical Alarm Messages

This section lists technical alarms, their default priority, indication on alarm reset, and the actions that can be taken when an alarm occurs.

Technical alarms give different alarm indicators when the alarm system is reset. In this section we classify the technical alarms into three categories for easy clarification:

- A: technical alarms are cleared. The monitor gives no alarm indications.
- B: technical alarms are changed to the prompt messages.
- C: the alarm is silenced and a √ appears before the alarm message, indicating that the alarm is acknowledged.

In the following tables we will use A, B, and C to refer to the indications on alarm reset.

D.2.1 General Technical Alarm Messages

Alarm message	Default priority	Indication on alarm reset	Cause and solution
XX Module Error	High	C	XX module does not work properly. Replug the module, if the alarm persists, contact your service personnel.

Note: XX represents a measurement or parameter label, such as HR, RR, SpO2, EtCO2, and so on.

D.2.2 ECG Technical Alarm Messages

Alarm message	Default priority	Indication on alarm reset	Cause and solution
ECG Noisy	Low/Prompt	A	The ECG signal is noisy. Check for any possible sources of signal noise around the cable and electrode, and check the patient for excessive motion.
ECG Amplitude Too Small	Low	C	The ECG amplitude does not reach the detected threshold. Check for any possible source of interference around the cable and electrode.
ECG Lead Off	Low	B	The electrode has become detached from the patient or the lead wire has become disconnected from the adapter cable. Check the connections of the electrodes and leadwires.
ECG XX Lead Off	Low	B	The electrode has become detached from the patient or the lead wire has become disconnected from the adapter cable. Check the connections of the electrodes and leadwires.
ECG Signal Invalid	Low	A	Patient skin impedance is too high. Check ECG electrode application.
ECG Learning	Prompt	/	ECG learning is manually or automatically triggered.
Cannot Analyze QT	Prompt	/	/
D12L not available	Prompt	C	The current Va and Vb combination does not support D12L. Choose an available Va and Vb combination. For more information, see *11.5 Using 6-lead Placement to Derive 12-lead ECG (D12L)*.

Note: XX represents ECG lead name, for example RL, LL, V, Va, Vb, and so on.

D.2.3 Resp Technical Alarm Messages

Alarm message	Default priority	Indication on alarm reset	Cause and solution
Resp Interference	Prompt	/	The respiration circuit is disturbed. Check for any possible sources of signal noise.
Electrode Poor Contact	Prompt	/	Check the electrode application. Reposition or replace the electrodes if necessary.

D.2.4 SpO_2 Technical Alarm Messages

Alarm message	Default priority	Indication on alarm reset	Cause and solution
SpO2/SpO2b Sensor Off	Adjustable	B	The SpO_2 sensor has become detached from the patient or the module. Check the sensor connection. If the alarm persists, replace the sensor.
SpO2/SpO2b No Sensor	Low	A	The SpO_2 extension cable is detached from the SpO_2 module, or the SpO_2 sensor is detached from the SpO_2 extension cable. Check the SpO_2 cable and the sensor connection. If the alarm persists, replace the sensor.
SpO2/SpO2b Excess Light	Low	C	Ambient light is too strong. Move the sensor to a place with lower level of ambient light or cover the sensor to minimize the ambient light.
SpO2/SpO2b No Pulse	Low	C	The SpO_2 sensor failed to obtain pulse signal. Check the patient's condition and replace the sensor application site. If the alarm persists, replace the sensor.
SpO2/SpO2b Sensor Incompatible	Low	C	Incompatible or an unspecified SpO_2 sensor is used. Use specified sensors.
SpO2/SpO2b Low Signal Quality	Low	C	1. Check the sensor and sensor position. 2. Make sure the patient is not shivering or moving. 3. The patient's pulse may be too low to be measured.
SpO2/SpO2b Interference	Low	C	The SpO_2 signal has been interfered. Check for any possible sources of signal noise and check the patient for excessive motion.
SpO2/SpO2b Sensor Error	Low	C	Replace the sensor and measure again.
SpO2/SpO2b Searching Pulse	Prompt	/	SpO_2 is searching for pulse.
SpO2/SpO2b Low Perfusion	Prompt	/	The SpO_2 sensor is not properly placed or the patient's perfusion index is too low. 1. Check the sensor and sensor position. 2. Reposition the sensor if necessary.

D.2.5 Temp Technical Alarm Messages

Alarm message	Default priority	Indication on alarm reset	Cause and solution
T1/T2 Sensor Off	Low	A	Check the sensor connection and reconnect the sensor.
TempIF Ambient Temp High (for tympanic thermometer)	Low	A	The ambient temperature is too high. Move the patient to a cooler place and take temperature measurement again if necessary.
TempIF Ambient Temp Low (for tympanic thermometer)	Low	A	The ambient temperature is too low. Move the patient to a warmer place and take temperature measurement again if necessary.
TempIF Overrange (for tympanic thermometer)	Low	C	The temperature measurement exceeds the measurement range. Check the patient's condition.

Alarm message	Default priority	Indication on alarm reset	Cause and solution
TempIF Thermometer Error (for tympanic thermometer)	High	C	The tympanic thermometer may fail. Take temperature measurement again. If the alarm persists, replace the tympanic thermometer.

D.2.6 NIBP Technical Alarm Messages

Alarm message	Default priority	Indication on alarm reset	Cause and solution
NIBP Cuff Loose	Low	A	There is a leak in the cuff or air tubing. Use a cuff of correct type based on the patient size. Apply the cuff and connect the air tubing as instructed in the manual.
NIBP Cuff or Airway Leak	Low	A	Check the NIBP cuff and pump for leakages.
NIBP Airway Error	Low	A	The air tubing may be occluded. Check the air tubing for an occlusion or kinking. If the alarm persists, contact your service personnel.
NIBP Weak Signal	Low	A	The patient's pulse is weak or the cuff is loose. Check the patient's condition and replace the cuff application site.
NIBP Overrange	Low	A	The measured NIBP value exceeds the module measurement range. Check the patient's condition.
NIBP Excessive Motion	Low	A	Check the patient's condition and reduce patient motion.
NIBP Cuff Overpressure	Low	A	The NIBP airway may be occluded. Check the airway and measure again. If the alarm persists, contact your service personnel.
NIBP Timeout	Low	A	The measurement time exceeds 120 seconds in the adult or pediatric mode, or exceeds 90 seconds in the neonatal mode, and the BP value cannot be obtained. Check the patient's condition and NIBP connections, or replace the cuff and measure again.
NIBP Cuff and Patient Mismatch	Low	A	The cuff type mismatches the patient category. Verify the patient category or replace the cuff if necessary. If patient catergory is correct, check that the tubing is not bent and the airway is not occluded.
NIBP Airway Leak	Low	A	Airway leakage is found during the NIBP leakage test. Check the NIBP cuff and pump for leakages.

D.2.7 IBP Technical Alarm Messages

Alarm message	Default priority	Indication on alarm reset	Cause and solution
XX Sensor Error	Med	C	The IBP sensor fails. Replace the sensor.
XX No Sensor	High, Med, or Low, configurable	A	The IBP patient cable and/or corresponding IBP sensor is not connected or detached. Check the cable and sensor connection.
XX No Pulse	Low	A	The catheter may be occluded. Please flush the catheter.

Alarm message	Default priority	Indication on alarm reset	Cause and solution
XX Disconnected	High	C	The liquid way is disconnected from the patient, or the three-way valve is open to the air. Check the connection of the liquid way, or check the valve is open to the patient. If the alarm persists, contact your service personnel.

Note: XX represents an IBP label, for example PA, CVP, FAP, P1, and so on.

D.2.8 C.O. Technical Alarm Messages

Alarm message	Default priority	Indication on alarm reset	Cause and solution
TB Sensor Off	Low	A	Check the sensor connection and reconnect the sensor.
TI Sensor Off	Low	A	Check the sensor connection and reconnect the sensor.

D.2.9 $ScvO_2$ Technical Alarm Messages

Alarm message	Default priority	Indication on alarm reset	Cause and solution
ScvO2 High Signal	Low	C	Check the sensor and reposition the catheter. Recalibrate the sensor.
ScvO2 Low Signal	Low	C	Check the sensor and reposition the catheter. Recalibrate the sensor.
ScvO2 Excess Light	Low	C	Avoid excessively strong backlight.
Optical Module Disconnected	Low	A	Connect the optical module.
Unsupported CeVOX version	Low	A	The module version is not compatible with the system. Contact your service personnel.
Disconnected from Vigilance	Low	A	The Vigilance monitor is disconnected. Check the connection between the CCO/SvO_2 module and the Vigilance monitor.
Disconnected from Vigileo	Low	A	The Vigileo monitor is disconnected. Check the connection between the CCO/SvO_2 module and the Vigilance monitor.

D.2.10 ICG Technical Alarm Messages

Alarm message	Default priority	Indication on alarm reset	Cause and solution
ICG Cable Error	Low	C	ICG cable is not calibrated or calibration failed. Replace the cable.

Alarm message	Default priority	Indication on alarm reset	Cause and solution
ICG Low Signal Quality	Low	C	Poor ICG sensor connection or high electromagnetic interference. 1. Check the sensor connection, re-apply the sensor if necessary. 2. Check if there is high electromagnetic interference. If yes, remove it. 3. If the alarm persists, contact your service personnel.
ICG No Cable	Low	A	Check and reconnect the cable.
ICG Sensor Off	Low	A	Check and reconnect the sensor.

D.2.11 CCO Technical Alarm Messages (From PiCCO Module)

Alarm message	Default priority	Indication on alarm reset	Cause and solution
Invalid PiCCO Catheter	Low	C	Erroneous or invalid catheter is used. Replace the catheter with the recommended catheter.
TI /TB Sensor Off	Low	A	Check the sensor connections.
TI Sensor Error	Low	C	Replace the sensor.
Invalid CCO calibration	Low	C	The arterial pressure is invalid. Check the pArt measurement.

D.2.12 CO_2 Technical Alarm Messages

Alarm message	Default priority	Indication on alarm reset	Cause and solution
CO2 Module High Temp	Low	C	Ambient temperature is too high or there is a module failure. 1. Lower the operating temperature. 2. Replug the module. 3. If the alarm persists, the CO_2 module may fail, contact your service personnel.
CO2 Module Low Temp	Low	C	Ambient temperature is too low or there is a module failure. 1. Raise the operating temperature. 2. Replug the module. 3. If the alarm persists, the CO_2 module may fail, contact your service personnel.
CO2 Zero Failed	Low	C	For mainstream CO_2 module, check the connections between the adapter and CO_2 transducer. Wait till the sensor's temperature becomes stabilized, and then perform a zero calibration again. For sidestream CO_2 module, replug the module. If the alarm persists, contact your service personnel.
CO2 No Watertrap	Low	B	Check the watertrap connections.

Alarm message	Default priority	Indication on alarm reset	Cause and solution
CO2 High Airway Pressure	Low	C	1. Check the airway pressure settings of the ventilator/anesthesia machine. 2. Disconnect the module from the ventilator/ anesthesia machine. 3. Replug the module. 4. If the alarm persists, contact your service personnel.
CO2 Low Airway Pressure	Low	C	1. Check the airway pressure settings of the ventilator/anesthesia machine. 2. Disconnect the module from the ventilator/ anesthesia machine. 3. Replug the module. 4. If the alarm persists, contact your service personnel.
CO2 High Barometric	Low	C	The ambient pressure exceeds the operating pressure range or CO_2 module fails. 1. Make sure that the ambient pressure meets the specifications, and check for sources that affect the ambient pressure. 2. Replug the module. If the alarm persists, contact your service personnel.
CO2 Low Barometric	Low	C	The ambient pressure exceeds the operating pressure range or CO_2 module fails. 1. Make sure that the ambient pressure meets the specifications, and check for sources that affect the ambient pressure. 2. Replug the module. If the alarm persists, contact your service personnel.
CO2 Airway Occluded	Low	C	1. Check if the sample line is kinked or occluded. 2. Replace the sample line. 3. Replug the module. 4. If the alarm persists, contact your service personnel.
CO2 No Filterline	Low	A	Make sure that the filterline is connected.
CO2 Calibration Required	Low	C	Perform a calibration.
CO2 Airway Error	Low	C	1. Check if the sample line is kinked or occluded. 2. Replace the sample line. 3. Replug the module. 4. If the alarm persists, contact your service personnel.
CO2 Adapter Error	Low	A	Check, clean or replace the airway adapter. Perform a zero calibration.
CO2 No Sensor	Low	A	Make sure that the CO_2 transducer is connected.
CO2: Change Watertrap	Low	C	Replace the watertrap.
CO2 Watertrap and Patient Mismatch	Low	C	Check the patient category and use a correct watertrap.

D.2.13 AG Technical Alarm Messages

Alarm message	Default priority	Indication on alarm reset	Cause and solution
AG No Watertrap	Low	B	Check the connections of the watertrap and re-connect it.
AG: Change Watertrap	Low	C	Replace the watertrap.
AG Watertrap and Patient Mismatch	Low	C	Check the patient category and use a correct watertrap.
AG Zero Failed	Low	C	There is external electromagnetic interference, airway occlusion or module failure. 1. Check for external inference sources. 2. Check for "AG Airway Occluded" alarm message. Remove the occlusion. 3. If the alarm persists, contact your service personnel.
Anesthetic Mixture	Low	C	Anesthetic mixture is detected.
AG Airway Occluded	Low	C	1. Check if the sample line is occluded. 2. Check the sample line. 3. Replug the module. 4. If the alarm persists, contact your service personnel.

D.2.14 RM Technical Alarm Messages

Alarm message	Default priority	Indication on alarm reset	Cause and solution
RM No Sensor	Low	A	Check and reconnect the sensor.
RM Zero Failed	Low	C	Replug the module. If the alarm persists, contact your service personnel.
RM Sensor and Patient Mismatch	Low	C	**Patient Category** is set to Adult, but a neonatal sensor is used. Check patient category setting and use correct RM sensor.

D.2.15 BIS Technical Alarm Messages

Alarm message	Default priority	Indication on alarm reset	Cause and solution
BIS Sensor Off	Low	A	Check and reconnect the BIS sensor. If the alarm persists, replace the sensor.
BIS Electrode XX Off	Low	A	Check the electrode connection, and re-attach the electrodes if necessary.
BIS Electrode XX Poor Contact	Low	A	Enter the **Sensor Check** menu, and check the connections of the sensor and electrodes.
BISx Error	High	C	Replug the module. If the alarm persists, contact your service personnel.

Alarm message	Default priority	Indication on alarm reset	Cause and solution
BIS No Sensor	Low	A	BIS sensor is not properly connected, BIS cable fails, BISx or BISx4 fails. 1. Check the BIS sensor connection. 2. Replug the BIS module. 3. Replace the BIS cable. 4. Replace BISx or BISx4.
BIS Sensor Too Many Uses	Low	A	Replace the sensor.
BIS Sensor Old	Low	A	Replace the sensor.
BIS XX Signal Quality Too Low	Low	A	SQI < 15 1. Check the patient's condition. 2. Check the sensor position, and its contact with the patient's skin. 3. Check that BISx or BISx4 is away from the electrically radiating equipment.
BIS XX Low Signal Quality	Low	A	SQI < 15 1. Check the patient's condition. 2. Check the sensor position, and its contact with the patient's skin. 3. Check that BISx or BISx4 is away from the electrically radiating equipment.
BIS Wrong Sensor Type	Low	A	Check or replace the sensor.
BIS Sensor Error	Low	C	Replace the sensor.
BISx Disconnected	Low	A	BISx or BISx4 is not connected properly or fails, or BIS patient cable fails. 1. Check that BISx or BISx4 is connected properly. 2. Replug the BIS Module. 3. Replace the BIS patient cable. 4. Replace BISx or BISx4.
Reconnect BIS	Low	A	Replug the BIS Module.

Note: XX represents BIS label, for example G, C, LE, LT, RL-RA, L-R, F-R, 1, 2, and so on.

D.2.16 EEG Technical Alarm Messages

Alarm message	Default priority	Indication on alarm reset	Cause and solution
EEG No Sensor	Low	A	The EEG patient cable is not connected. Connect the cable.
EEG Sensor Off	Low	A	EEG electrodes are not connected or detached. Check electrode connection and reconnect the electrodes.
EEG Electrode X + Y Off	Low	A	X + Y electrode is detached. Check the electrode connection and reconnect the electrode.
EEG Electrode X + Y Poor Contact	Low	A	X + Y electrode does not properly contact the patient. Check the electrode connection and reconnect the electrode.
EEG: Module Protected	High	C	EEG module may fail. Disconnect the EEG module and reconnect it. If the alarm persists, replace the module, or contact your service personnel.

Note: X represents EEG channel and polarity, for example A+, A-, A+, A-, and so on. Y represents electrode location, for example Fp1, T3, and so on.

D.2.17 NMT Technical Alarm Messages

Alarm message	Default priority	Indication on alarm reset	Cause and solution
NMT No Cable	Low	A	Check that NMT patient cable is properly connected to the NMT module.
NMT No Sensor	Low	A	Check that NMT sensor is properly connected to the NMT patient cable. If the alarm persists, replace the sensor.
NMT Stimulation Electrode Off	Low	A	Check that NMT sensor is properly connected to the NMT patient cable. If the alarm persists, check the application of electrodes.
NMT Sensor Error	Low	C	Contact your service personnel.

D.2.18 rSO_2 Technical Alarm Messages

Alarm message	Default priority	Indication on alarm reset	Cause and solution
rSO2-1 No Sensor rSO2-2 No Sensor rSO2-1’ No Sensor rSO2-2’ No Sensor	Low	A	rSO_2 sensor is detached, or the sensor cable is disconnected from the pre-amplifier. Re-connect the sensor to the pre-amplifier.
rSO2-1 Excess Light rSO2-2 Excess Light rSO2-1’ Excess Light rSO2-2’ Excess Light	Low	C	The sensor is detached or ambient light is too strong. Re-attach the sensor or reduce the level of ambient light.
rSO2-1 Low Signal Quality rSO2-2 Low Signal Quality rSO2-1’ Low Signal Quality rSO2-2’ Low Signal Quality	Low	C	The signal acquired by the sensor was unstable or weak due to power supply noise. Check the sensor connection. If the alarm persists, contact your service personnel.
rSO2 -1/rSO2-2/rSO2-1’/ rSO2-2’ No Preamplifier	Low	A	Properly connect the pre-amplifier.
rSO2 -1/rSO2-2/rSO2-1’/ rSO2: Change Sensor	Low	C	The sensor type mismatches patient category, the reusable sensor cable fails, the sensor reaches the lifetime, or the sensor type mismatches the monitor and patient category setting. Verify patient category and use sensors of correct patient category.
rSO2 -1/rSO2-2/rSO2-1’/ rSO2-2’ Interference	Low	C	There is noise interference (such as electrosurgical unit). Check for any possible sources of signal noise.
rSO2-1 Auto Baseline rSO2-2 Auto Baseline rSO2-1’ Auto Baseline rSO2-2’ Auto Baseline	Prompt	/	The monitor automatically sets the rSO_2 baseline.
Disconnect/ Reconnect rSO2	Low	A	Remove the rSO_2 module and reconnect it.

D.2.19 EWS Technical Alarms

Alarm message	Default priority	Indication on alarm reset	Cause and solution
EWS param XX is timeout	Low	A	The manually input parameter is timeout. Input a parameter numeric again.
EWS score needs to be confirmed	Low	A	Confirm to save or give up current score.

XX represents RR, SpO2, Supp. O2, Temp, BP, HR, Consciousness, Blood Sugar, Urine Output, Catheter, Pain Score, Pain, EtCO2, FiO2, Airway, or Customer defined parameter.

D.2.20 Power Supply Technical Alarm Messages

Alarm message	Default priority	Indication on alarm reset	Cause and solution
Low Battery	Med	C	Connect the monitor to an AC power source and allow the batteries to charge.
Critically Low Battery	High	C	Connect the monitor to an AC power source and allow the batteries to charge.
Battery Service Required (N22/N19)	Low	B	The battery reaches its lifetime. Replace the battery.
Battery Overload (N22/ N19)	High	C	Too many parameter modules are connected, causing system overload and high power consumption. Use AC power supply.
Power Board Comm Error	High	C	Restart the monitor. If the alarm persists, contact your service personnel.
Battery Error	High	C	The battery may fail. Contact your service personnel.
Battery Charging Error (N22/N19)	High	C	The charging circuit fails or the battery fails. Contact your service personnel.
RT Clock Need Reset	High	C	Contact your service personnel.
RT Clock Not Exist	High	C	Contact your service personnel.
XX V Too High	High	C	There is a problem with the system power supply. Restart the monitor.
XX V Too Low	High	C	

Note: XX represents 2.5 V, 3.3 V,5 V, or 12 V.

D.2.21 Recorder Technical Alarm Messages

Alarm message	Default priority	Indication on alarm reset	Cause and solution
Recorder Init Error	Low	A	An error occurred during the recorder initialization. Replug the module. If the alarm persists, contact your service personnel.
Recorder Comm Error	Low	A	Replug the recorder and restart the monitor if not solved. If the alarm persists, contact your service personnel.
Recorder Unavailable	Low	A	Recorder module failure. Replace the module.

Alarm message	Default priority	Indication on alarm reset	Cause and solution
Recorder Head Hot	Low	C	The recorder has been working for too long time. Stop the recording and resume the recording till the recorder's print head cools down.
Recorder Initializing	Prompt	/	Wait until the recorder initialization is completed.
Recorder out of Paper	Prompt	/	The recorder paper is not loaded or the recorder door is not closed. Check the recorder, load the recorder paper or close the recorder door.
Recorder Busy	Prompt	/	The buffer queue for recording is full.
Recorder Not Exist	Prompt	/	The recorder module is not plugged. Plug the module.

D.2.22 Printer Technical Alarm Messages

Alarm message	Default priority	Indication on alarm reset	Cause and solution
Printer Buffer Full	Prompt	/	The printer buffer is full. Wait till the printer finishes the printing task.
Fail	Prompt	/	The printer runs out of paper or cannot be connected. Check the printer.
Printing Stopped	Prompt	/	Printing is manually stopped.
Printer Unavailable	Prompt	/	The printer may fail. Check the printer.
PDF storage space is nearly full	Prompt	/	Delete the files saved under the PDF file path to release storage space. Otherwise you cannot save new PDF files.
Error storing PDF file	Prompt	/	The PDF file path settings on the printer server and the PDFCreator are not consistent or the PDF storage space is full. Check the PDF file path settings for consistency, or delete the files saved under the PDF file path to release storage space.
Change the print server language to be consistent with this monitor	Prompt	/	Verify that the language settings of the printer server and the monitor are consistent, Otherwise you cannot perform printing.
Print Server Disconnected	Prompt	/	Check that the monitor is properly connected with the printer server.

D.2.23 Technical Alarm Messages Related to Networked Monitoring

Alarm message	Default priority	Indication on alarm reset	Cause and solution
No CMS	Low	B	The monitor is disconnected from the CMS. Check the network connection.
View Bed XX YY-ZZ, Network Disconnected.	Low	A	The network is interrupted when the monitor is viewing the remote device. Check the network connection.
Viewed by Bed XX YY-ZZ, Network Disconnected.	Low	A	The network is interrupted when the monitor is viewed by another remote device. Check the network connection.
WLAN IP Address Conflict	Low	C	Wireless network IP network conflicts. Check the network settings.

Alarm message	Default priority	Indication on alarm reset	Cause and solution
LAN1 IP Address Conflict	Low	C	Wired network LAN1 IP network conflicts. Check the network settings.
Fail To Get WLAN IP Address	Low	C	Unable to automatically obtain the wireless network IP address. Check the network settings.
Fail To Get LAN1 IP Address	Low	C	Unable to automatically obtain the wired network LAN1 IP address. Check the network settings.

Note: XX refers to the department name, YY refers to the room number, and ZZ refers to the bed number.

D.2.24 Technical Alarm Messages Related to Telemetry Monitors and BP10 Modules

Alarm message	Default priority	Indication on alarm reset	Cause and solution
Telemetry Disconnected	High	B	The TM80 is power-off powered off, the monitor or the TM80 is not connected to the Wi-Fi network, or out of the network coverage. 1. Power on the TM80. 2. Connect the monitor and the TM80 to the network. 3. Move the TM80 in the network coverage. The exchanger network connected by the TM80 and the monitor does not support multicast data transfer. Contact your service personnel.
Telemetry NIBP Disconnected	High	B	The BP10 is power- off, or out of the MPAN coverage. 1. Power on the BP10. 2. Move the BP10 in the MPAN coverage area.
Telemetry Error	High	C	An error occurred to the TM80. Restart the TM80. If the problem still persists, replace with a known good TM80.
Telemetry Low Battery	Med	C	The TM80 battery charge is low. Replace with a known good battery.
Telemetry Battery Depleted	High	C	The TM80 battery charge is critically low. Replace with known good batteries.
Telemetry Battery Maintenance Required	Med	C	The TM80 lithium-ion battery may reach its life. Replace with known good batteries.
Telemetry Battery Error	Med	C	The TM80 lithium-ion battery communication encounters an error. Replace with known good batteries.
Telemetry Battery Type Error	Med	C	The TM80 battery contacts may fail. Replace with known good batteries.
Telemetry NIBP Error	High	C	An error occurred to the BP10. Restart the BP10. If the problem persists, replace with a known good BP10.
Telemetry NIBP Low Battery	Med	C	The BP10 battery charge is low. Replace with a known good battery.
Telemetry NIBP Battery Depleted	High	C	The BP10 battery charge is critically low. Replace with a known good battery.
Telemetry NIBP Battery Maintenance Required	Med	C	The BP10 lithium-ion battery is may reach its lifetime. Replace with a known good battery.

Alarm message	Default priority	Indication on alarm reset	Cause and solution
Telemetry NIBP Battery Error	Med	C	The BP10 lithium-ion battery communication encounters an error. Replace with a known good battery.
Telemetry NIBP Voltage Error	High	C	The BP10 battery voltage is abnormal. Replace with a known good battery.

D.2.25 Other System Technical Alarm Messages

Alarm message	Default priority	Indication on alarm reset	Cause and solution
Primary Screen Alarm Error	High	C	The alarm signal communication between the primary display and the main unit interrupts. The primary display cannot provide alarm indications. Check the connection between the main unit and the primary display.
Secondary Screen Alarm Error (for N22/N19 only)	High	C	The alarm signal communication between the secondary display and the main unit interrupts. The secondary display cannot provide alarm indications. Check the connection between the main unit and the secondary display.
XX: Disconnected (XX refers to the name of the external device)	High	B	Corresponding external device is disconnected. Check the connection between the monitor and the external device.
Storage Card Error	High	C	The storage card fails or files are damaged. Restart the monitor to format the storage card. If the alarm persists, contact your service personnel.
Loading Default Config Failed	Low	A	The default configuration is not correctly loaded. The monitor will restore to the factory default configuration for the current patient category.
XX Conflicts (XX refers to the module label)	Prompt	/	The same type of corresponding module being used exceeds the supported number. Remove the conflict module.
XXX Measurement has been closed (XX refers to the module label)	Prompt	/	The parameter module is disabled. Switch on the module if you want to use it. For more information, see *3.11.1 Switching On or Off a Parameter*.
The display setup for XXX is disabled. (XX refers to the parameter label)	Prompt	/	The parameter of the newly inserted module is not displayed on the screen. Select a desired area to display the parameter numerics and waveforms. For more information, see *39.12 The Other Settings*.
The patient data storage space is nearly full. Please delete some discharged patients.	Med	B	Delete unnecessary earlier discharged patient.

E Electrical Safety Inspection

The following electrical safety tests are recommended as part of a comprehensive preventive maintenance program. They are a proven means of detecting abnormalities that, if undetected, could prove dangerous to either the patient or the operator. Additional tests may be required according to local regulations.

All tests can be performed using commercially available safety analyzer test equipment. These procedures assume the use of a 601PROXL International Safety Analyzer or equivalent safety analyzer. Other popular testers complying with IEC 60601-1 used in Europe, such as Fluke, Metron, or Gerb, may require modifications to the procedure. Please follow the instructions of the analyzer manufacturer.

The electrical safety inspection should be periodically performed every two years.The safety analyzer also proves to be an excellent troubleshooting tool to detect abnormalities of line voltage and grounding, as well as total current loads.

E.1 Power Cord Plug

Test Item		Acceptance Criteria
The power plug	The power plug pins	No broken or bent pin. No discolored pins.
	The plug body	No physical damage to the plug body.
	The strain relief	No physical damage to the strain relief. No plug warmth for device in use.
	The power plug	No loose connections.
The power cord		No physical damage to the cord. No deterioration to the cord.
		For devices with detachable power cords, inspect the connection at the device.
		For devices with non-detachable power cords, inspect the strain relief at the device.

E.2 Device Enclosure and Accessories

E.2.1 Visual Inspection

Test Item	Acceptance Criteria
The enclosure and accessories	No physical damage to the enclosure and accessories.
	No physical damage to meters, switches, connectors, etc.
	No residue of fluid spillage (e.g., water, coffee, chemicals, etc.).
	No loose or missing parts (e.g., knobs, dials, terminals, etc.).

E.2.2 Contextual Inspection

Test Item	Acceptance Criteria
The enclosure and accessories	No unusual noises (e.g., a rattle inside the case).
	No unusual smells (e.g., burning or smoky smells, particularly from ventilation holes).
	No taped notes that may suggest device deficiencies or operator concerns.

E.3 Device Labeling

Check the labels provided by the manufacturer or the healthcare facilities are present and legible.

- Main unit label
- Integrated warning labels

E.4 Protective Earth Resistance

1. Plug the probes of the analyzer into the device's protective earth terminal and protective earth terminal of the AC power cord.
2. Test the earth resistance with a current of 25 A.
3. Verify the resistance is less than limits.

LIMITS

For all countries, R = 0.2 Ω Maximum

E.5 Earth Leakage Test

Run an Earth Leakage test on the device being tested before performing any other leakage tests.

The following outlet conditions apply when performing the Earth Leakage test:

- normal polarity (Normal Condition),
- reverse polarity (Normal Condition),
- normal polarity with open neutral (Single Fault Condition),
- reverse polarity with open neutral (Single Fault Condition)

LIMITS

For UL60601-1,

- ◆ 300 μA in Normal Condition
- ◆ 1000 μA in Single Fault Condition

For IEC60601-1,

- ◆ 500 μA in Normal Condition
- ◆ 1000 μA in Single Fault Condition

E.6 Patient Leakage Current

Patient leakage currents are measured between a selected applied part and mains earth. All measurements have a true RMS only

The following outlet conditions apply when performing the Patient Leakage Current test.

- normal polarity (Normal Condition);
- reverse polarity (Normal Condition),
- normal polarity with open neutral (Single Fault Condition);
- reverse polarity with open neutral (Single Fault Condition).
- normal polarity with open earth (Single Fault Condition);
- reverse polarity with open earth (Single Fault Condition).

LIMITS

For CF applied parts

- ◆ 10 µA in Normal Condition
- ◆ 50 µA in Single Fault Condition

For BF applied parts

- ◆ 100 µA in Normal Condition
- ◆ 500 µA in Single Fault Condition

E.7 Mains on Applied Part Leakage

The Mains on Applied Part test applies a test voltage, which is 110% of the mains voltage, through a limiting resistance, to selected applied part terminals. Current measurements are then taken between the selected applied part and earth. Measurements are taken with the test voltage (110% of mains) to applied parts in the normal and reverse polarity conditions

The following outlet conditions apply when performing the Mains on Applied Part test.

- Normal Polarity;
- Reversed Polarity

LIMITS

- ◆ For CF applied parts: 50 µA
- ◆ For BF applied parts: 5000 µA

E.8 Patient Auxiliary Current

Patient Auxiliary currents are measured between any selected Applied Part connector and the remaining Applied Part connector s. All measurements may have a true RMS only response.

The following outlet conditions apply when performing the Patient Auxiliary Current test.

- normal polarity (Normal Condition);
- reverse polarity (Normal Condition),
- normal polarity with open neutral (Single Fault Condition);
- reverse polarity with open neutral (Single Fault Condition).
- normal polarity with open earth (Single Fault Condition);
- reverse polarity with open earth (Single Fault Condition).

LIMITS

For CF applied parts,

- 10 μA in Normal Condition
- 50 μA in Single Fault Condition

For BF applied parts,

- 100 μA in Normal Condition
- 500 μA in Single Fault Condition

NOTE

- **Make sure the safety analyzer is authorized comply with requirement of IEC60601-1.**
- **Follow the instructions of the analyzer manufacturer.**

F A ECG Wave Recognition Method for Mindray Resting 12-lead ECG Analysis Algorithm

F.1 Preprocessing

Initially, a 50Hz or 60Hz notch filter should have been applied within the acquiring device. The ECG data is then filtered to minimize the effects of noise. The next step is to calculate a difference of each lead. And then choose the best 3 leads based on the amplitude of ECG. Combining the ECG data and the difference in these best 3 leads, the QRS locations are derived.

F.2 QRS typing

For each lead, the QRS complexes is compared each other, if the QRS width, RR Interval, and the morphology of QRS complex are similar, the QRS complexes are classified to the same class. Synthesizing QRS class of all the 12 leads, the beats are classified to different classes.

F.3 Selection of required QRS class

If more than one class of beat is present, then a decision has to be made as to which morphology will be used for the averaging procedure. A complex logic is used and the required QRS class is regarded as being conducted in the normal sequence through the ventricles.

F.4 Averaging

All beats in the selected class are averaged. First the alignment points are detected, and then all corresponding aligned points are straight averaged.

F.5 Wave measurement

From the 12 average beats, first the peak of QRS is determined, and then considering the amplitude and the slope, the QRS onset and termination are determined.

In each individual lead, the QRS onset is taken as the baseline and hence Q, R, S, R' waves are measured with respect to the QRS onset.

A sorting algorithm is then applied to all 12 onsets to determine the global QRS onset as follows. The two earliest onsets are excluded and the next onset that also lies within 10ms of two before that is then selected as the overall onset. The reverse process is used to find the overall QRS termination but the interval limit is changed from 10ms to 16ms. The isoelectric segment at the beginning of a QRS complex which is a flat segment between the globe QRS onset and individual lead QRS onset are exclude from the first component of the QRS, the same process is used for the isoelectric segment at the end of a QRS complex.

F.6 QRS components

Within the QRS complex, the amplitude and duration of the various Q, R, S, R' waves are then measured. In keeping with the CSE recommendations, the minimum wave acceptable has to have a duration >8 ms and an amplitude >20 ?V. The global QRS duration is from global QRS onset to the global QRS termination.

F.7 ST segment

The ST segment measurements are made at J point, and at equal intervals throughout the ST segment.

F.8 P and T waves

P wave is searched in the interval preceding the QRS complex. A P wave may not be found in certain arrhythmias. P onset and termination are determined basing on the amplitude and slope. The globe P onset and termination is used over all 12 leads because in many leads the p wave amplitude may be too low. The baseline for P wave amplitude measurement respect to P onset.

T termination is determined also depend on the amplitude and slope. The global T termination is derived similarly to the globe QRS termination. The other components of the ECG waveform (ST and T) amplitudes are also measured with respect to QRS onset.

F.9 Evaluation results of absolute interval and wave duration measurements

MEASUREMENT	Mean Difference (ms)	Acceptable standard (ms)	Standard Deviation (ms)	Acceptable standard (ms)
P DURATION	-10	±10	2.256	SD<=8
QRS DURATION	-0.143	±6	2.413	SD<=5
PR INTERVAL	-8.286	±10	1.729	SD<=8
QT INTERVAL	1.385	±12	6.501	SD<=10
Q DURATION	-0.108	±6	4.241	SD<=5
R DURATION	3.020	±6	2.710	SD<=5
S DURATION	-3.282	±6	3.396	SD<=5

F.10 Evaluation results of interval measurements on biological ECGs

Measurement	Mean Difference (ms)	Acceptable standard (ms)	Standard Deviation (ms)	Acceptable standard (ms)
P Duration	-2.708	±10	10.194	SD <=15
QRS Duration	-9.750	±10	6.676	SD <=10
PQ Interval	2.458	±10	7.182	SD <=10
QT Interval	-4.500	±25	14.483	SD <=30

F.11 Evaluation results of stability of measurements against noise

Global Measurement	Type of Added Noise	Disclosed Differences	
		Mean Difference (ms)	Standard Deviation (ms)
P Duration	High Frequency	1.4	9.192
P Duration	Line Frequency (50Hz)	-0.2	8.404
P Duration	Line Frequency (60Hz)	0.8	5.181
P Duration	Base-Line	4.2	8.244
QRS Duration	High Frequency	-0.6	2.119
QRS Duration	Line Frequency (50Hz)	0	0.943
QRS Duration	Line Frequency (60Hz)	0.4	1.265
QRS Duration	Base-Line	0.8	3.553

Global Measurement	Type of Added Noise	Disclosed Differences	
		Mean Difference (ms)	Standard Deviation (ms)
QT Interval	High Frequency	-2.2	6.070
QT Interval	Line Frequency (50Hz)	-1.4	6.867
QT Interval	Line Frequency (60Hz)	2.4	3.978
QT Interval	Base-Line	0.6	3.134

This page intentionally left blank.

G Units, Symbols and Abbreviations

G.1 Units

Abbreviation	In Full
μA	microampere
μV	microvolt
μs	microsecond
A	ampere
Ah	ampere hour
bpm	beat per minute
bps	bit per second
ºC	centigrade
cc	cubic centimeter
cm	centimeter
dB	decibel
DS	dyne second
ºF	Fahrenheit
g	gram
GHz	gigahertz
GTT	gutta
h	hour
Hz	hertz
in	inch
k	kilo
kg	kilogram
kPa	kilopascal
L	litre
lb	pound
m	meter
mAh	milliampere hour
Mb	mega byte
mcg	microgram
mEq	milli-equivalents
mg	milligram
min	minute
ml	milliliter
mm	millimeter

Abbreviation	In Full
mmHg	millimeters of mercury
cmH2O	centimeters of water
ms	millisecond
mV	millivolt
mW	milliwatt
MΩ	megaohm
nm	nanometer
rpm	breaths per minute
s	second
V	volt
VA	volt ampere
Ω	ohm
W	watt

G.2 Symbols

Symbol	Explanation
−	minus
–	negative
%	percent
/	per; divide; or
∼	to
+	plus
=	equal to
<	less than
>	greater than
≤	less than or equal to
≥	greater than or equal to
±	plus or minus
×	multiply
©	copyright

G.3 Abbreviations

Abbreviation	In Full
$AaDO_2$	alveolar-arterial oxygen gradient
AC	alternating current
ACI	acceleration index
Adu	adult
AG	anaesthesia gas
AHA	American Heart Association
Ao	aortic pressure
Art	arterial
ATMP	barometric pressure
AUC	area under the curve
Avg	rSO_2 average
aVF	left foot augmented lead
aVL	left arm augmented lead
aVR	right arm augmented lead
awRR	airway respiratory rate
BAP	brachial arterial pressure
BC	burst count
BIS	bispectral index
BL	baseline
BoA	Balance of Anesthesia
BSA	body surface area
BT	blood temperature
BTPS	body temperature and pressure, saturated
CAA	Clinical Assistive Application
CaO_2	arterial oxygen content
CCF	CPR quality index
CCI	continuous cardiac index
CCO	continuous cardiac output
CCU	cardiac (coronary) care unit
CE	Conformité Européenne
CFI	cardiac function index
C.I.	cardiac index
CIS	clinical information system
CISPR	International Special Committee on Radio Interference
CMOS	complementary metal oxide semiconductor
CMS	central monitoring system
C.O.	cardiac output

Abbreviation	In Full
CO_2	carbon dioxide
COHb	carboxyhemoglobin
Compl	compliance
COPD	chronic obstructive pulmonary disease
CPI	cardiac power index
CQI	CPR quality index
CPO	cardiac power output
CVP	central venous pressure
DC	direct current
Des	desflurane
Dia	diastolic
dpi	dot per inch
dPmx	left ventricular contractility
DVI	digital video interface
DO_2	oxygen delivery
DO_2I	oxygen delivery index
ECG	electrocardiograph
EDV	end-diastolic volume
EE	Energy Expenditure
EEC	European Economic Community
EEG	electroencephalogram
EMC	electromagnetic compatibility
EMG	electromyograph
EMI	electromagnetic interference
Enf	enflurane
ESU	electrosurgical unit
Et	end-tidal
EtAA	end-tidal anesthetic agent
EtDes	end-tidal anesthetic agent
EtEnf	
EtHal	
EtIso	
EtSev	
$EtCO_2$	end-tidal carbon dioxide
EtN_2O	end-tidal nitrous oxide
EtO	ethylene oxide
EtO_2	end-tidal oxygen
EVLW	extravascular lung water
ELWI	extravascular lung water index

Abbreviation	In Full
EWS	Early Warning Score
FAP	femoral arterial pressure
FCC	Federal Communication Commission
FDA	Food and Drug Administration
$FeCO_2$	Mixed Expired CO2 Concentration
Fi	fraction of inspired
FiAA	inspired anesthetic agent
FiDes	inspired anesthetic agent
FiEnf	
FiHal	
FiIso	
FiSev	
FiCO2	fraction of inspired carbon oxygen
FiN_2O	fraction of inspired nitrous oxide
FiO_2	fraction of inspired oxygen
FPGA	field programmable gate array
FV	flow-volume
GCS	Glasgow Coma Scale
GEDV	global end diastolic volume
GEDI	global end diastolic volume index
GEF	global ejection fraction
Hal	halothane
Hb	hemoglobin
Hct	haematocrit
HIS	hospital information system
HR	heart rate
IBP	invasive blood pressure
IBW	ideal body weight
ICG	impedance cardiography
ICP	intracranial pressure
ICT/B	intracranial catheter tip pressure transducer
ICU	intensive care unit
ID	identification
I:E	inspiratory time: expiratory time ratio
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronic Engineers
IP	internet protocol
IPS	individual parameter score
Iso	isoflurane

Abbreviation	In Full
ITBI	intrathoracic blood volume index
ITBV	intrathoracic blood volume
LA	left arm
LAP	left atrial pressure
LCD	liquid crystal display
LCW	left cardiac work
LCWI	left cardiac work index
LDAP	Lightweight Directory Access Protocol
LED	light emitting diode
LL	left leg
LVET	left ventricular ejection time
LVSW	left ventricular stroke work
LVSWI	left ventricular stroke work index
MAC	minimum alveolar concentration
MAP	mean arterial pressure
Mb	Myoglobin
MetHb	methemoglobin
MEWS	Modified Early Warning Score
MLDAP	Mindray LDAP, Mindray Lightweight Directory Access Protocol
MRI	magnetic resonance imaging
MV	minute volume
MValv	Alveolar Minute Volume
$MVCO_2$	CO_2 minute production
MVe	expiratory minute volume
MVi	inspiratory minute volume
MVO_2	O_2 minute consumption
N/A	not applied
N2	nitrogen
N2O	nitrous oxide
Neo	neonate
NEWS	National Early Warning Score
NIBP	noninvasive blood pressure
NIF	negative inspiratory force
O_2	oxygen
O_2%	oxygen concentration
OR	operating room
oxyCRG	oxygen cardio-respirogram
PA	pulmonary artery
pArt	artery pressure from the PiCCO module

Abbreviation	In Full
pArt-D	diastolic artery pressure from the PiCCO module
pArt-M	mean artery pressure from the PiCCO module
pArt-S	systolic artery pressure from the PiCCO module
Paw	airway pressure
PAWP	pulmonary artery wedge pressure
pCVP	central venous pressure
Ped	pediatric
PEEP	positive end expiratory pressure
PEF	peak expiratory flow
PEP	pre-ejection period
PIF	peak inspiratory flow
PIP	peak inspiratory pressure
Pleth	plethysmogram
Pmean	mean pressure
PO_2	oxygen supply pressure
Pplat	plateau pressure
PPV	pulse pressure variation
PR	pulse rate
PVC	premature ventricular contraction
PVPI	pulmonary vascular permeability index
PVR	pulmonary vascular resistance
PVRI	pulmonary vascular resistance index
qSOFA	quick Sepsis-Related Organ Failure Assessment
RA	right arm
RAP	right atrial pressure
Raw	airway resistance
Rec	record, recording
Resp	respiration
RL	right leg
RM	respiratory mechanics
RQ	respiratory quotient
RR	respiration rate
RSBI	rapid shallow breathing index
rSO_2	regional oxygen saturation
SaO_2	arterial oxygen saturation
$ScvO_2$	central venous oxygen saturation
SEF	spectral edge frequency
Sev	sevoflurane
SI	stroke index

Abbreviation	In Full
$SlopeCO_2$	Slope of the alveolar plateau
SMR	satellite module rack
SOFA	Sepsis-Related Organ Failure Assessment
SpO_2	arterial oxygen saturation from pulse oximetry
SQI	signal quality index
SR	suppression ratio
SSC	Surviving Sepsis Campaign
SSI	signal strength index
STR	systolic time ratio
SV	stroke volume
SVI	stroke volume index
SVR	systemic vascular resistance
SVRI	systemic vascular resistance index
SVV	stroke volume variation
SvO_2	venous oxygen saturation
Sync	synchronization
Sys	systolic pressure
TB	Blood Temperature
$tcpCO_2$	transcutaneous carbon dioxide partial pressures
$tcpO_2$	transcutaneous oxygen partial pressures
TD	temperature difference
Temp	temperature
TFC	thoracic fluid content
TFI	thoracic fluid index
TFT	thin-film technology
TI	injectate temperature
TP	total power
TRC	tube resistance compensation
TVe	expiratory tidal volume
TVi	inspiratory tidal volume
TV	tidal volume
UAP	umbilical arterial pressure
UPS	uninterruptible power supply
USB	universal serial bus
UVP	umbilical venous pressure
VAC	volts alternating current
VCO_2	CO_2 production for one breath
Vdaw	airway dead space
Vdaw/Vt	airway dead space to tidal volume ratio

Abbreviation	In Full
Vdalv	alveolar dead space
Vdalv/Vt	alveolar dead space to tidal volume ratio
Vdphy	physiologic dead space
Vd/Vt	dead space to tidal volume ratio
VEPT	volume of electrically participating tissue
VI	velocity index
VO_2	O_2 consumption for one breath
VO_2I	oxygen consumption index
VPB	ventricular premature beat per minute
Vtalv	alveolar tidal volume
WOB	work of breathing

This page intentionally left blank.

H Declaration of Conformity

Declaration of Conformity V2.0

Declaration of Conformity

CE

Manufacturer:	Shenzhen Mindray Bio-Medical Electronics Co., Ltd. Mindray Building, Keji 12th Road South, Hi-tech Industrial Park, Nanshan, Shenzhen, 518057, P. R. China
EC-Representative:	Shanghai International Holding Corp. GmbH (Europe) Eiffestraße 80 20537 Hamburg, Germany
Product:	Patient Monitor (Including Accessories)
Model:	BeneVision N17/BeneVision N15/ BeneVision N12/BeneVision N12C

We herewith declare under our sole responsibility that the above mentioned products meet the provisions of the Council Directive 2014/53/EU concerning radio equipment. All supporting documentation is retained under the premises of the manufacturer.

Standards Applied:

☒ EN 60601-1:12006 / A1 :2013	☒ EN 60601-1-2:2015
☒ EN 62311:2008	☒ EN 50385:2002
☒ EN 62479:2010	☒ ETSI EN 301 489-1 V2.2.0
☒ ETSI EN 301 489-17 V3.1.1	☒ EN 300 328 V2.1.1
☒ ESTI EN 301 893 V2.1.1	

Start of CE-Marking:	**2017-6-13**
Place, Date of Issue:	Shenzhen, 2018.12.4
Signature:	[signature]
Name of Authorized Signatory:	Mr. Wang Xinbing
Position Held in Company:	Manager, Technical Regulation

Declaration of Conformity V2.0

Declaration of Conformity

CE

Manufacturer:	Shenzhen Mindray Bio-Medical Electronics Co., Ltd. Mindray Building, Keji 12th Road South, Hi-tech Industrial Park, Nanshan, Shenzhen, 518057, P. R. China
EC-Representative:	Shanghai International Holding Corp. GmbH (Europe) Eiffestraße 80 20537 Hamburg, Germany
Product:	Patient Monitor (Including Accessories)
Model:	BeneVision N19/BeneVision N22

We herewith declare under our sole responsibility that the above mentioned products meet the provisions of the Council Directive 2014/53/EU concerning radio equipment. All supporting documentation is retained under the premises of the manufacturer.

Standards Applied:

☒ EN 60601-1:2006/A1:2013	☒ EN 60601-1-2:2015
☒ EN 62311:2008	☒ EN 50385:2002
☒ EN 62479:2010	☒ ETSI EN 301 489-1 V2.2.0
☒ ETSI EN 301 489-17 V3.1.1	☒ EN 300 328 V2.1.1
☒ ESTI EN 301 893 V2.1.1	

Start of CE-Marking:	**2017-06-13**
Place, Date of Issue:	Shenzhen, 2018.12.29
Signature:	
Name of Authorized Signatory:	Mr. Wang Xinbing
Position Held in Company:	Manager, Technical Regulation

P/N:046-009995-00 (12.0)