BeneHeart D30/BeneHeart D20A

BeneHeart D20/BeneHeart D20C

Defibrillator/Monitor

Operator's Manual

CE 2797

Publication date: January 2023

Revision: 1.0

Intellectual Property Declaration

SHENZHEN MINDRAY BIO-MEDICAL ELECTRONICS CO., LTD. (hereinafter referred to as Mindray) owns the intellectual property rights to this product and this manual. This manual may reference information protected by copyright or patents and does not grant any license to Mindray's patent rights or the rights of other manufacturers.

Mindray intends to keep the contents of this manual confidential. Disclosure of the information in this manual, in any form, is strictly prohibited without Mindray's written permission.

Publication, modification, reproduction, distribution, rental, adaptation and translation of this manual, in any form, are strictly prohibited without the written permission of Mindray.

mindray and BeneHeart These are trademarks or registered trademarks owned by Mindray in China and other countries. All other trademarks appearing in this manual are used for editorial purposes only, without any intention of misuse, and are the property of their respective owners.

Manufacturer's responsibility

The contents of this manual are subject to change without notice.

All information contained in this manual is assumed to be correct. Mindray is not liable for any errors herein, nor for any accidental or consequential damages arising from the supply, application, or use of this manual.

Mindray is only responsible for the safety, reliability, and performance of the product in the following cases:

ÿ If all installation, expansion, change, modification, and repair operations of this
The product is manufactured by authorized Mindray personnel.

ÿ If the electrical installation at the location where the device is placed meets local requirements and
applicable national laws.

ÿ The product is used according to the instructions for use.

WARNING

- **This equipment must be used by people who have received training on its operation. The operator must be trained in basic life support and advanced cardiac life support or other emergency medical assistance techniques.**

- **It is important that the hospital or organization using this equipment implement a plan**
Proper operation and maintenance are essential. Failure to do so could result in machine malfunction or personal injury.

NOTE

- **In case of inconsistency or ambiguity between the English version and this version, the English version takes precedence.**
English version.

Warranty

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

Disclaimers

Mindray's obligations and responsibilities under this warranty do not include transportation or any other expenses, nor liability for delays or direct, indirect, or consequential damages resulting from the application or improper use of the product or accessories not approved by Mindray. The company is also not responsible for repairs performed by individuals other than authorized Mindray personnel.

This warranty does not extend to the following situations:

- ÿ Damage or malfunction caused by improper use or human error.
- ÿ Malfunction or damage caused by an unstable or out-of-range power supply.
- ÿ Damage or loss caused by force majeure, such as fires and earthquakes.
- ÿ Failure or damage caused by improper operation or repair by personnel of unqualified or unauthorized maintenance.
- ÿ Malfunction of the instrument or component whose serial number is not sufficiently legible.
- ÿ Other malfunctions that are not caused by the instrument or component itself.

Company contact person

Manufacturer:	Shenzhen Mindray Bio-Medical Electronics Co., Ltd.
Address	Mindray Building, Keji 12th Road South, High-tech Industrial Park, Nanshan, Shenzhen 518057, People's Republic of China
Website	www.mindray.com
Email address: service@mindray.com	
Tel.:	+86 755 81888998
Fax:	+86 755 26582680
Representative to the EC:	Shanghai International Holding Corp. GmbH (Europe)
Address:	Eiffestraye 80, 20537 Hamburg, Germany
Tel.:	0049-40-2513175
Fax:	0049-40-255726
Safety and Clinical Performance Summary (SSCP):	https://www.mindray.com/etc.clientlibs/xpace/clientlibs/clientlib-site/resources/plugins/web/viewer.html?file=/content/dam/xpace/en/site/mdr-sscp/d6-cpr-sensor-mdr/KF-0656-4-0018-Summary-of-safety%20and-clinical-performance.pdf

Notification of adverse events

As a healthcare professional, in the event of certain events, you may notify SHENZHEN MINDRAY BIO-MEDICAL ELECTRONICS CO., LTD., and possibly the competent authority of the Member State in which the user or patient is located.

These events include deaths, illnesses, and serious injuries related to the device. Furthermore, as part of our Quality Assurance Program, SHENZHEN MINDRAY BIO-MEDICAL ELECTRONICS CO., LTD. requests notification of any device malfunctions or defects. This information is necessary to ensure that the products supplied by SHENZHEN MINDRAY BIO-MEDICAL ELECTRONICS CO., LTD. are of the highest quality.

Prologue

Objective of the manual

This manual contains the instructions necessary to use the product safely and according to its intended function and use. Following the instructions in this manual is a prerequisite for proper product operation and performance, and ensures the safety of patients and technicians.

This manual is based on the complete configuration and, therefore, some of its content may not apply to your product. If you have any questions, please contact us.

This manual is part of the product. It should always be kept near the equipment so that it can be easily consulted when needed.

NOTE

- **If the equipment includes any function not specified in this manual, consult the latest version in English.**

Recipients

This manual is intended for medical professionals who are expected to have a working knowledge of procedures, practice, and terminology in the field of medicine for monitoring critically ill patients.

Illustrations

All illustrations in this manual are provided for illustrative purposes only. They may not necessarily match the configuration or data displayed on your device.

Conventions

- Italicized text is used in this manual to cite manuals, chapters, sections, and formulas to which reference is made.
- **Bold text** is used to indicate on-screen text and key names.
- is used to indicate usage procedures.

Index

Part I: General Information

Part II: Therapy Functions

Part III: Monitoring Functions

Part IV: System Functions and Others

This page has been intentionally left blank.

1 Security

1.1 Security information

DANGER

• Indicates an imminent danger that, if not avoided, could cause serious injury or even death.

WARNING

• Indicates a potential hazard or a practice that compromises safety and that, if not avoided, could cause serious injury or even death.

CAUTION

• Indicates a potential hazard or a practice that compromises safety and that, if not avoided, may result in minor injuries or property damage.

NOTE

• Offers application suggestions or other helpful information to ensure you get the most out of the product.

1.1.1 Dangers

DANGER

• The device delivers up to 360 J of electrical energy. Unless used correctly
Failure to follow the instructions provided by the equipment manufacturer may result in serious injury or death. Do not attempt to use this equipment unless you are thoroughly familiar with the operation and function of all controls, indicators, connectors, and accessories.

• To avoid explosion hazards, do not use the equipment in environments enriched with
Oxygen, flammable anesthetic substances, or other flammable agents (such as gasoline). Keep equipment and the operating environment dry and clean.

• The defibrillation current can cause serious injury or death to the operator or bystander. Stay clear of the patient or any metal devices connected to them during defibrillation.

1.1.2 Warnings

WARNING

- Use only the parts and accessories specified in this manual. Follow the operating instructions and heed all warnings and precautions.
- This equipment is used for one patient at a time.
- This equipment is not intended for use in magnetic resonance imaging (MRI)

environments. • Do not disassemble the equipment, as it contains no user-serviceable components and dangerously high voltage may be present. Contact authorized service personnel for repairs.

- Before connecting the equipment to an external power supply, check that the voltage and frequency ratings are the same as those indicated on the equipment label or in this manual.

- Before each use, the operator must check the condition of the equipment to ensure it is ready. for its operation.
- To avoid the risk of electric shock, this equipment should only be connected to a power source with a protective earth connection. If it does not include a protective earth conductor, use it with battery power if possible.
- Do not use power strips or extension cords connected to the AC mains. Ensure that the sum of the individual earth leakage currents do not exceed the permitted limits.
- Before starting the system, the operator must check that the equipment, connection cables and accessories are working correctly and are in good condition.
- Do not rely solely on audible alarms for patient monitoring. Setting the alarm volume low or turning off the alarm sound can pose a risk to the patient. Customize alarm settings according to the patient's condition and closely monitor the patient.

- Physiological data and alarm messages provided by the device should not be used as the sole basis for diagnosis or treatment decisions. They should be considered in conjunction with clinical symptoms and findings. Incorrect interpretation of measured values or other parameters may pose a risk to the patient.
- Do not place the equipment or accessories in any position that could cause them to fall. patient.
- Do not start or use the equipment until you have verified that the configuration is correct.
- Position and secure cables and tubes carefully to avoid tripping, entanglement, and strangulation of the patient.
- Mindray is the sole copyright holder of the computer software. No organization or individual may modify, copy, or replace it, nor may they infringe upon it in any other way or by any means without proper permission.

- Disconnect non-defibrillation-resistant devices from the patient during defibrillation.
- Ensure that the synchronized input system is applied to this equipment and that the input signal is correct, if necessary.
- Do not defibrillate the patient if they are on a wet floor or a metallic surface.
- Do not perform any functional checks if the equipment is connected to a patient. Otherwise, the patient could receive a shock.
- When administering therapy, you must closely monitor the patient at all times. If there is a delay in delivering the shock, the rhythm analyzed as shockable may become a non-shockable rhythm, which can lead to incorrect shock delivery.

- For the treatment of patients with implantable pacemakers, place the electrodes of Defibrillate or keep the paddles away from the pacemaker's internal generator if possible, in order to avoid damage to it.
- Do not touch the device connectors, the recorder printhead, or the connector of the Do not use batteries or other equipment while in use if they are in contact with the patient. Otherwise, the patient may be harmed.

- Do not touch the patient and live parts simultaneously.
- If the accuracy of any value displayed on the equipment or the CMS, or printed on a chart or report, is questionable, the patient's vital signs must be determined by other means. Check that all equipment is functioning correctly.

1.1.3 Safety warnings

CAUTION

- Ensure that the equipment receives a continuous power supply while in operation. Sudden power outages can result in data loss.
- Electric and magnetic fields can interfere with the proper functioning of the equipment.
  For this reason, ensure that all external devices used near the equipment meet the relevant EMC requirements. Potential sources of interference include mobile phones, X-ray equipment, and MRI devices, as these can emit high levels of electromagnetic radiation.
- Install or move the equipment correctly to avoid damage caused by falls, bumps, strong vibrations or other mechanical forces.
- Dry the equipment immediately if it rains or gets sprayed with water.
- Some settings are password protected and can only be changed by authorized personnel. Contact your department head or the bioengineering department for information about the passwords used at your center.
- When the useful life of the equipment and its accessories ends, they must be disposed of according to the Instructions governing the disposal of such products. If you have any questions regarding the disposal of the equipment, please contact us.
- Never charge or deliver shocks in non-clinical situations. Otherwise, they could damage to the equipment may occur.
- Following the instructions in the manual is a prerequisite for obtaining a The product functions and performs properly, and ensures the safety of patients and technicians.

1.1.4 Grades

NOTE

- The equipment uses the mains power plug as a means of insulating the Mains power supply. Do not place the equipment in a location where it is difficult to access the mains power plug.
- During normal use, the operator is expected to have the equipment in front of them.
- The software has been developed in accordance with the IEC62304 standard.
- This manual includes information about all the functions of the equipment. Some functions may not be available on your equipment.
- Keep this manual near the equipment so you can easily refer to it whenever needed.
  necessary.

1.2 Team symbols

	Consult the manual/brochure of instructions		General warning sign
	Dangerous tension		Download button

	Manufacturer		Date of manufacture
	AC		DC
	Power indicator		Status indicator
	Battery charge indicator		Computer network
	CF TYPE APPLIED PART PROOF OF DEFIBRILLATION		APPLIED PART TYPE BF PROOF OF DEFIBRILLATION
	Equipotentiality	IP55	Protected against dust; Protected against water jets
	Unlock		Waiting
	USB connector		Stop USB
MD	Medical device		Entrance/Exit
	Gas inlet		Gas outlet
	Stacking limit		Keep in a dry place
	This part upwards		Fragile, handle with care
	Humidity limit		Atmospheric pressure limits
	Temperature limit		Non-ionizing electromagnetic radiation
SN	Serial number		Do not push
	Plastic identification symbol		General symbol of recovery/ recyclable
	Graphic record	EC REP	Authorized Representative in the Union European

CE 2797	The product is labelled with the CE mark, which indicates its conformity with the provisions of Directive 2017/745/EU relating to medical devices and compliance with the essential requirements of Annex I of this Directive. Note: The product complies with Council Directive 2011/65/EU.
	The following definition of the WEEE label applies only to EU member states. This symbol indicates that the product is not considered household waste. Ensuring proper disposal of the product will help prevent potential negative consequences for the environment and human health. For detailed information about product returns and recycling, please consult the retailer where you purchased the product. * In system products, this label will only be attached to the main unit.

This page has been intentionally left blank.

2. Equipment Overview

2.1 Intended use

2.1.1 Declaration of intended use

This device is designed for external defibrillation, internal defibrillation, synchronized cardioversion, and automated external defibrillation (AED). It can also be used for non-invasive external pacing, CPR information, and monitoring of ECG parameters, respiration, SpO2, pulse pressure, NIBP, and CO2.

2.1.2 Instructions for use

y External defibrillation/AED/internal defibrillation

The external defibrillation, AED, and internal defibrillation modes are designed for patients with ventricular fibrillation, pulseless ventricular tachycardia, and ventricular flutter.

y Synchronized cardioversion

Synchronized cardioversion is designed for the treatment of atrial fibrillation and atrial flutter.

y Non-invasive external stimulation

Non-invasive external stimulation is designed for the treatment of bradycardia and asystole.

y CPR Information

CPR information is indicated for patients with cardiac arrest.

y arrhythmias

The monitoring is designed for the analysis of resting ECG, as well as for the monitoring of ECG parameters, SpO2, FP, NIBP and CO2.

2.1.3 Intended users

The equipment must be handled by qualified medical personnel with appropriate training in the use of this equipment and in basic and advanced cardiac life support or defibrillation.

2.1.4 Patient population

y DEA

AED mode is contraindicated if the patient exhibits any of the following:

• Awareness

• Breathing

• Detectable pulse or other signs of circulation

y Manual defibrillation mode

Manual defibrillation is designed for the initial treatment of ventricular fibrillation and ventricular tachycardia in pulseless and unconscious patients. Synchronized cardioversion is designed to treat atrial fibrillation.

y Non-invasive stimulation mode

Non-invasive stimulation therapy is indicated in patients with asymptomatic bradycardia.

y Monitoring mode

All parameters can be monitored in adult, pediatric, and neonatal patients.

2.1.5 Expected medical conditions

The equipment is suitable for hospital and pre-hospital environments.

2.1.6 Contraindications

ÿ DEA

AED mode is contraindicated if the patient exhibits any of the following:

- Awareness
- Breathing
- Detectable pulse or other signs of circulation

ÿ Manual defibrillation

Manual defibrillation is contraindicated if the patient exhibits any of the following:

- Awareness
- Breathing
- Detectable pulse or other signs of circulation

2.1.7 Side effects

According to clinical data from the available medical literature and post-market surveillance activities of the defibrillators/ monitors in question, no side effects have been found.

After searching the existing literature on similar devices, the results of the SOTA evaluation show that myocardial damage can be included among the unwanted effects.

2.1.8 Clinical benefit

ÿ AED/external defibrillation/synchronized cardioversion/internal defibrillation/external pacing not invasive

These functions can directly improve patient survival, alleviate symptoms, and enhance quality of life.

ÿ CPR Information

CPR data could standardize chest compressions based on the measurement range of compression depth and frequency, as well as improve the quality of CPR.

ÿ Monitoring

By monitoring ECG, Resp, SpO2, NIBP and CO2 parameters, the patient's physiological parameters can be established thanks to precise measurement, which could detect any disease early and thus benefit the patient's health.

2.2 Applied parts

The applied parts of the equipment are:

ÿ ECG leads and electrodes

ÿ SpO2 sensor

ÿ PANI sleeve

ÿ CO2 nasal sampling tube/cannula and airway adapter

ÿ Multifunction electrodes

ÿ External defibrillation paddles

ÿ Internal defibrillation paddles

ÿ CPR Sensor

WARNING

- **When the equipment is in an ambient temperature above 55°C, the surface temperature of the applied parts must be limited to less than 58°C.**

23 Operating modes

The device has several operating modes. The following table includes all operating modes and related information:

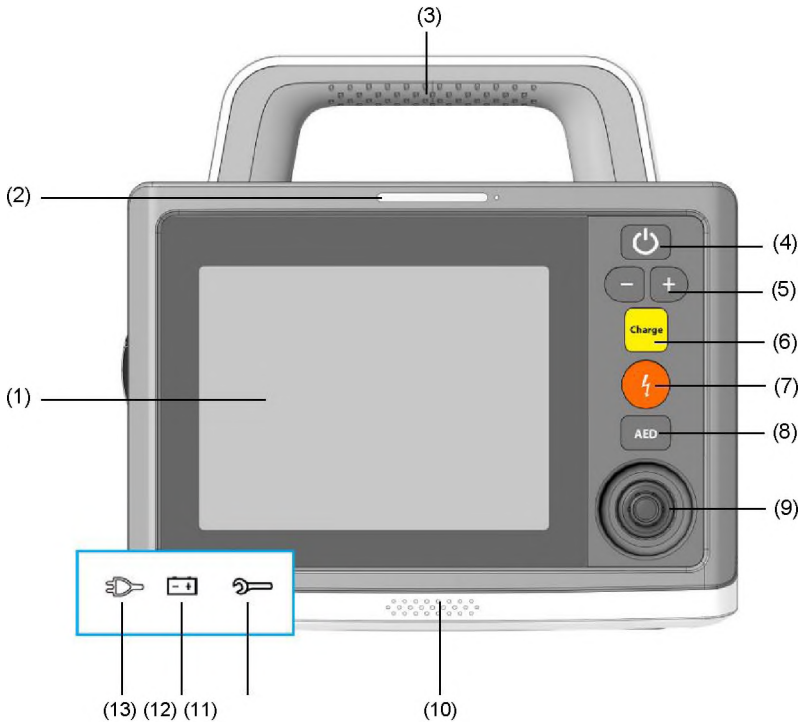
Function type	Mode name	Description	Additional information
Clinical function, performed by healthcare personnel.	AED mode	This mode is used for semi-automatic external defibrillation.	Consult 5 DEA.
	Manual defibrillation mode (Manual Defibrillation)	This mode is used for asynchronous defibrillation and synchronized cardioversion.	See 6 Manual Defibrillation.
	Pacemaker mode (Pacemaker)	This mode is used for fixed-on-demand stimulation therapy.	See 8 Non-invasive stimulation.
	Monitor Mode	This mode is used to monitor various physiological parameters.	Refer to 9 Monitoring Preparation to 16 Carbon Dioxide (CO_2) Monitoring.
Non-clinical function*, performed by healthcare and service personnel.	Discharged patient mode	This mode is used to manage discharged patients.	See 20 Admon. of discharged patients.
	Configuration management mode	This mode is used to change the device settings.	See 22 Configuration Management.
	Test mode	This mode is used for user testing.	See 25.4.2 User Testing.
	Maintenance mode	This mode is used for preventive maintenance of the equipment.	See 25.6.1 User Maintenance Settings.
	Training mode	This mode is used for rescue training and independent training.	See 17.1 Training of rescue.

* After performing operations related to non-clinical functions and exiting the corresponding mode, the equipment restarts automatically.

2.4 Main unit and connectors

Various configurations can be selected for this equipment. In the following sections, the equipment configured without the blade tray is used as an example to describe the front, left, and right views.
To describe the rear view, equipment with different configurations is used.

2.4.1 Front view



(1) Display screen

(2) Alarm light: flashes with a different frequency and color depending on the alarm level.

(3) Handle

(4) Power switch

• When the device is on, press the switch to turn it on. • When the device is on, press and hold the switch for 3 seconds to turn it off.

(5) Energy Select Buttons

• When it is on, press it to access Manual Defib. mode. • In Manual Defib. mode, press it to select the desired energy level.

(6) Charging Button

• When powered on, press to access Manual Defib mode. • In Manual Defib mode, press to charge the device to the desired energy level.

(7) Download button

• When powered on, press to access Manual Defibrillation mode. • In AED or Manual Defibrillation mode, press to deliver a shock to the patient.
It blinks when the device is charged and ready.

(8) AED button: accesses AED mode when the device is powered on.

(9) Navigation control: provides screen-related operations.

(10) Speaker

(11) Status indicator

ÿ Fixed green:

- An external power supply is connected and the equipment is functioning correctly.
- Only the battery is connected as a power source; the equipment is switched on and functioning correctly.

ÿ Flashing green:

- Only the battery is connected as a power source; the equipment is switched off and It works correctly.

ÿ Flashing red:

- Self-test failure, or equipment error detected. • The connected DC power supply is experiencing current overload or overload. of tension.
- Only the battery is connected as a power source; the battery charge level is low or the battery is faulty.
- Only one external power supply is connected as a power source and **Without battery** is defined in **Active status indicator.**

ÿ Off: The external power supply and battery are disconnected.

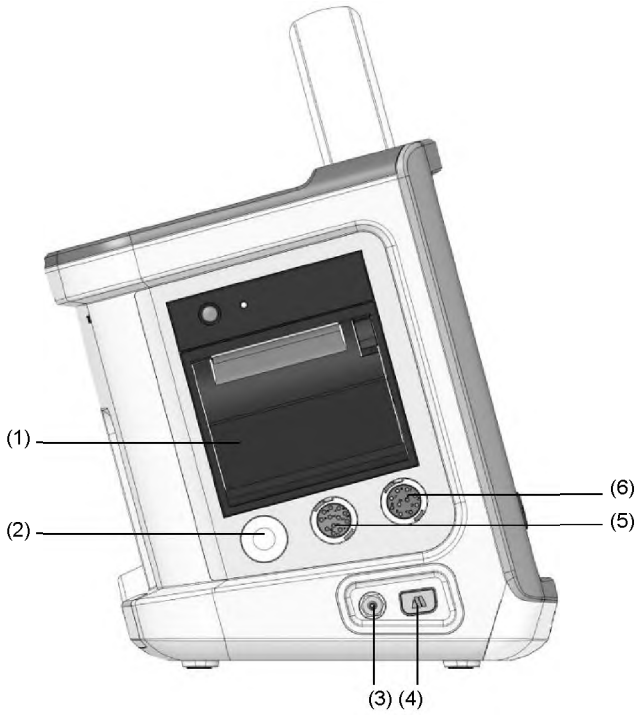
(12) Battery charge indicator

- Yellow: The battery is charging.
- Green: The battery is fully charged or the device is running on battery power.
- Off: No battery is installed or it is faulty.

(13) Power indicator

- Power On: The external power supply is connected.
- Off: The external power supply is not connected.

2.4.2 Left side view



(1) Registrar

(2) PANI cuff connector

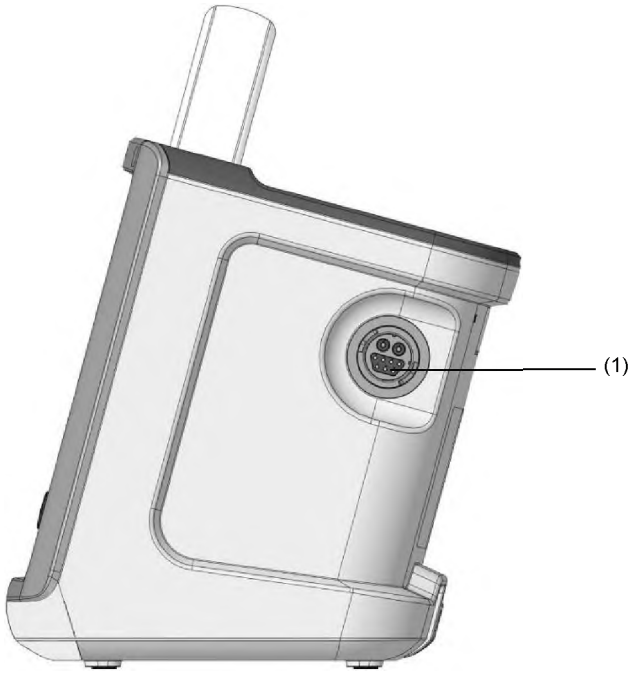
(3) Gas outlet

(4) CO2 connector

(5) ECG cable connector

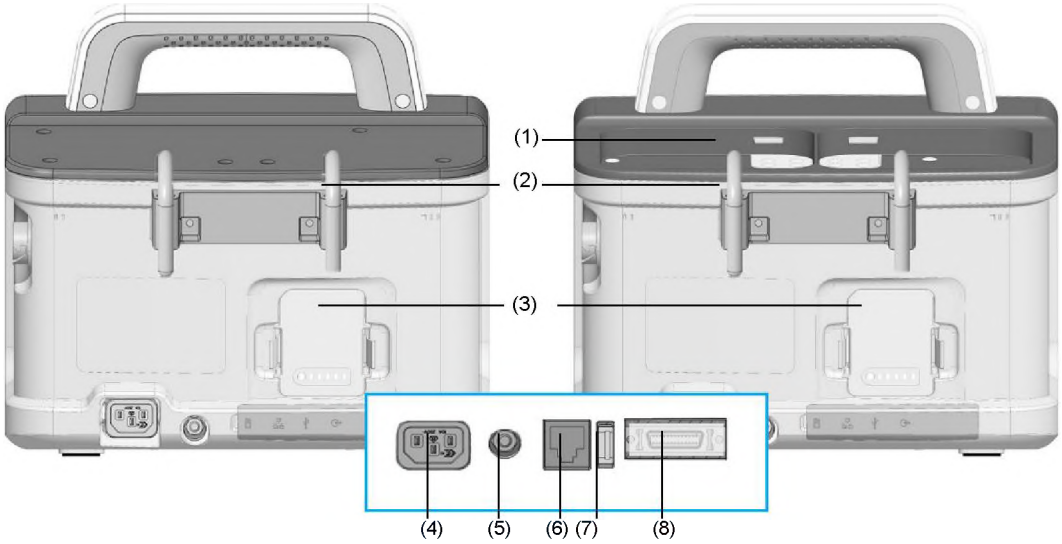
(6) SpO2 sensor connector

2.4.3 Right side view



(1) Therapy port: connect the therapy cable.

2.4.4 Rear view



Equipment without paddle tray

Equipment with shovel tray

(1) Paddle tray: contains external paddles.

(2) Hook: holds the cables.

(3) Battery

(4) Power input: Connect an external power supply.

(5) Equipotential ground terminal:

When the equipment is to be used together with other devices, its equipotential grounding terminals must be connected together so that the potential difference between them is eliminated.

(6) Network connector: It is a standard RJ45 connector.

(7) USB connector: connect the USB drive.

(8) Multifunctional connector: connects a CPR sensor or a cable for analog output or synchronized cardioversion.

This page has been intentionally left blank.

3 Equipment Preparation

3.1 Introduction to equipment preparation

Before using the equipment, you must be fully familiar with its operation, and prepare and configure the equipment properly.

3.2 Safety information for team preparation

WARNING

- **Use only the installation accessories specified by Mindray.**
- **Connect only devices approved for this system. Devices connected to the equipment**
  They must comply with the requirements of applicable IEC standards (e.g., IEC 60950 safety standard for information technology equipment and IEC 60601-1 safety standard for medical electrical equipment). The system configuration must comply with the requirements of IEC 60601-1 for medical electrical systems. Any personnel member connecting devices to the equipment's signal input/output port is responsible for verifying that the devices' safety certification has been performed according to IEC 60601-1.

  If you have any questions, please contact Mindray.
- **The equipment and accessories connected to the equipment are suitable for use in the patient environment. For other devices and accessories connected to the equipment, consult the respective manufacturers regarding their suitability for use in the patient environment.**
- **When, based on equipment specifications, it is uncertain whether a particular combination with other devices could be dangerous, for example, due to the sum of leakage currents, consult the manufacturer or an expert in the field. It must be determined whether the proposed combination will adversely affect the devices themselves or patient safety.**

CAUTION

- **Equipment may only be installed by authorized Mindray personnel. •**

When disposing of packaging material, be sure to follow waste management regulations.
applicable and keep out of reach of children.

- **Before using, check that the packaging is intact, especially for single-use accessories. If you notice any damage, do not use the equipment with patients.**
- **Ensure that the environment in which the devices will be used meets the requirements. Otherwise, unexpected consequences, such as equipment damage, may occur.**

NOTE

- **Place the equipment in a location where you can easily see and use it.**
- **Keep the packaging box, because you may need to use it if you need to return the equipment.**

3.3 Equipment installation

The equipment can be installed in different ways as needed.

y Placed on the table

ÿ Installed on an emergency stretcher with hooks

y Installed in the ambulance with a simple assembly

3.3.1 Unpacking and checking

Before unpacking the product, please inspect the product packaging for damage. If you find any damage, please contact us or the person responsible for delivering the product.

If the packaging is intact, open it and carefully remove the equipment and accessories. Check the contents against the packing list and ensure that the items supplied are undamaged. Please contact us if any problems arise.

3.3.2 Environmental requirements

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

The environment in which the equipment is used should be free (as far as possible) from noise, vibration, dust, corrosive, flammable, and explosive substances. If the equipment is installed in a cabinet, sufficient space must be left in front of and behind the equipment for its use, repair, and maintenance. Furthermore, to maintain good ventilation, the equipment should be located at least 5 cm (2 inches) away from the cabinet.

When equipment is moved from one location to another, condensation may occur as a result of differences in temperature or humidity. In this case, never start the system until the condensation has disappeared.

3.4 Power supply connection

The equipment provides several types of power supply.

WARNING

- **Always use the power cord supplied with the equipment.**
- **Before connecting the equipment to the power supply, check that the voltage ratings and The power supply frequency is the same as that indicated next to the power input of the equipment.**
- **Use the battery when you are in doubt about the integrity of the protective earth conductor or the protective earth system.**

3.4.1 AC power supply connection

The equipment can operate on an AC power supply.

To connect the equipment to the AC power source, follow this procedure:

1. Connect one end of the power cord to the AC power input of the equipment.
2. Connect the other end of the power cord to an AC outlet. Check that the power indicator is lit.

3.4.2 DC power supply connection

If connected to a DC/AC converter, the equipment can operate on DC power.

To connect the equipment to the DC power supply, follow this procedure:

1. Connect one end of the DC/AC converter to the AC power input of the equipment.
2. Connect the other end of the DC/AC converter to the DC power outlet. Check that the power indicator is lit.

If the connected DC power supply experiences current overload or voltage overload, the equipment status indicator will flash red and beep periodically.

CAUTION

- **Use only the specified DC/AC converter.**

- **When connected to the transport coupling, it is specified as part of the equipment. Use only the specified DC/AC converter.**

3.4.3 Battery installation

The device can operate on battery power if an external power source is not available. For more information on battery installation, see section 23.3 Replacing the Battery.

3.5 Powering on the equipment

Before turning on the equipment, perform the following checks:

1. Check the equipment for any mechanical damage. Ensure all external cables, plugs, and accessories are properly connected.
2. Connect the device to the external power source. If the device is battery-powered, make sure it has sufficient charge.

Press the power switch to turn on the device. When the startup screen appears, the device beeps, the alarm light illuminates red, then turns yellow, and finally turns off.

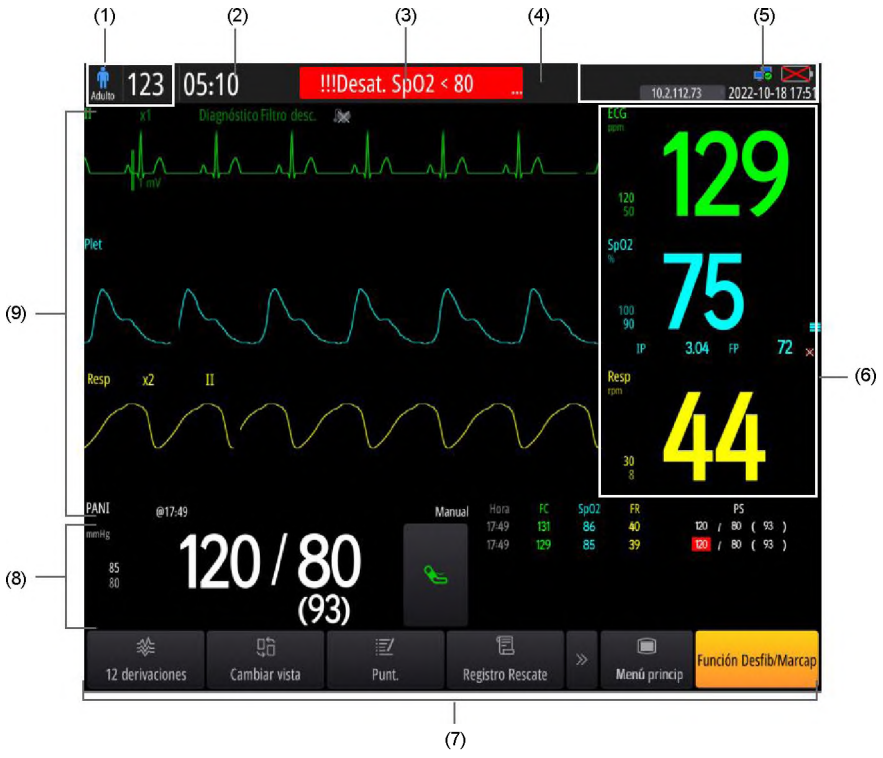
If AED mode or Manual Defibrillation mode is the default startup mode, the alarm system will deactivate when the alarm light turns off. If Monitor mode is the default startup mode, the alarm system will activate when the alarm light turns off. The **Default Startup Mode** setting can only be changed in Setup mode. For more information, see section 22.7.1 General Setup Menu.

CAUTION

- **If you suspect the equipment is not functioning correctly or if you detect any mechanical damage, do not use it with patients. Contact maintenance personnel or Mindray.**
- **Verify that the visual and audible alarm signals are emitted correctly when the equipment is switched on.**

3.6 Main screen display

The following image shows the main screen.



(1) Patient Information Area: Displays the patient's name/bed number (configurable) and patient category. The **Patient Name** and **Bed Number** screen can only be configured in configuration mode. For more information, see section 22.7.8 Patient Administration Settings Menu.

(2) Operating time area: displays the operating time since the equipment was turned on.

(3) Alarm information area: technical alarm messages, physiological alarms and indication messages.

(4) Alarm status area: Displays the alarm status symbol. For more information, see 10.1.4 Alarm status symbols.

(5) System information area: Displays network status, battery status, voice recording symbol, IP address of the connected CMS, and system time. For more information, see 3.6.1 Display Symbols.

(6) Parameter Numerical Values Area: Displays parameter values, units, alarm limits, and alarm status. The parameter list is also displayed in this area. Selecting a parameter's numeric values area opens the corresponding parameter's menu. Selecting the parameter list takes you to the **tabular trends review page.**

(7) Quick access area: Provides quick access to general operations. The locations of the **Main Menu** and **Function Delete/Capture** keys cannot be changed.

(8) Area of the parameter waves/Area of the numerical values of the parameters:

- Parameter waveform area: Displays parameter waveforms and parameter alarms. Selecting a waveform opens the corresponding parameter menu.
- Parameter Numerical Values Area: Displays parameter values, units, alarm limits, and alarm status. The parameter list is also displayed in this area. Selecting the numeric values area for a parameter opens the corresponding parameter menu. Selecting the parameter list takes you to the **tabular trends review page.**

(9) Parameter waveform area: Displays parameter waveforms and parameter alarms. Selecting a waveform opens the corresponding parameter menu.

3.6.1 Screen symbols

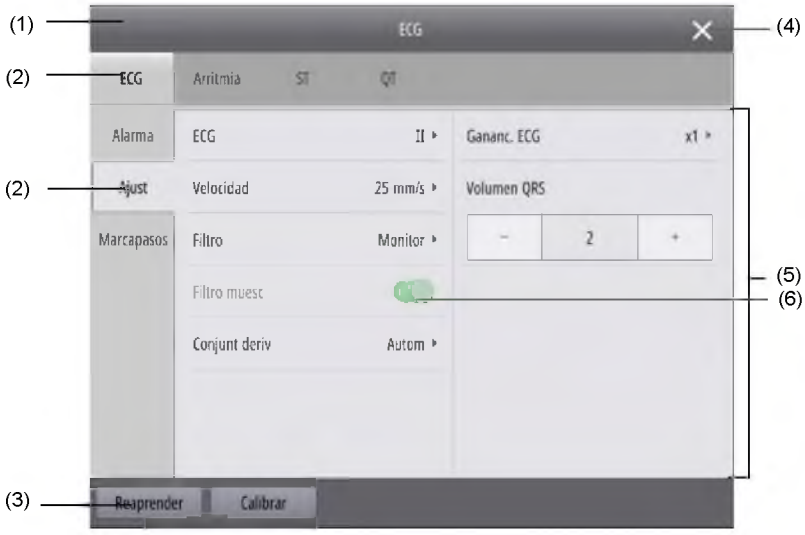
The following table lists the symbols that appear in the system information area:

Symbol Description		Symbol	Description
	Adult, male (with blue background)		Adult, sex not specified (with white background)
	Pediatric, male (with blue background)		Pediatric, sex not specified (with white background)
	Newborn, male (with blue background)		Newborn, sex not specified (with white background)
	Adult, female (with pink background)		Pediatric, female (with pink background)
	Newborn, female (with pink background)		The alarm system has been reset.
	All alarms are on pause.		Alarm tones are paused.
	Individual physiological alarms are deactivated or the equipment is in the deactivated alarm state.		The alarm tones are off.

Symbol Description		Symbol	Description
	The battery is working properly. The green part represents the remaining charge.		The battery is charging.
	The battery has a low charge level and should load.		The battery has an extremely low charge level and must be charged immediately. Otherwise, the device will automatically shut down shortly.
	There is no battery installed.		The voice recording function is activated.
	The touchscreen is locked.		The touchscreen lock has been disabled.
	The wired network is connected.		The wired network is not connected.
	The wireless network is connected. The dark area indicates the network signal strength.		The wireless network is not connected.
4G	The 4G mobile network is connected. The dark area indicates the network signal strength.	4G	The 4G mobile network is not connected.
5G	The 5G mobile network is connected. The dark area indicates network signal strength.	5G	The 5G mobile network is not connected.

3.6.2 Menus

All the device's menus have a similar style and structure. The following image shows the ECG settings menu:



(1) Menu heading: summarizes the functions of the current menu.

(2) Submenu tabs: Provides access to a submenu.

(3) Operation key: performs the corresponding operation.

(4) Exit button: closes the current menu.

(5) Main content area: displays the menu options and items.

(6) Switch:

• Green: the element is activated.

• Gray: the element is disabled.

3.6.3 Hotkeys

The shortcut keys are located at the bottom of the screen. The shortcut key on the main screen provides quick access to general computer operations. The shortcut key located below a window provides quick access to the corresponding functions.

The following table lists all the shortcut keys available on the main screen.

Symbol	Label	Description	Symbol	Label	Description
	Main menu	Open the main menu.	/	Function Defib/Marcap	Enter the **Desfib window. Manual.**
	12-lead Enter the	12-lead ECG window.		Change screen	Change the display of the main screen.
	Punt.	Enter the Score window.		Record Rescue	Enter the **Rescue Registry window.**
	TBI	Enter the TBI Evaluation window.		Freeze	Freeze waves.
	/	Show more hotkeys.			

3.7 General Operations

The screen displays everything needed to operate the equipment. Screen elements include the parameter numerical values area, the parameter waveform area, shortcut keys, the system information area, the alarm information area, and the menus.

3.7.1 Using the touchscreen

3.7.1.1 Movements to speed up the use of the device

You can perform the following actions to speed up the use of the device.

ÿ Touch the screen •

To select an item from the menus or lists, touch it with your finger.

• To select a shortcut key, tap it with your finger.

• To access a parameter menu, tap the numeric values area or the area of Waveforms of the corresponding

parameter. ÿ Swipe the screen with a single finger:

• To scroll through a list and menu, swipe up and down.

ÿ Swipe the screen with two fingers:

• To switch to another screen, swipe the screen to the right or to the left.

3.7.1.2 Touchscreen Lock

To prevent misuse, you can also temporarily disable the touchscreen. You can do this in one of the following ways:

ÿ No operation has been performed in 5 minutes. The **Screen Lock Duration** setting can only be changed in settings mode.
For more information, see 22.7.1 Menu
General settings.

ÿ Select the shortcut key **Main Menu** ÿ in the **Common column,** select **Screen Lock.**

ÿ Press and hold the **Menu** key to display above as shown. , slide the slider towards

The quick key **Menu principal** indicates that the touch screen is disabled.

To unlock the touchscreen, tap anywhere on the screen to display the slider up, as shown. and slide the

CAUTION

- **Check that the touchscreen is not damaged or broken. If there are any signs of damage, stop using the device and contact service personnel.**
- **If the touchscreen is not accurate, stop using the device and contact support staff.**
  service.

3.7.2 Using the navigation controller

To prevent touchscreen malfunctions that could delay patient rescue, a navigation remote control is also included. You can use the navigation remote control to perform the following operations:

ÿ Displaying a submenu

- Turn the navigation knob to move the cursor over the desired item in the main menu, and then press the navigation knob.

ÿ Introduction of information

1. Turn the navigation knob to move the cursor over the desired text box in a menu, and then press the navigation knob.

2. Turn the navigation knob to move the cursor over the desired character to be entered, and then press the navigation knob.

ÿ Change of configuration: the change of patient category is taken as an example below.

1. Turn the navigation knob to move the cursor over the patient category symbol in the area
   from patient information and then press the navigation control.
2. Turn the navigation knob to move the cursor over the **Patient Categ.** and then press the navigation knob.

3. Turn the navigation knob until you find the desired item, and then press the control.
   navigation to confirm the selection.

3.7.3 Using the on-screen keyboard

The on-screen keyboard is also provided for entering information:

ÿ Select one character at a time to enter text. To hide the password.

ÿ Select to show or

ÿ Select to delete the previous character or select to delete all entered text.

ÿ Select to switch between uppercase and lowercase.

ÿ Select to confirm the entered data and close the on-screen keyboard.

3.8 Equipment configuration

3.8.1 Date and time adjustment

Before using the equipment for the first time, you must set the time zone and system time according to the local time.

To set the system date and time, follow this procedure:

1. Enter **System Time** in one of the following ways:
   - Select the shortcut key **Main Menu** ÿ in the **System column,** select **Time.**
   - Select the system information area from the main screen.
2. Define the system date.
   - **Date format:** allows you to set the system's date format.
   - **Date:** Allows you to set the system date.
3. Set the system time.
   - **24-hour** switch : If 12-hour mode is needed, turn it off.
   - **Time:** Allows you to set the system time.
4. Configure **Daylight Saving Time.** If Daylight Saving Time is needed, activate it.

You can also set the system date and time in configuration mode. For more information, see section 22.7.1 General Settings Menu.

If the device is connected to a central monitoring system (CMS) or an NTP server, the date and time will be automatically obtained from that CMS or NTP server. In that case, you will not be able to change the device's date and time settings. For more information about the connection, see 21.5 Connecting to the CMS and 21.9 Connecting to the NTP Server.

If the system time is changed in setup mode, the computer will restart. If the system time is changed in other cases, the computer will generate an operation event to remind you. For more information, see 18.7 Event Review.

CAUTION

- **Changing the date and time affects the storage of trends and events, and can lead to data loss.**

3.8.2 Adjusting screen brightness

To adjust the screen brightness, follow this procedure:

1. Enter **Screen** in one of the following ways:
   - Select the shortcut key **Main Menu** ÿ in the **Display** column select **Display settings** ÿ Select the **Screen tab.**
   - Select the shortcut key **Main Menu** ÿ in the **Display** column select **Brightness.**
2. Adjust the screen brightness.

NOTE

- **If Brightness is set to Auto, the screen brightness will automatically adjust with the ambient light. environmental.**

3.8.3 Volume adjustment

To adjust the system volume, follow this procedure:

1. Select the shortcut key **Main Menu** ÿ in the **Common column,** select the **Volume tab.**
2. Adjust **Alarm Volume, QRS Volume** and **Key Volume,** respectively.

3.8.4 High contrast screen adjustment

The device provides a high contrast option to offer better visibility in bright environments.

To activate high contrast, select the **Menu** shortcut key and select **High Contrast** in the **Common column.**

To turn off high contrast, select the **Menu** key and select **All Color** in the **Common column.**

The high contrast setting is retained when changing the operating mode. However, this setting is not saved when the device is turned off.

3.8.5 Software licenses

A software license is required to run the following functions:

y Non-invasive stimulation

y CPR quality index trend

y Glasgow Coma Scale (GCS)

y Early Warning Score (EWS)

y Punt HEART (HEART)

y Traumatic brain injury (TBI) assessment

y HL7 numeric data output

y HL7 Waveform Output

y Rescue training

To install the licenses, please contact the service staff.

3.9 Editing current patient information

The current patient's name/bed number (configurable) and patient category are displayed in the patient information area of the main screen.

To edit the current patient's information, follow this procedure:

1. Select the patient information to access the **Demographic Data window. Patient.**

2. Edit patient information as needed.

If the equipment is connected to the CMS, the current patient's name, bed number, patient ID, department, height, weight, admission date, or physician information can also be changed in the CMS.

3.10 Voice Recording

The device provides voice recording functionality during all therapy and patient monitoring procedures. Voice recording is disabled by default. The **voice recording** activation setting can only be changed in configuration mode. For more information, see section 22.7.1, General Settings Menu.

 This indicates that the voice recording function is activated. It is displayed in the system information area of the home screen.

3.11 Record of the ransom data

After powering on, the device automatically records the startup time, the defibrillation event, and pacing operations. For subsequent analysis and treatment, it can also manually record medications and measurements that affect the patient's condition.

In Monitor mode, you can manually record vital signs, medications, and measurements. To do this, follow this procedure:

1. Select the shortcut key **Registry Rescue.**

2. Select the name of the medication used or the measure taken, for example **Bandaged.**
3. Select **Vital Signs Recording** to record current waveforms and values of the parameters.
4. Select **Save.**

In AED and Manual Defibrillator modes, you can only manually record medications and measurements. This data can be recorded by selecting the shortcut key located below the corresponding therapy window. The display of these shortcut keys can only be configured in setup mode. For more information, see section 22.7.2.5, Shortcut Key Settings tab.

Selecting **Review** will take you to the event review page. For more information, see section 18.7 Event Review.

If you select **Log,** the rescue log report will begin printing. For more information, see 19 Printing.

NOTE

- **In Marcap mode, the device automatically records data related to stimulation. These operations cannot be recorded manually.**

3.12 Turning off the equipment

Before turning off the equipment, check the following:

1. Ensure that the patient's treatment and monitoring have been completed.
2. Disconnect all cables and sensors from the patient.
3. If necessary, save or delete the patient's data.

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

Turning the device off does not disconnect it from the power source. To completely disconnect the power supply, unplug the power cord.

CAUTION

- **Press and hold the power switch for 10 seconds to force the device to shut down if you were unable to turn it off normally. This may result in the loss of patient data.**

NOTE

- **To prevent loss of changes in the event of a sudden power failure, the device saves settings in real time. In the event of a temporary power failure, if power is restored within 60 seconds, the device will resume with all active settings unchanged. If power is interrupted for more than 120 seconds, the device will respond as if it had been shut down normally. If power is restored within 60 to 120 seconds, the device will resume with all active settings unchanged or will respond as if it had been shut down normally.**

4. Therapy Preparation

4.1 Selection of therapy accessories

Before therapy, you should choose the appropriate accessories based on the patient's condition.

The following table lists the accessories available for each operating mode:

Operating mode	Function	Available accessories
DEA	DEA	Multifunction electrodes
	CPR assistance	• Multifunction electrodes • CPR sensor
Manual defibrillation	Manual defibrillation	• Multifunction electrodes • External blades • Internal blades
	CPR assistance	• Multifunction electrodes • CPR sensor • SpO2 sensor
	Synchronized cardioversion	• Multifunction electrodes • External blades • Multifunction electrodes and ECG electrodes • External paddles and ECG electrodes • Internal paddles and ECG electrodes
Marcap	Non-invasive stimulation	Multifunction electrodes and ECG electrodes

4.2 Connecting the therapy cable

To connect the therapy cable, follow this procedure:

1. Align the arrow indicated on the cable plug with the arrow on the therapy port of the device.
2. Connect the therapy cable to the corresponding port and press until you hear a click.

To remove the therapy cable from the device, turn the cable plug clockwise.

4.3 Connecting the multifunction electrodes

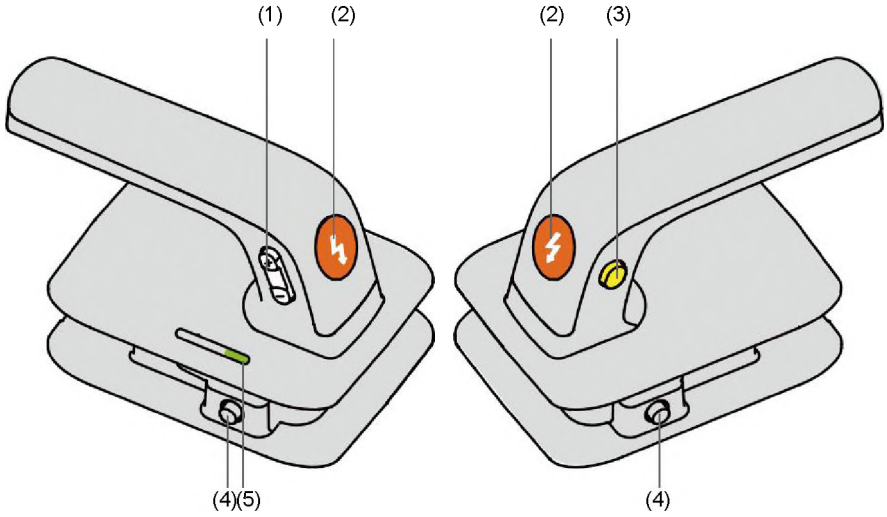
To connect the electrodes, follow this procedure:

1. Connect the therapy cable. For more information, see 4.2 Connecting the therapy cable.
2. Press the therapy cable into the electrode connector until you hear a click.

3. If a defibrillation test is required, connect the test load to the therapy cable.

4.4 Connecting the external blades

The following image shows the external blades for adults.



Sternum blade

Vertex shovel

(1) Power Select Button

(2) Download Button

(3) Charging Button

(4) Lock button

(5) Patient contact indicator: Indicates the contact status between the patient and the external paddles. The patient contact indicator on the manual window defibrillator has the same function. For more information, see section 4.8, Checking the Patient Contact Indicator.

- Green: indicates that contact with the patient is good, the impedance is adequate for defibrillation.
- Orange: indicates that contact with the patient is not good, the impedance is slightly high for defibrillation.
- Red: indicates that contact with the patient is very poor or that there is a Short circuit between the outer paddles. The impedance is completely unsuitable for defibrillation.
- Off: indicates that the therapy cable is detached, that the paddles are in place in the paddle tray or that the equipment is not in Manual Defib mode.

4.4.1 Connecting the external paddles for adults

To connect the adult external paddles, follow this procedure:

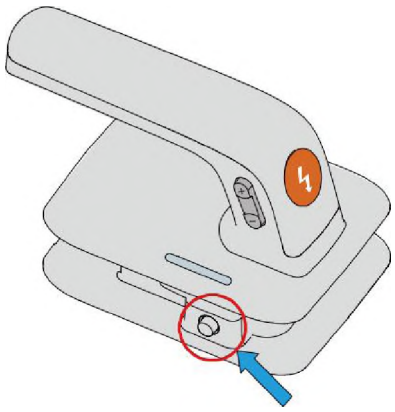
1. Connect the therapy cable. For more information, see 4.2 Connecting the therapy cable.
2. Grab the paddles by the handles and remove the paddle set from the paddle tray.

4.4.2 Connecting the pediatric external blades

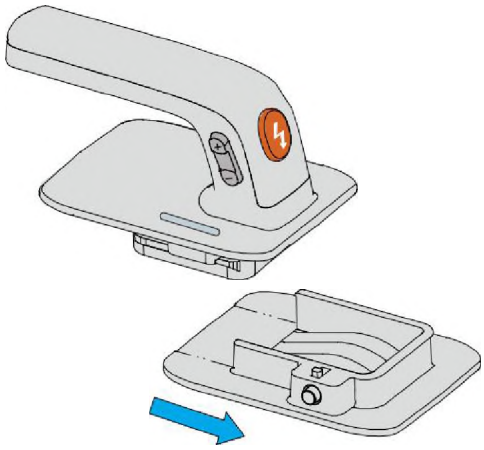
The external paddles provide adult and pediatric paddle electrodes, included inside.

To connect the pediatric external paddles, follow this procedure:

1. Connect the therapy cable. For more information, see 4.2 Connecting the therapy cable.
2. Press the locking buttons on the outer blades.



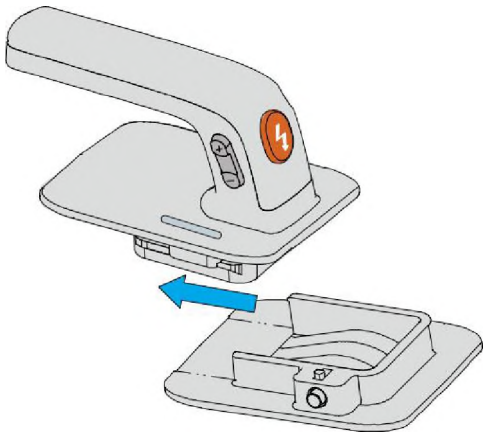
3. Pull the adult paddle electrodes forward to remove them.



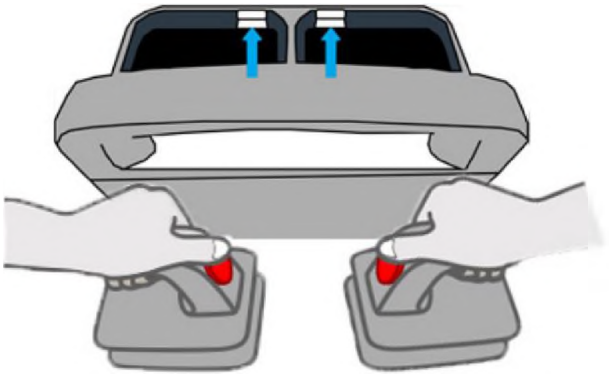
4.4.3 Placement of the external blades

If the external blades are not in use, you should place them in the blade tray. To do this, follow this procedure:

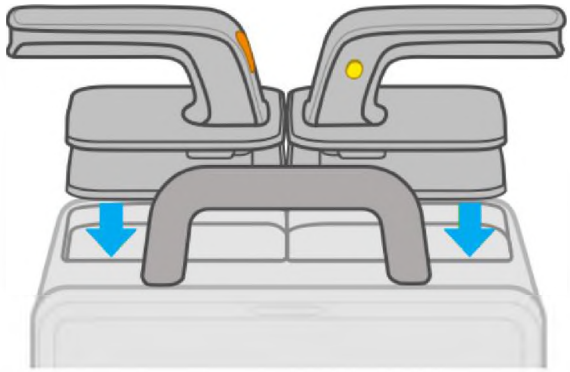
1. If pediatric electrodes have been used, they must be placed back inside the adult external paddles.



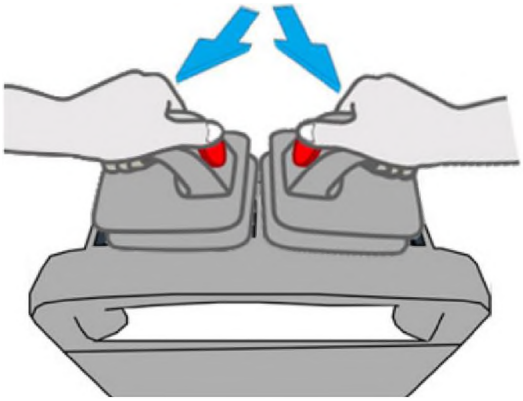
2. Grasp the handles of the apex blade and the sternum blade, and then align them with the parts metal parts of the paddle tray.

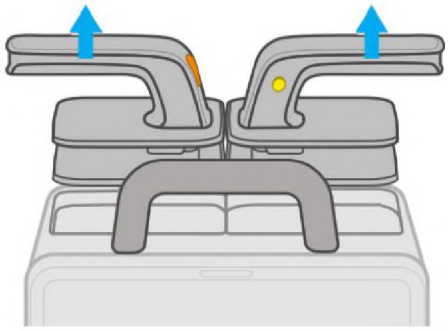


3. Press the outer blades until you hear a click.



To remove the outer blades from the blade tray, push the two handles firmly and lift them up.

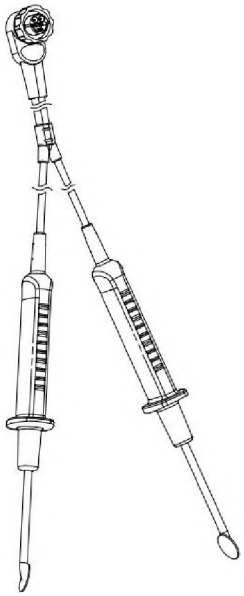




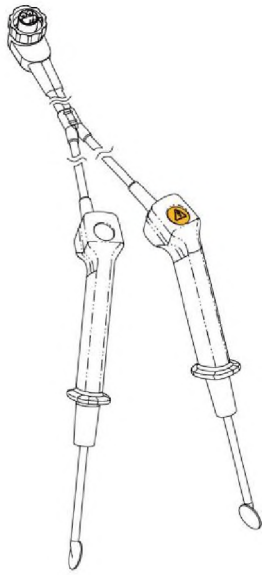
4.5 Internal blade connection

There are two types of internal paddles: paddles without a button and paddles with a button. Check the type of transport coupling before use.

The following image shows the internal blades.



Paddles without a button



Paddles with a button

To connect the internal paddles, connect the therapy cable to the corresponding port on the device. For more information, see section 4.2 Connecting the Therapy Cable.

4.6 CPR sensor connection

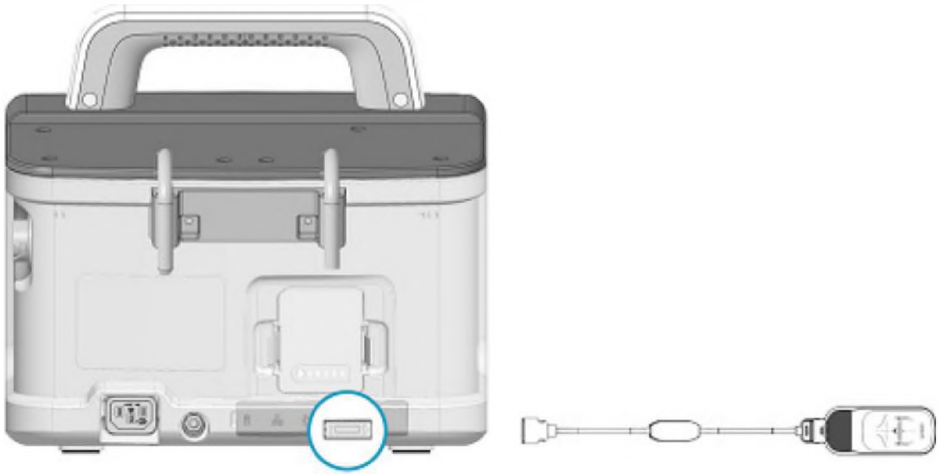
If connected to the CPR sensor, the device can provide CPR information, charge the configured CPR sensor with a battery, and upload the last hour's data from the CPR sensor.

The CPR sensor is designed to provide real-time CPR information for patients at least 8 years old or weighing more than 25 kg. For more information, refer to the CPR sensor operator's manual.

To connect the CPR sensor, follow this procedure:

1. Take one end of the CPR sensor cable with the Mindray logo facing up and plug it into the CPR sensor connector.
2. Secure the CPR sensor cable with the cable retainer.
3. Pull the CPR sensor cable to ensure it is securely connected.

4. Plug the other end of the sensor cable into the multifunction connector located on the back of the equipment.



4.7 Patient preparation for electrode application

The skin must be properly prepared to ensure that the electrode area receives a good quality signal, as the skin is not a good conductor of electricity.

To properly prepare the skin, choose smooth areas and then perform this procedure:

1. Expose the patient's chest.
2. Check that the skin is clean and dry.
3. Dry the patient's torso and shave off excess hair if necessary.

4.8 Checking the patient contact indicator

In AED and Manual Defibrillation modes, the patient contact indicator is used to indicate the contact status between the patient and the electrodes or between the patient and the external paddles.

The patient contact indicator and impedance value displays are disabled by default. The activation settings for the **Contact Impedance Indicator** and **Contact Impedance Value** can only be changed in configuration mode. For more information, see section 22.7.2.1, Manual Impedance Adjustment tab.

The following table shows the contact status of the patient contact indicator and the corresponding actions:

Patient contact indicator	Description	Corrective measures
Green	It indicates that contact with the patient is good, and the impedance is adequate for defibrillation.	None
Orange	It indicates that contact with the patient is not good; the impedance is slightly high for defibrillation.	Securely attach the electrodes or external paddles to the patient, or adjust the placement of the electrodes or external paddles until the indicator lights up green. If the indicator remains lit in orange, it can also be used for defibrillation. However, the expected effects may not be achieved under these conditions.
Red	This indicates that contact with the patient is very poor or that there is a short circuit between the electrodes or external paddles. The impedance is completely inadequate for defibrillation.	Securely attach the electrodes or external paddles to the patient, or adjust the placement of the electrodes or external paddles until the indicator lights up green or orange.

Patient contact indicator	Description	Corrective measures
[redacted] Off	This indicates that the therapy cable is detached, the paddles are placed in the paddle tray, or the device is not in AED mode or Defibrillation mode. Manual.	Check that the therapy cable is correctly connected to the device.

NOTE

- **Defibrillation is recommended if the patient contact indicator is illuminated in green. If the patient contact indicator is illuminated in orange, it can also be used for defibrillation. However, the expected effects may not be achieved under these conditions.**

This page has been intentionally left blank.

5 DEA

5.1 Introduction to DEA

In AED mode, the device immediately analyzes the patient's heart rhythm once the electrodes are placed.

- If a shockable rhythm is detected, you must press the flashing Shock button on the device.
- If no shockable rhythm is detected, the device defaults to CPR mode.

If the device enters CPR mode or an electrode malfunction occurs, the device automatically stops analyzing the patient's heart rhythm.

The device also provides CPR assistance for chest compressions. For more information, see section 7, CPR Assistance.

5.2 DEA safety information

DANGER

- **The defibrillation current can cause serious injury or death to the operator or bystander. Do not touch the patient or any metal object connected to the patient (including the bed or wheeled stretcher) during defibrillation.**
- **Avoid contact between areas of the patient's body (such as exposed skin on the head or the extremities), conductive fluids such as gel, blood or saline solution and metallic objects (such as the frame of a bed or stretcher) that may offer an unwanted path for the defibrillation current.**
- **During defibrillation, prevent the electrodes from coming into contact with each other and from entering Contact with ECG electrodes, electrode wires, dressings, etc. Contact with metallic objects can divert the path of the heart's current, which can cause electrical arcing and burns to the patient's skin.**

WARNING

- **Motion artifacts can delay analysis or affect the ECG signal, generating an inappropriate or non-recommended shock message. Do not touch the patient during ECG rhythm analysis or while charging in AED mode.**
- **Air pockets between the patient's skin and the electrodes can cause electrical arcing and burns to the patient's skin during defibrillation. To prevent poor adhesion and air pockets, ensure that the electrodes are fully adhered to the patient's skin.**
- **Do not use dry electrodes.**

CAUTION

- **Electrodes can be damaged during storage or before use if handled improperly (for example, they can be bent or broken). Discard electrodes if you notice they are damaged.**
- **In patients with pacemakers, the sensitivity and specificity of the AED algorithm can be seen affected.**

NOTE

- **The success of resuscitation depends on many variables specific to the physiological state of the**
  The patient and the circumstances surrounding the patient's situation are important factors. Unsatisfactory patient outcomes are not a reliable indicator of equipment performance. The presence or absence of muscle response to energy transfer during electrical shock therapy is not a reliable indicator of equipment performance or energy delivery.

5.3 Access to AED mode

To access AED mode, choose one of the following options:

y Press the **AED** button on the device.

y If **Default Boot Mode** is set to **AED,** the device automatically enters AED mode after power-up. The **Default Boot Mode** setting can only be changed in setup mode. For more information, see 22.7.1 General Setup Menu.

y Select the shortcut key **Function Defibrillator/Marcap** y select the **AED tab.**

y In the Manual Defibrillation window, select the **AED tab.**

y In the **Marcap window,** select the **DEA tab.**

In AED mode , **the AED** window is displayed. The first waveform shown corresponds to the ECG signals obtained through the electrodes; all parameters are monitored. Alarms are disabled.

5.4 AED Window Display

The following image shows the **DEA window.**

(1) Operating mode

(2) Connection indication/CPR panel:

- Connection indication: If the therapy cable is not connected, a warning is displayed.
- CPR Panel: Provides instructions on chest compressions, including compression rate, pause time, and relevant CPR indications.

(3) Selected energy

(4) Patient contact indicator and impedance value (configurable): Indicates the contact status between the patient and the electrodes. For more information, see 4.8 Checking the patient contact indicator.

(5) Download counter

(6) Message about therapy: indicates the therapy operations.

5.5 AED Procedure

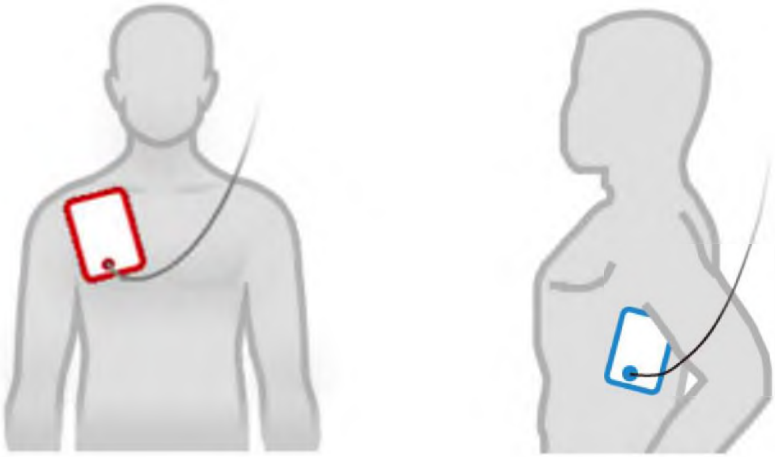
For rapid and immediate rescue, the device provides rhythm analysis during CPR. This reduces the time you need to stop CPR to analyze the ECG rhythm. For more information, see section 7.4 Rhythm Analysis During CPR.

To perform an AED rescue, follow this procedure:

1. Access the patient and ensure they are a suitable candidate for the AED procedure.
2. Connect the therapy cable to the device, and then connect the therapy cable and electrodes. For more information, see 4.2 Connecting the therapy cable and 4.3 Connecting the multifunction electrodes.
3. Prepare the patient's skin. For more information, see 4.7 Patient Preparation for the application of electrodes.
4. Apply the electrodes to the patient as indicated on the package.

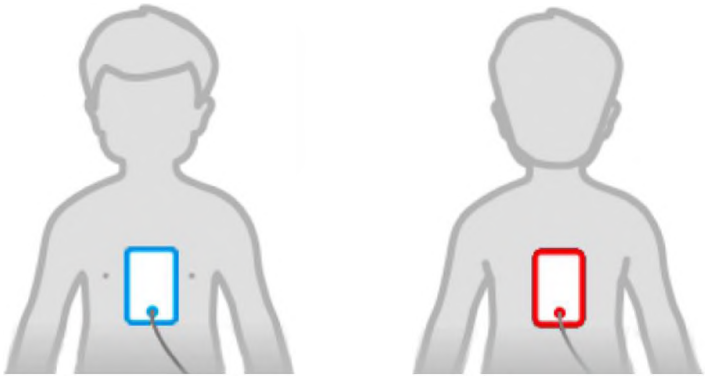
ÿ In the case of adult patients, use anterolateral placement:

- Place the red electrode (sternum) on the upper right side of the patient's torso, next to the sternum and below the clavicle.
- Place the blue electrode (apex) over the patient's left nipple, in the mid-axillary line, with the center of the electrode on that line.



ÿ In the case of pediatric patients, use the anteroposterior positioning:

- Place the blue electrode (apex) in the center of the patient's chest between the nipples.
- Place the red electrode (sternum) in the center of the patient's back.

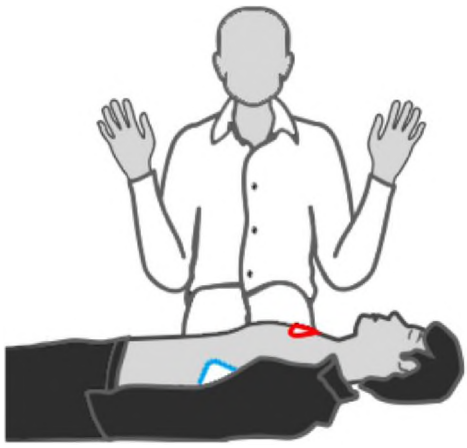


5. Check the patient category symbol in the patient information area. If necessary, select the patient category symbol and change the **Patient Category setting.**
6. The default energy level changes automatically depending on the patient category setting.

- For adult patients, the recommended energy level for the first shock is 200 J.
- For pediatric patients, the recommended energy level for the first shock is 50 J.

7. Do not touch the patient, wait until the heart rhythm analysis is performed.

- As soon as a shockable rhythm is detected, the device displays **"Shock recommended" .** Next, perform step 8.
- If no shockable rhythm is detected, the device displays **"Shock not recommended"** and enters CPR mode by default. Then, perform step 10.



8. Do not touch the patient; wait for the equipment to charge to the predetermined power level.

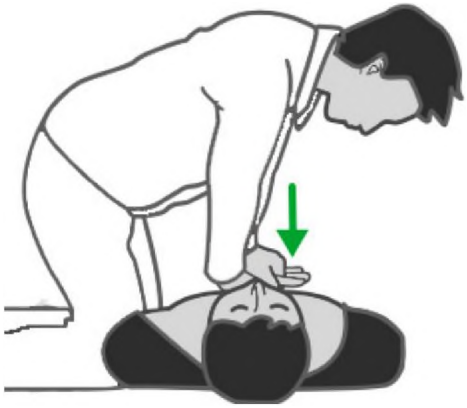
- If no changes in heart rate are detected and the device remains compatible with a shock, it automatically charges to the default power level. The device emits a charging tone, the Shock button flashes, and **"Do not touch patient. Press shock button" is displayed.** Then, perform step 9.
- If changes in heart rate are detected and it is not compatible with a shock, the device will It automatically deactivates. Then, perform step 7.

9. Manage the download.

- Press the flashing Discharge button on the device for the set time, and the device will then deliver a discharge at the default energy level. Then, perform step 10.
- If changes in heart rhythm are detected and it is not compatible with a Once downloaded, the device will automatically deactivate. Then, proceed to step 7.

10. Perform CPR.

- If CPR time runs out, perform the operations indicated in the rhythm analysis during CPR. The system automatically resumes the analysis at the end of the pause period.
- If the patient is conscious and breathing normally, wait for medical services to arrive. emergency.



When a value greater than one is set for **Shock Sequence ,** the device resumes heart rhythm analysis after delivering the shock to determine if the shock produced the desired effects and then proceeds to deliver subsequent shocks at the default energy level. **Time to Auto-Off, Shock Sequence ,** and default energy levels can only be changed in setup mode. For more information, see section 22.7.2.2, AED Settings tab.

NOTE

- **The recommended electrode placements for defibrillation are anterolateral placement in adult patients and the anteroposterior placement in pediatric patients.**
- **For defibrillation in pediatric patients, pediatric electrodes should be used. • If pediatric electrodes are not available, adult electrodes may be used and established Patient category in Pediatrics.**
- **The Download button must be held down to manage a download. The device does not manage downloads automatically.**
- **Impedance is the resistance between the defibrillation electrodes or external paddles. To deliver an effective energy shock, the impedance must be overcome. The degree of impedance varies from patient to patient. It is affected by several factors, such as the presence of chest hair, moisture, and lotions or powders on the patient's skin. If the message "Very high impedance, shock not admin" appears, ensure the patient's skin is dry and no chest hair is caught on it. If the message persists, replace the defibrillation electrodes or electrode cable with a new one.**

5.6 Modification of AED settings

AED settings can only be changed in setup mode. For more information, see 22.7.2.2 AED Settings tab.

5.7 AED Voice Prompts (CPR Voice Prompts)

The following table lists the voice prompts that may occur in AED mode.

Voice prompt	Description
Connect the electrode cable.	There is no therapy cable connected or there has been an electrode connection failure.
Apply the electrodes.	It has been detected that the patient is not connected to the electrodes.
Analysis in progress. Do not touch the patient.	This process is repeated until the heart rhythm analysis is complete. This prompt will stop when the device is ready to deliver the shock.
Download recommended.	It indicates that a shockable rhythm has been detected.
Downloading is not recommended.	It indicates that a non-shockable rhythm has been detected.
Do not touch the patient. Press the discharge button.	It indicates that the equipment is fully charged and ready to manage the download.
Managed download.	It indicates that the download has been administered.
Load disconnected.	The device detects a change in rhythm and cancels the download.
Breathing	It instructs you to administer breaths to the patient.
Begin CPR immediately.	It indicates that CPR should be started immediately.
Stop CPR.	It indicates that CPR should be stopped.
Movement detected. Do not touch or move the patient.	The equipment detects noise artifacts on the ECG; stop moving or touching the patient.
Noise detected. Patches needed be securely fastened.	The device detects ECG noise artifacts. The contact of the multifunction electrodes or patches with the patient's skin must be corrected.
Perform compressions immediately.	It indicates that compressions should be performed on the patient.

This page has been intentionally left blank.

6 Manual defibrillation

6.1 Introduction to manual defibrillation

In manual defibrillation mode (Manual Defibrillation), you must assess the patient's heart rhythm and decide whether to perform manual defibrillation based on the patient's condition. Manual Defibrillation mode also provides a synchronized cardioversion function. The provided prompts will guide you through the defibrillation process.

The device also provides CPR assistance for chest compressions. For more information, see section 7, CPR Assistance.

6.2 Safety information for manual defibrillation

DANGER

- **The defibrillation current can cause serious injury or death to the operator or bystander. Do not touch the patient or any metal object connected to the patient (including the bed or wheeled stretcher) during defibrillation.**
- **Avoid contact between areas of the patient's body (such as exposed skin on the head or the extremities), conductive fluids such as gel, blood or saline solution and metallic objects (such as the frame of a bed or stretcher) that may offer an unwanted path for the defibrillation current.**
- **During defibrillation, prevent the electrodes and paddles from coming into contact with each other and come into contact with ECG electrodes, electrode wires, dressings, etc. Contact with metallic objects can divert the current's path to the heart, which can cause electrical arcing and burns to the patient's skin.**
- **During manual defibrillation, make sure your hands are dry and do not contain conductive gel to avoid electric shocks.**

WARNING

- **During synchronized cardioversion, if the patient's ECG is monitored using external paddles, the artifact created by the paddle movement could be similar to an R wave and trigger a defibrillation shock.**
- **Do not use conductive liquid. Use only the conductive gel specified by the manufacturer. of the team.**
- **If external paddles are used for defibrillation, apply them safely and evenly over the patient's chest in order to ensure proper skin contact.**
- **Physicians must select the appropriate energy level for patient defibrillation pediatric.**

CAUTION

- **Access to Manual Defibrillation mode may be password protected. Make sure you know and remember the password. Otherwise, you will not be able to administer manual defibrillation therapy.**
- **Clean the conductive gel off the outer blades once therapy is complete to prevent corrosion of the blades.**
- **Before using the equipment, disconnect the patient from all equipment that does not include defibrillation protection.**
- **Never charge or deliver shocks in non-clinical situations. Otherwise, they could damage to the equipment may occur.**

NOTE

• Impedance is the resistance between the defibrillation electrodes or external paddles.

To deliver an effective energy discharge, the impedance must be overcome. The degree of impedance varies from patient to patient. It is affected by several factors, such as the presence of chest hair, moisture, and lotions or powders on the patient's skin. If the message "Very high impedance, discharge not admin" appears, ensure the patient's skin is dry and no chest hair is caught on it. If the message persists, replace the electrodes, external paddles, or therapy cable with a new one.

• When the device is in manual defibrillation mode, the alarms are deactivated.

The alarms automatically deactivate and the message "Alarm desac." appears. The alarms remain deactivated until they are activated by pressing the Alarm Pause button and accessing Sync mode, Monitor mode, and Dial mode.

• Defibrillation is always performed using paddles or electrodes. However, it can also be performed with other methods.

You can use the ECG electrode as an alternative ECG source to monitor the ECG during defibrillation. If the ECG electrodes are connected, all available electrodes will be displayed.

• The success of resuscitation depends on many variables specific to the physiological state of the

The patient and the circumstances surrounding the patient's situation are important factors. Unsatisfactory patient outcomes are not a reliable indicator of equipment performance. The presence or absence of muscle response to energy transfer during electrical shock therapy is not a reliable indicator of equipment performance or energy delivery.

6.3 Accessing Manual Defib Mode

To access Manual Defib mode, choose one of the following options:

ÿ Select the shortcut key **Function Defib/Marcap.**

ÿ Press any of the Select Power, Charge, and Discharge buttons on the device.

ÿ If **Default Startup Mode** is set to **Manual,** the device enters

Automatically in Defib mode. Manual after powering on. The **default startup mode** setting can only be changed in setup mode. For more information, see 22.7.1 General Setup Menu.

ÿ In the **DEA window,** select the **Manual tab.**

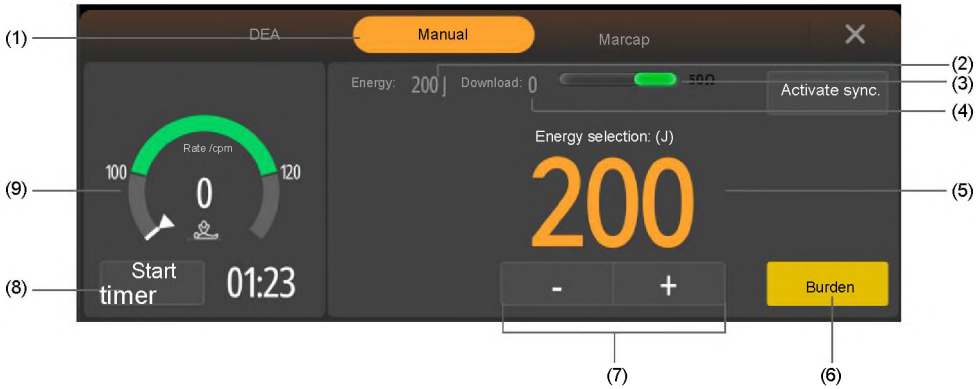
ÿ In the **Marcap window,** select the **Manual tab.**

Access to Manual Defibrillation mode can be password protected. The **Therapy Access** setting can only be changed in configuration mode. For more information, see section 22.7.2.1, Manual Defibrillation Setting tab.

In manual defibrillation mode, the manual defibrillation window is displayed. The first waveform shown corresponds to the ECG signals obtained through the electrodes or paddles; all parameters are monitored. Alarms are disabled.

6.4 Manual Defib window display

The following image shows the manual desfib window.



(1) Operating mode

(2) Selected energy

(3) Patient contact indicator and impedance value (configurable): Indicates the contact status between the patient and the electrodes or between the patient and the external paddles. For more information, see 4.8 Checking the patient contact indicator.

(4) Download counter

(5) Message about therapy: indicates the therapy operations.

(6) Charging key: charges the device to the desired power level.

(7) Energy Select key: selects the desired energy level.

(8) CPR Timer: Starts or stops the CPR countdown.

(9) Connection indication/CPR panel:

- Connection indication: If the therapy cable is not connected, a warning is displayed.
- CPR Panel: Provides instructions on chest compressions, including CPR timer, compression rate, and break time.

6.5 External defibrillation procedure

6.5.1 Intelligent analysis during external defibrillation

Intelligent analysis is disabled by default during manual defibrillation. The **Intelligent Analysis** activation setting can only be changed in configuration mode. For more information, see section 22.7.2.1, Manual Defibrillation Setting tab.

Intelligent analysis detects the patient connection, analyzes the patient's heart rhythm, and provides guidance on device charging and shock delivery. You can perform operations by following the prompts and images displayed on the screen. When the message **"ECG signal with interference" appears**, there is signal interference or motion artifact. In that case, you should check the connection between the electrodes or external paddles and the patient.

The smart scan pauses during upload. Once the upload is complete, the smart scan will restart when you confirm that a download is still needed and press the Download button.

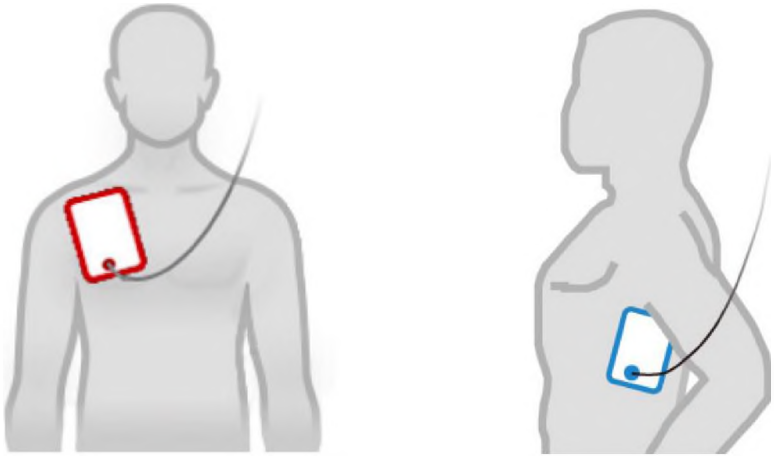
6.5.2 Use of electrodes for external defibrillation

To perform external defibrillation, follow this procedure:

1. Access the patient and ensure they are compatible with external defibrillation.
2. Connect the therapy cable to the device, and then connect the therapy cable and electrodes. For more information, see 4.2 Connecting the therapy cable and 4.3 Connecting the multifunction electrodes.
3. Prepare the patient's skin. For more information, see 4.7 Patient Preparation for the application of electrodes.
4. Apply the electrodes to the patient as indicated on the package.

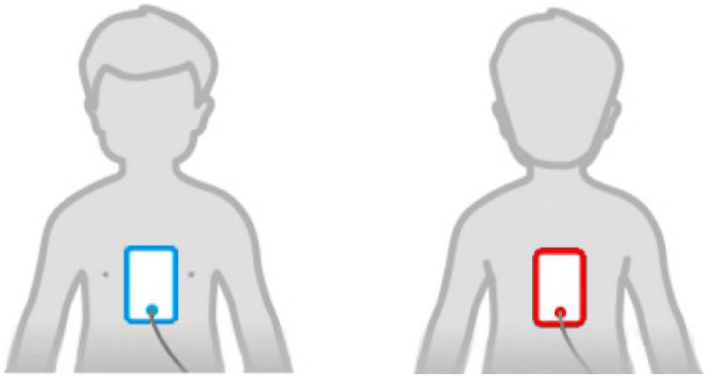
ÿ In the case of adult patients, use anterolateral placement:

- Place the red electrode (sternum) on the upper right side of the patient's torso, next to the sternum and below the clavicle.
- Place the blue electrode (apex) over the patient's left nipple, in the mid-axillary line, with the center of the electrode on that line.



ÿ In the case of pediatric patients, use the anteroposterior positioning:

- Place the blue electrode (apex) in the center of the patient's chest between the nipples.
- Place the red electrode (sternum) in the center of the patient's back.



5. Check the patient category symbol in the patient information area. If necessary, select the patient category symbol and change the **Patient Category setting.**
6. The default energy level changes automatically depending on the patient category setting.

   - For adult patients, the recommended energy level for the first shock is 200 J.
   - For pediatric patients, the recommended energy level for the first shock is 50 J.

7. Select the energy level in one of the following ways:

   - Press the power select button on the device.
   - Select the Power Select key in the Manual Deactivation window. If selected and held down, You can make a quick selection.

8. Press the device's **Charge** button.
9. Wait for the device to charge to the desired energy level. The device will emit a charging tone and the The progress bar changes.

   - If the selected energy level is not suitable for the patient, perform step 7 and the equipment will will automatically deactivate.
   - If changes in heart rate are detected and a download is not compatible, you can select **Deactivate** to stop the upload.

10. Press the Download button to manage a download. If you do not press the Download button within the configured time period, the device will automatically shut down.
11. Perform CPR. If necessary, select **Start Timer** to activate the CPR countdown.

When **Power Series** is activated, the equipment manages a discharge at the predetermined power level.
After three shocks, the device manages subsequent shocks at the default energy level of **Energy** 3. The **Energy Series** activation setting and default energy levels can only be modified in configuration mode. For more information, see 22.7.2.1 Manual Shock Setting tab.

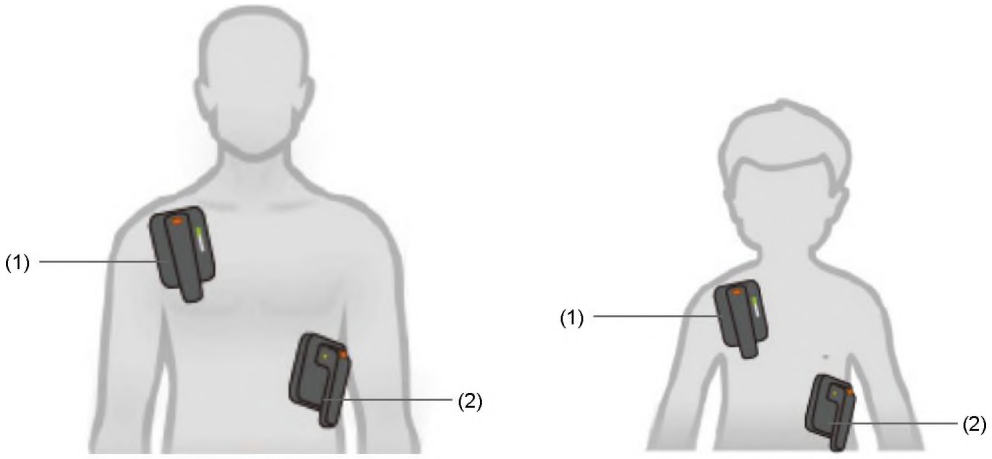
NOTE

- **The recommended electrode placements for defibrillation are anterolateral placement in adult patients and the anteroposterior placement in pediatric patients.**
- **For defibrillation of pediatric patients, you can use the default energy level or adjust it according to local medical protocols.**
- **For defibrillation in pediatric patients, pediatric electrodes should be used. • If pediatric electrodes are not available, adult electrodes may be used and established Patient category in Pediatrics.**
- **For defibrillation of neonatal patients, set the energy level according to the patient's clinical condition. The energy level for a neonatal patient should be lower than the predetermined parameters.**

6.5.3 Use of external paddles for external defibrillation

To perform external defibrillation, follow this procedure:

1. Access the patient and ensure they are compatible with external defibrillation.
2. Connect the therapy cable to the device, and then connect the therapy cable and external paddles. For more information, see 4.2 Connecting the therapy cable and 4.4 Connecting the external paddles.
3. Prepare the patient's skin. For more information, see 4.7 Patient Preparation for the application of electrodes.
4. Apply electrode gel to the blade electrodes.
5. Apply the external blades to the patient using the anterolateral placement.
   - Place the sternum blade on the upper right side of the patient's torso, next to the sternum and below the clavicle.
   - Place the vertex blade over the patient's left nipple, in the mid-axillary line, with the center of the electrode on said line.

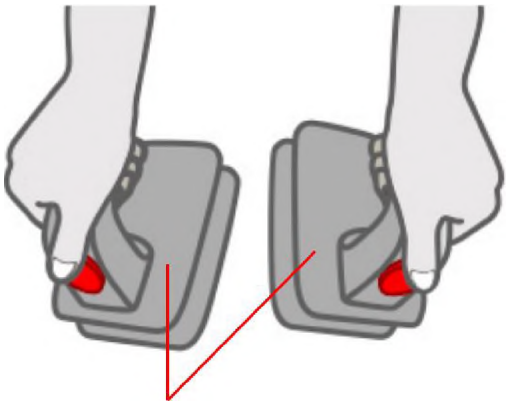


(1) Sternum blade (2) Vertex shovel

6. Check the patient category symbol in the patient information area. If necessary, select the patient category symbol and change the **Patient Category setting.**
7. The default energy level changes automatically depending on the patient category setting.
   - For adult patients, the recommended energy level for the first shock is 200 J.
   - For pediatric patients, the recommended energy level for the first shock is 50 J.
8. Select the energy level in one of the following ways:
   - Press the power select button on the device.
   - Press the Select energy button on the vertex palette.

- Select the Power Select key in the Manual Deactivation window. If selected and held down, You can make a quick selection.

9. Charge the equipment in one of the following ways:
   - Press the Select energy button on the vertex palette.
   - Press the device's **Charge** button.
   - Select **Load** in the manual defib window.
10. Wait for the device to charge to the desired energy level. The device will emit a charging tone and The progress bar changes.
    - If the selected energy level is not suitable for the patient, perform step 8 and the equipment will will automatically deactivate.
    - If changes in heart rate are detected and a download is not compatible, you can select **Deactivate** to stop the upload.
11. Press the Discharge buttons on the external blades simultaneously. If you do not press the Discharge buttons within the configured time period, the equipment will automatically shut down.



12. Perform CPR. If necessary, select **Start Timer** to activate the CPR countdown.

When **Power Series** is activated, the equipment manages a discharge at the predetermined power level.
After three shocks, the device manages subsequent shocks at the default energy level of **Energy** 3. The **Energy Series** activation setting and default energy levels can only be modified in configuration mode. For more information, see 22.7.2.1 Manual Shock Setting tab.

WARNING

- **Hold the shovel only by the insulating parts of the handles to avoid the risk of electric shock during charging or administering shocks.**

NOTE

- **For defibrillation with external paddles, the only placement is anterolateral.**
- **When using external blades, the Front Panel Unload button is disabled.**
- **For defibrillation of pediatric patients, you can use the default energy level or adjust it according to local medical protocols.**
- **For defibrillation of neonatal patients, set the energy level according to the patient's clinical condition. The energy level for a neonatal patient should be lower than the predetermined parameters.**

6.6 Internal defibrillation procedure

To perform internal defibrillation, follow this procedure:

1. Access the patient and ensure they are suitable for internal defibrillation.

2. Connect the therapy cable for the internal paddles to the device. For more information, see 4.2 Connecting the therapy cable.

3. Press the Select power button on the device to select the power.

4. Place the conductive surface of the paddle electrodes on the right atrium and ventricle left side of the patient.

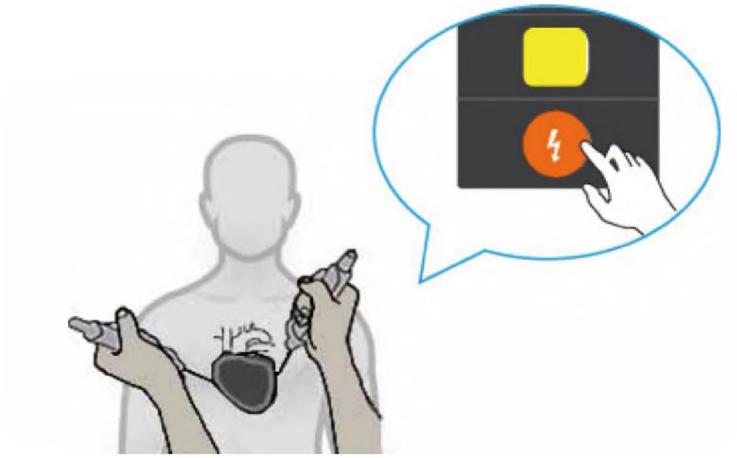
5. Charge the equipment in one of the following ways:

   • Press the device's **Charge** button.

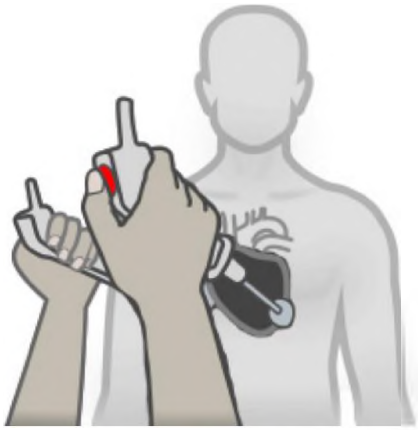
   • Select **Load** in the manual defib window.

6. Administer a shock to the patient.

   • For shovels without a button, press the Download button on the device.



   • For paddles with a button, press the Download button located on the right handle of the paddle.



NOTE

- **To avoid potential cardiac damage from higher energies, the energy selection for the Internal defibrillation is limited to 50 J.**
- **Clean and sterilize the internal blades after each use. Otherwise, there is a risk of serious infection.**

6.7 Synchronized cardioversion

Certain arrhythmias, such as atrial fibrillation, require synchronizing the defibrillation shock with the R wave of the ECG to avoid inducing ventricular fibrillation. When the Shock button (or buttons, if using paddles) is held down, the device delivers the shock with the next detected R wave.

With synchronized cardioversion activated, it is recommended to use ECG electrodes for ECG monitoring, as well as electrodes, external paddles, or internal paddles for shock delivery. Alternatively, you can use only the electrodes or external paddles for ECG monitoring and shock delivery.

If a remote patient monitor, such as a patient bedside monitor, is connected, the equipment provides remote synchronized cardioversion.

CAUTION

- **If you wish to use the internal paddles for synchronized cardioversion, the patient's ECG must be acquired via a standard ECG cable. The patient's ECG acquired through the internal paddles may not be reliable for synchronized cardioversion due to excessive noise or artifacts, which can cause errors during** R- wave detection.

6.7.1 Activation of synchronized cardioversion

To activate synchronized cardioversion, follow this procedure:

1. Access the manual defibrillator mode. For more information, see 6.3 Accessing the manual defibrillator mode. Manual.
2. Choose the appropriate mode according to the Remote Sync activation setting . **Remote Sync** is disabled by default. This setting can only be changed in setup mode.
   For more information, see 22.7.2.1 Manual defib adjustment tab.
   - If it is disabled, select **Enable sync ÿ Yes.**
   - If enabled, select **Enable sync ÿ Yes ÿ Local.**

If synchronized cardioversion is activated, the alarm system is automatically activated, the **SINCR** marker appears in the manual defibrillation information area, and a marker is displayed over each R wave.

The following image shows the manual defibrillation window with synchronized cardioversion activated.

(1) R wave marker (2) SYNC Marker

6.7.2 Synchronized cardioversion procedure

Synchronized cardioversion procedure: In this section, ECG electrodes are used for ECG monitoring, and external paddles are used for shock delivery.

To perform synchronized cardioversion, follow this procedure:

1. Access the patient and ensure they are a suitable candidate for synchronized cardioversion.
2. Connect the therapy cable to the device, and then connect the therapy cable and external paddles. For more information, see 4.2 Connecting the therapy cable and 4.4 Connecting the external paddles.
   For detailed information on connecting other accessories to administer the shock, see the corresponding description in 4 Therapy Preparation.
3. Prepare the patient's skin. For more information, see 4.7 Patient Preparation for the application of electrodes.

4. Apply the ECG electrodes to the patient. For more information, see 11.4.2 Application of the ECG electrodes.
5. Activate synchronized cardioversion. For more information, see 6.7.1 Activating the synchronized cardioversion.
6. Select a lead. The selected lead should have a clear signal and a QRS complex. broad.
7. Verify that the white R-wave marker appears over these waves. If it does not appear or does not match, R waves (for example, appear above T waves) select another lead.
8. Press the Energy Select button at the top to select the energy level. For detailed information on selecting the energy level with other accessories, see the corresponding descriptions in 6.5.2 Using the Electrodes for External Defibrillation and 6.6 Internal Defibrillation Procedure.
9. Press the Load button on the apex blade. For more information on loading the equipment with For other accessories, see the corresponding description in 6.5.2 Use of electrodes for external defibrillation and 6.6 Internal defibrillation procedure.
10. Press the Discharge buttons on the external paddles simultaneously. For detailed information on delivering the shock with other accessories, see the corresponding descriptions in 6.5.2 Using the electrodes for external defibrillation and 6.6 Internal defibrillation procedure.
11. Press and hold the Discharge buttons on both external paddles until the discharge is delivered.

NOTE

- **During synchronized cardioversion, the shock will be delivered when the device detects the next R wave. If using internal electrodes or paddles without a button, press and hold the Shock button on the device until the shock is delivered. If using external paddles, press and hold the Shock buttons on both external paddles until the shock is delivered. If using internal paddles with a button, press and hold the Shock button located on the handle of the right paddle until the shock is delivered.**

6.7.3 Remote synchronized cardioversion

To activate remote synchronized cardioversion, you must enable **Remote Sync. Remote Sync** is disabled by default. This setting can only be changed in setup mode. For more information, see section 22.7.2.1, Manual Defibrillation Adjustment tab.

To perform remote synchronized cardioversion, follow this procedure:

1. Connect one end of the synchronous defibrillation input cable to the multifunctional connector of the bedside monitor.
2. Connect the other end of the synchronous defibrillation input cable to the multifunctional connector of the equipment.
3. In the Manual Defib. window, select **Activate Sync,** and then **Remote** to access the Remote synchronized cardioversion. The indication **"Remote Sync"** is highlighted in a yellow box and displayed in the window.
4. Check if the square wave flashes with each R wave detected on the remote monitor, which indicates that a synchronization pulse is received on the equipment.

5. Perform synchronized cardioversion. For more information, see 6.7.2 Procedure for synchronized cardioversion.

NOTE

- **During remote synchronized cardioversion, the device will not display the ECG waveform. To view the patient's ECG, check the remote monitor.**
- **When using a remote monitor as the ECG source, a biomedical technician must verify that the remote monitor and equipment combination deliver a synchronized shock once 60 ms have elapsed after the peak of the next R wave is generated.**

6.7.4 Management of additional synchronized downloads

To manage additional synchronized downloads, choose the corresponding mode based on the **Sync after download** activation setting .

ÿ If activated, repeat steps 6 through 11 as described in 6.7.1 Activating Cardioversion synchronized.

ÿ If it is deactivated, reactivate synchronized cardioversion and repeat steps 5 through 11 as shown. described in 6.7.1 Activation of synchronized cardioversion.

Sync after download is disabled by default. This setting can only be changed in configuration mode. For more information, see 22.7.2.1 Manual defib setting tab.

6.7.5 Exiting synchronized cardioversion

To exit synchronized cardioversion, choose the corresponding mode based on the **Syncr activation setting after discharge.**

ÿ If enabled, select **Disable sync.**

ÿ If disabled, the device automatically exits synchronized cardioversion after delivering a shock.

Sync after download is disabled by default. This setting can only be changed in configuration mode. For more information, see 22.7.2.1 Manual defib setting tab.

6.8 Change manual defibrillation settings

The manual defibrillation setting can only be changed in setup mode. For more information, see section 22.7.2.1, Manual Defibrillation Setting tab.

7 CPR Assistance

7.1 Introduction to CPR Assistance

When performing CPR, the team can provide assistance with chest compressions.

7.2 Safety information for CPR assistance

WARNING

- **If possible, perform CPR on a firm surface. If CPR is performed on a patient lying on a mattress, a backboard should be used to limit the amount of compression the mattress absorbs. Depending on the characteristics of the mattress, backboard, and patient, the compression depth does not guarantee that the patient's chest will be compressed 50 mm.**

- **When the patient's respiratory rate is high or during high-frequency ventilation, CPR assistance may be affected by chest movements and may provide inaccurate information. In these conditions, you should count the compressions yourself and not rely on the compression rate provided by the CPR assistance.**

- **CPR assistance is not designed for use in a moving environment, such as by**
  For example, in an ambulance. If used during patient transport, CPR assistance may provide inaccurate information. If CPR needs to be performed in a moving environment, it should not be based on information provided by CPR assistance in such conditions.

NOTE

- **The CPR sensor is not available in the UK, Germany, and France.**

7.3 Access to CPR status

The equipment automatically switches to CPR mode under the following conditions:

y In AED mode, a non-shockable rhythm is detected and the indication **"Shock not recommended" is displayed.**

y In AED mode, a shock is delivered and heart rhythm analysis is stopped.

y In Manual Defibrillation mode, the CPR sensor is shaken and compressed.

The CPR status is maintained for 2 minutes by default. The **CPR time** setting can only be changed in setup mode. For more information, see 22.7.2.1 Manual Defibrillation Setting tab and 22.7.2.2 AED Setting tab.

7.4 Rhythm analysis during CPR

In AED mode, the device immediately analyzes the patient's heart rhythm once the CPR time has elapsed.

y If it is analyzed as a shockable rhythm and the **"Shock recommended"** indication is displayed , you should press the flashing Shock button on the device.

y If it is analyzed as a non-shockable rhythm and the indication **"Shock not recommended"** is displayed , it should Continue performing CPR.

y If it is analyzed as an indeterminate rhythm and the indication **"Do not touch patient analyzing..."** is displayed , you must wait for the analysis without performing any operation.

7.5 CPR Metronome

If the CPR metronome is on, the device will guide you with metronome sounds to perform chest compressions and ventilations at the AHA/ERC recommended rate. The default compression/ventilation ratio is 30:2.

The CPR metronome is enabled by default. The **CPR metronome** settings and the compression/ventilation rate can only be changed in setup mode. For more information, see 22.7.2.4 CPR Settings tab and 22.7.2.2 AED Settings tab.

WARNING

- **The sound of the CPR metronome does not provide any information about the patient's condition. Because the patient's condition can change rapidly, you must constantly assess it. Do not perform CPR on a patient who is responsive or breathing normally.**

NOTE

- **The CPR metronome settings are affected by the Voice Indication and Voice Volume settings in the AED Adjustment menu.**

7.6 CPR filter

Performing CPR introduces a CPR artifact into the ECG signal. If the CPR filter is enabled, the device automatically initiates filtering of the CPR artifact and provides an approximation of the patient's underlying ECG rhythm when it detects CPR compressions.

The CPR filter is enabled by default. The **CPR filter** activation setting can only be changed in configuration mode. For more information, see section 22.7.2.4, CPR Settings tab.

The electrodes or CPR sensor must be connected to the CPR filter. For more information, see 4.6 Connecting the CPR sensor, and the corresponding description of electrode connection in 5.5 AED Procedure and 6.5.2 Using the electrodes for external defibrillation.

The CPR filter automatically stops working under the following conditions:

ÿ Exits AED mode or Manual Defibrillation mode.

ÿ The patient's impedance is not valid.

ÿ The ECG electrodes fall off.

7.6.1 Visualization of the filtered ECG waveform

To visualize the filtered ECG waveform, follow this procedure:

1. Access the CPR status. For more information, see 7.3 Accessing the CPR status.
2. Select the shortcut key **Menu principal** ÿ in the **Display column,** select **Display settings.**
3. Select the **Tile Design tab.**
4. Select the desired parameter waveform area, and then select **CPR** ÿ **CPR Filter.**

7.6.2 Filtered ECG waveform consultation

When performing CPR, the original ECG waveform with CPR artifact is displayed on the first line, and the filtered ECG waveform is displayed in the area labeled **"Filter."** When the filtered ECG waveform is displayed, you cannot change the CPR filter activation, lead, or gain settings. However, you can change the lead settings (only in Manual Defibrillation mode) and the gain of the original ECG.

The device automatically initiates CPR artifact filtering upon detecting CPR compressions.

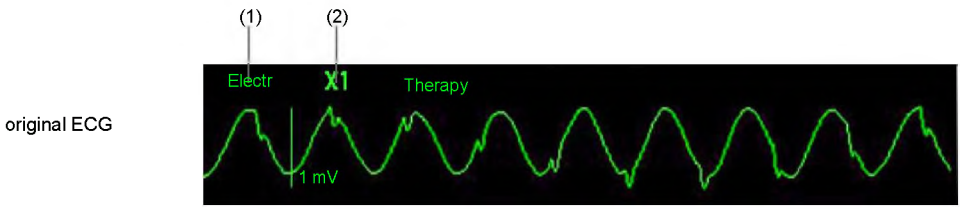
When the patient is connected to both the electrodes and the CPR sensor, the filtered waveform is displayed as follows:

ÿ In DEA mode, the filtered waveform is acquired through the electrodes.

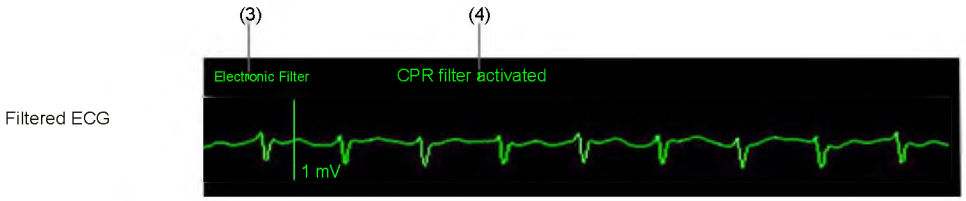
ÿ In Manual Defibrillation mode, if the ECG lead is set to **Electr,** the filtered waveform is acquired at through the electrodes.

y In Manual Defibrillation mode, if the ECG lead is set to monitoring lead (by
For example, I, II, III), the filtered waveform is acquired through the CPR sensor.

The following image shows the original waveform and the filtered ECG waveform in DEA mode.



(1) ECG lead label (2) ECG waveform gain



(3) CPR filter derivation (4) CPR filter

CAUTION

- **The CPR filter only works when CPR is performed with electrodes or with the CPR sensor.**
- **CPR compressions introduce CPR artifact into the ECG signal. The CPR filter is based on the correlation between CPR compressions and CPR artifacts in the ECG signal. The filtered ECG waveform should be used as a reference for the actual waveform. The CPR filter will not completely eliminate CPR artifact under some conditions. For example, in the case of asystole or low-amplitude pulseless electrical activity (PEA), the residual artifact after filtering resembles fine-grained ventricular fibrillation. You should always follow the standard procedure for discontinuing CPR to verify the patient's ECG rhythm before making treatment decisions.**

NOTE

- **There is a slight delay between the original and filtered ECG waves.**

7.7 CPR Information

When CPR compressions are detected, the equipment provides real-time CPR information.

y In the case of electrodes: the compression frequency and interruption time are provided.

y In the case of the CPR sensor: compression frequency, interruption time, compression bar graph, compression depth, and CPR compression fraction are provided.

The electrodes or CPR sensor must be connected to obtain CPR information. For more information, see 4.6 Connecting the CPR sensor, and the corresponding description of electrode connection in 5.5 AED Procedure and 6.5.2 Using the electrodes for external defibrillation.

7.7.1 Visualization of the bar chart and the numerical values of the compressions

When CPR is performed, the compression rate is displayed in the therapy window. When CPR is stopped, the interruption time is displayed in the therapy window.

If CPR is performed using a CPR sensor, in addition to the compression rate and pause time, you will be able to view a bar graph and numerical compression values in the waveform area and the parameter's numerical value area. To do this, follow this procedure:

1. Access the CPR status. For more information, see 7.3 Accessing the CPR status.
2. Select the shortcut key **Menu principal** ÿ in the **Display column,** select **Display settings.**
3. Select the **Tile Design tab.**
4. Select the desired parameter waveform area, and then select **CPR** ÿ **Sensor CPR.**

7.7.2 Visualization of the bar chart and the numerical values of the compressions

The following image shows the information provided when performing CPR with the CPR sensor.

(1) Compression bar chart: indicates the compression depth scale, the depth and retraction of each compression, and indicator messages.

• Compression depth scale: indicates that the depth range is adequate with a green background.

• Compression and retraction depth: the length of each bar indicates the depth of compression; the white part represents retraction.

• Indication message: provides instructions on current inadequate compression.

(2) Compression depth: Indicates the current compression depth.

• Green: indicates that the compression depth is good.

• Red: indicates that the compression depth is deficient.

(3) CPR compression fraction: indicates the percentage of compression time in the duration of CPR.

(4) CPR Panel: Indicates the current compression rate.

If the electrodes and CPR sensor are connected, the compression rate is obtained from the CPR sensor. When CPR is stopped, the interruption time is displayed.

• Green: indicates that the compression rate is good.

• Red: indicates that the compression frequency is deficient.

7.8 Monitoring the quality of CPR (CPR quality index)

The equipment configured with the Mindray SpO2 module provides the CPR quality indicator (CPR quality index).

When performing CPR with an SpO2 sensor, the CPR quality index is obtained and calculated based on the SpO2 sensor pulse signals and chest compressions. The CPR quality index values form a quality index trend.

The CPR quality index monitoring is designed to assess the effect of CPR on adult patients.

An SpO2 sensor must be connected to monitor the CPR quality index. For more information, see the corresponding description of SpO2 sensor connection in section 14.5, Preparation for SpO2 Monitoring.

WARNING

- **Monitoring of the CPR quality index is not indicated for pediatric patients and newborns.**
- **The results of the CPR quality index should not be used as the sole basis for the It is not intended to replace the judgment of a qualified healthcare professional. CPR quality index monitoring should be used in conjunction with the patient's medical history, the cause of the myocardial infarction, and clinical judgment.**

NOTE

- **The appropriate license is required to monitor the quality index of CPR.**

7.8.1 Limitations of monitoring the CPR quality index

CPR quality index monitoring is contraindicated in patients unsuitable for SpO2 monitoring. It should be used with caution in patients with the following conditions:

ÿ Defect at the fingertips

ÿ Dyes at the measurement point such as methylene blue, indigo carmine, nail polish, etc.

ÿ Arterial blood flow is too low to be measured due to vasoconstrictor drugs, to Raynaud's phenomenon, etc.

ÿ Severe anemia

ÿ High levels of carboxyhemoglobin (COHb) and methemoglobin (MetHb)

CAUTION

- **Use the recommended SpO2 sensor and place it in a suitable location.**
- **Avoid moving the measurement point.**
- **Apply the SpO2 sensor correctly. Failure to apply the sensor correctly or using an incorrect SpO2 sensor may result in incorrect CPR parameters and CPR quality indices. For more information, see section 14.3 Limitations of SpO2 Measurement.**

7.8.2 Visualization of trends and numerical values of the quality index CPR

When performing CPR, the compression rate is displayed in the therapy window. When CPR is stopped, the interruption time is displayed in the therapy window. In addition to the compression rate and interruption time, you can view trends and numerical values for the CPR quality index in the waveform area and the parameter numerical values area. To do this, follow this procedure:

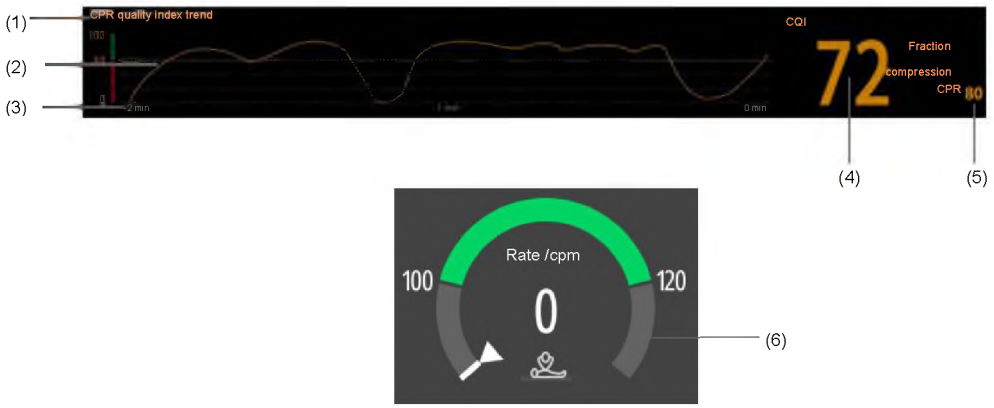
1. Access the CPR status. For more information, see 7.3 Accessing the CPR status.
2. Select the shortcut key **Menu principal** ÿ in the **Display column**, select **Display settings.**

3. Select the **Tile Design tab.**

4. Select the desired parameter waveform area, and then select **CCP** y **CQI.**

7.8.3 View trends and numerical values of the CPR quality index

The following image shows the trends and numerical values of the CPR quality index when the CPR quality index is monitored.



(1) CPR Quality Index Scale:

- >60: indicates that the patient's peripheral circulation and the quality of CPR are good.
- y60: indicates that the patient's peripheral circulation and the quality of CPR are not good.

(2) CPR quality index trend: Indicates the change in the value of the CPR quality index.

(3) Time of the CPR quality index trend: indicates the time period up to the moment
The device displays up to 30 minutes of the CPR quality index trend.

(4) CPR Quality Index value: indicates the quality of CPR. The higher the CPR Quality Index value, the better the patient's peripheral circulation and the quality of the CPR.

- Green: indicates that the patient's peripheral circulation and the quality of CPR are good.
- Yellow: indicates that the patient's peripheral circulation and the quality of CPR are normal.
- Red: indicates that the patient's peripheral circulation and the quality of CPR are not good.

(5) CPR compression fraction: indicates the percentage of compression time in the duration of CPR.

(46 CPR Panel: indicates the current compression rate.
If the electrodes and CPR sensor are connected, the compression rate is obtained from the CPR sensor. When CPR is stopped, the interruption time is displayed.

- Green: indicates that the compression rate is good.
- Red: indicates that the compression frequency is deficient.

7.9 Rescue summary consultation

During the rescue, real-time data can be stored. After it begins, the system provides a rescue summary with analysis and statistics from the last rescue.

To view the rescue summary, select **Rescue Summary** below the therapy window.

When the computer shuts down, a rescue summary event is automatically generated. You can view all saved rescue summary events when you restart the computer. For more information, see 18.7 Event Review.

If connected to the rescue summary statistics system, the equipment automatically loads the rescue summary included in the autocom report. For more information, see 21.10 Connecting to the rescue summary statistics system.

7.10 Loading CPR data

If you are using the CPR sensor independently, you can connect it to the device and upload the latest hour of data to the device. You can also review the CPR events uploaded from the CPR sensor on the device. For more information, see 18.7 Event Review.

7.11 Modifying CPR settings

REP settings can only be changed in configuration mode. For more information, see 22.7.2.4 CPR Settings tab.

7.12 Voice prompts for CPR

The following table compiles the voice prompts that can be given when performing CPR.

Voice prompt	Description
Deeper compression	If CPR is performed with electrodes or a CPR sensor, it indicates that the compression intensity should be adjusted.
Superficial compression	
Faster compression	If CPR is performed with a CPR sensor, it indicates that the compression rate should be adjusted.
Slower compression	
Incomplete retraction	If CPR is performed with a CPR sensor, it indicates that greater effort should be made and all pressure released when raising the hands.

This page has been intentionally left blank.

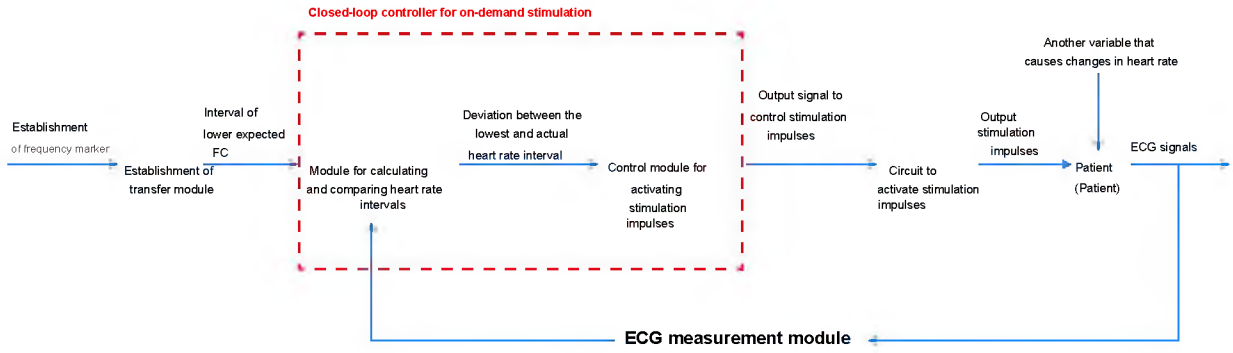
8 Non-invasive stimulation

8.1 Introduction to stimulation

Marcap mode offers non-invasive transcutaneous pacing therapy. In Marcap mode, ECG signals are acquired through ECG electrodes, and pacing impulses are delivered through the electrodes. The electrodes cannot be used to monitor ECG rhythm and deliver pacing impulses simultaneously.

Stimulation pulses can be delivered to the patient. Each time a stimulation pulse is delivered to the patient, a white stimulation marker appears on the ECG waveform. If stimulation is performed in Demand Mode, the white R-wave marker also appears on the ECG waveform until capture occurs.

In Demand Mode pacing, the pacemaker delivers a pulse only when needed. The Demand Pacemaker searches for intrinsic cardiac activity. If no heartbeat is detected within the designated interval, a pacing pulse is delivered. If an intrinsic heartbeat is detected, the Demand Pacemaker resets the timer and continues searching for intrinsic cardiac activity.



Closed-loop controller system

8.2 Stimulation safety information

WARNING

- **Heart rate and related alarms may be unreliable during pacing, so the patient should be closely monitored at all times. Neither the reported heart rate nor related alarms should be used as the sole basis for determining the patient's perfusion status.**
- **ECG monitoring alone is sometimes insufficient to determine whether the patient's cardiac output is adequate. A patient's response to pacing should be assessed by signs of improved cardiac output, such as a palpable pulse rate equal to the rate of delivered pacing impulses, an increase in blood pressure, or an improvement in skin color.**
- **To avoid a possible risk of electric shock, take special care when placing the electrodes.**
  in the patient during stimulation.
- **If you are using the battery-powered stimulation function and the "Low Battery" alarm is displayed, connect the device to an external power source or install a fully charged battery.**

CAUTION

- **Access to dial-up mode can be password protected. Make sure you know and remember the password.**
  Password. Otherwise, you will not be able to administer the stimulation therapy.

- **To treat patients with implanted devices, such as permanent pacemakers or**
  For defibrillators/cardioverters, consult a doctor and read the instructions for use supplied with the device.

- **Prolonged non-invasive stimulation can cause burns and irritation in the patient**
  Skin. Periodically inspect the skin and change the electrodes and ECG leads.

NOTE

- **If stimulation is interrupted for any reason, you must select Start Stim to restart the stimulation.**
- **In pacemaker mode, you cannot modify the patient's internal pacemaker status in the menu ECG.**
- **If the electrodes make poor contact with the patient, it may be possible**
  display the alarms "Anomalous stop marking" and "Electr desc".
- **Electrodes are not available as an ECG waveform source option in Marcap mode.**
- **In Marcap mode, arrhythmia analysis is supported and the available arrhythmia alarms are:**
  asystole, ventricular fibrillation, and ventricular tachycardia.
- **The monitoring or stimulation function may operate unstably in the presence of electrosurgical units or other electronic devices.**

8.3 Access to dial mode

To access dial-up mode, choose one of the following methods:

ÿ Select the shortcut key **Function Desfib/Marcap** ÿ select the **Marcap tab.**

ÿ In the **DEA window,** select the **Marcap tab.**

ÿ In the Manual Defibrillation window, select the **Markup tab.**

In marcap mode, the **Marcap** window is displayed and all parameters are monitored except for Resp.
The alarms are activated automatically.

8.4 Marcap Window Display

The following image shows the **Marcap window.**

(1) Dial mode

(2) Frequency marking

(3) Operating mode

(4) Indication message

(5) Exit brand

8.5 Selecting the dial mode setting

Two settings are available for the marcap mode: on-demand stimulation and fixed-mode stimulation.

ÿ In demand pacing, the pacemaker only delivers pacing impulses when the
The patient's heart rate is lower than the selected pacemaker rate.

ÿ In fixed-mode pacing, the pacemaker delivers pacing pulses at the frequency
selected.

You can change the stimulation mode setting during stimulation. Changing the stimulation mode setting does not stop stimulation; the device continues to deliver stimulation pulses at the selected pacemaker rate and output.

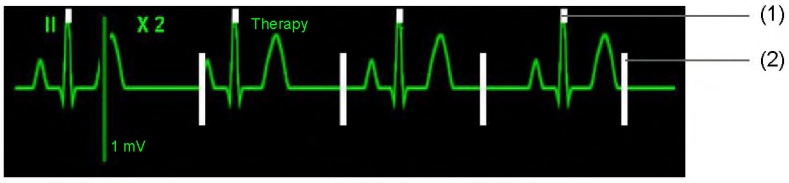
NOTE

- **Use demand pacing whenever possible. Use fixed pacing only when interference makes the R wave unreliable or when ECG electrodes are unavailable.**

8.5.1 Stimulation procedure in demand mode

To perform stimulation in on-demand mode, follow this procedure:

1. Access the patient and ensure that they are compatible with the on-demand stimulation mode.
2. Connect the therapy cable to the device, and then connect the therapy cable and electrodes. For more information, see 4.2 Connecting the therapy cable and 4.3 Connecting the multifunction electrodes.
3. Prepare the patient's skin. For more information, see 4.7 Patient Preparation for the application of electrodes.
4. Apply the ECG electrodes to the patient. For more information, see 11.4.2 Application of the ECG electrodes.
5. Access Marcap mode and select **Config mode** in the **Marcap window.**
6. Select a lead with an easily detectable R wave.
7. Verify that the white R-wave marker appears over these waves. If it does not appear or does not match, R waves (for example, appear above T waves) select another lead.
8. If necessary, change the **dial frequency** and **dial output settings.**
9. Select **Start Stim** to begin stimulation. The **"Stimulation" indicator will be displayed.**
10. Verify that the white stimulation markers appear on the ECG waveform.



(1) R wave marker (2) Stimulation marker

11. Adjust the pacemaker output until cardiac capture occurs (which will be indicated by a QRS complex after each stimulation marker) and then reduce the output to the minimum level that still maintains capture.
12. Press and hold **4:1** to temporarily stop stimulation.
13. Take the pulse in the patient's femoral, right brachial, or radial artery and check for a peripheral pulse. When you release **4:1,** you can resume pacing.
14. Select **Stop Stim** to stop stimulation.

If you stop stimulation and select **Start stimulation,** stimulation can be resumed.

CAUTION

- **Check the patient's cardiac output often.**

NOTE

- **Stimulation will not start if there is a problem with the electrode cable connection, patient electrode connection or ECG monitoring electrode connection. If either of these connection problems occurs, a message will appear in the pacemaker information area indicating that a lead is disconnected or the electrode connection is improper.**

8.5.2 Stimulation procedure in fixed mode

To perform stimulation in fixed mode, follow this procedure:

1. Access the patient and ensure that it is compatible with the fixed stimulation mode.
2. Connect the therapy cable to the device, and then connect the therapy cable and electrodes. For more information, see 4.2 Connecting the therapy cable and 4.3 Connecting the multifunction electrodes.
3. Prepare the patient's skin. For more information, see 4.7 Patient Preparation for the application of electrodes.
4. Apply the ECG electrodes to the patient. For more information, see 11.4.2 Application of the ECG electrodes.
5. Access Marcap mode and select **Fixed Mode** in the **Marcap window.**
6. Select a lead.
7. Change the **dial frequency** and **dial output** settings .
8. Select **Start Stim** to begin stimulation. The **"Stimulation" indicator will be displayed.**
9. Verify that the white stimulation markers appear on the ECG waveform.

(1) Stimulation marker

10. Adjust the pacemaker output until cardiac capture occurs (which will be indicated by a QRS complex after each stimulation marker) and then reduce the output to the minimum level that still maintains capture.
11. Press and hold **4:1** to temporarily stop stimulation.
12. Take the pulse in the patient's femoral, right brachial, or radial artery and check for a peripheral pulse. When you release **4:1,** you can resume pacing.
13. Select **Stop Stim** to stop stimulation.

If you stop stimulation and select **Start stimulation,** stimulation can be resumed.

NOTE

- **In fixed-mode pacing, R-wave markers do not appear in the heartbeats of pacemaker.**

8.6 Modification of Stimulation settings

Stimulation settings can only be changed in configuration mode. For more information, see section 22.7.2.3, Markup Adjustment tab.

Part III: Monitoring Functions

9. Monitoring Preparation

9.1 Start of patient monitoring

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

1. Access Monitor mode in any of the following ways:
   - If **Default Boot Mode** is set to **Monitor,** the computer enters
     It automatically enters Monitor mode after power-up. The **Default Startup Mode** setting
     can only be changed in Setup mode. For more information, see 22.7.1 General Setup Menu.
   - In any of the therapy windows, select .
2. Edit the current patient information.
3. Check that the patient settings, alarm limits, patient category, MARC status, etc., are appropriate for your patient.
4. Change the parameter settings if necessary.
5. Take the necessary measurements. For more information, see the relevant chapter.
   on parameter measurements.

9.2 Definition of the monitoring screen

9.2.1 Screen selection

To choose a screen, follow this procedure:

1. Access the screen option in any of the following ways:
   - Select the Switch View shortcut key .
   - Select the shortcut key **Menu principal** ÿ in the **Display column,** select **Display settings.**
2. Select the desired screen.
   - **Normal screen:** This is the one most frequently used for patient monitoring.
   - **Large numbers:** Displays the numerical values of the parameters with a large font size.

9.2.2 Setting up the activation of a parameter

You can manually enable or disable a parameter. When a parameter is disabled, the device stops data acquisition and alarms for that measurement.

To configure the activation of a parameter, follow this procedure:

1. Select the shortcut key **Menu principal** ÿ in the **Display column,** select **Display settings.**
2. Select the **Activate/Deactivate Parameter tab.**
3. Configure the activation of the desired parameter.

NOTE

- **If you manually disable a parameter, you will not be able to monitor that parameter even if the related accessories are connected.**

9.2.3 Definition of normal screen display

You can configure the numerical values and waveforms of the parameters, as well as the order in which they are displayed on the normal screen.

To define the normal screen display, follow this procedure:

1. Select the shortcut key **Menu principal** ÿ in the **Display column,** select **Display settings.**
2. Select the **Tile Design tab.**
3. Select the numeric value area or the waveform area for a parameter, and then select the desired item from the drop-down list. Parameters and waveforms that are not selected will not appear on the screen.

NOTE

- **The numerical values and the ECG waveform are always displayed on the first line of the numerical values area and the parameter waveform area.**

9.2.4 Definition of a large number display

To define the large number display, follow this procedure:

1. Select the shortcut key **Menu principal** ÿ in the **Display column,** select **Display settings.**
2. Select the **Large Numbers tab.**
3. Select the numeric value area or the waveform area of a parameter, and then, from the drop-down list, select the desired item.

9.2.5 Displaying the parameter list

You can view trends in HR, SpO2, RR, and NIBP in the numerical parameter values area.

To display the parameter list, follow this procedure:

1. Select the shortcut key **Menu principal** ÿ in the **Display column,** select **Display settings.**
2. Select the **Tile Design tab.**
3. Select the numeric value area of the desired parameter, and then select **List parameters** in the drop-down list.

9.2.6 Modification of measurement colors

You can define the color you want to use for the values and waveforms of each parameter's measurements. These settings can only be changed in configuration mode. For more information, see section 22.7.4.1, General Settings tab.

9.3 Wave freezing parameters

In Monitor mode, you can freeze the waveforms displayed on the screen to understand the patient's condition. Additionally, you can select any frozen waveform to print it.

9.3.1 Freezing of waves

To freeze waveforms, select the **Freeze** hotkey in Monitor mode. All displayed waveforms will stop updating and scrolling when you select the **Freeze hotkey.** All numerical parameter values will be updated.

9.3.2 Frozen wave visualization

To view the frozen waves, select < - > in the **Freeze** window .

In the bottom right corner of the lowest waveform, the freeze time is displayed. The freeze time is set to "0.0 s". As the waves scroll, the freeze time changes in one-second increments. For example, -2 s means two seconds before the freeze time. This adjustment applies to all waves displayed on the screen.

NOTE

• **You can view frozen waves of up to 120 seconds.**

9.3.3 Continuation of waves

To defrost frozen waves, select ✕ in the Freeze window .

9.3.4 Frozen wave print

To print the frozen waves, select in the Freeze window .

9.4 Stopping the monitoring of a parameter

To stop monitoring a parameter, follow this procedure:

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

This page has been intentionally left blank.

10 Alarms

10.1 Introduction to alarms

10.1.1 Alarm Categories

The equipment provides two types of alarms: physiological alarms and technical alarms.

ÿ Physiological alarms are activated when patient measurements exceed parameter limits or when abnormal conditions are detected in the patient.

ÿ Technical alarms are triggered when an electrical, mechanical, or other type of failure occurs in the equipment, or if a sensor or component malfunctions. Technical alarms can also be displayed when an algorithm is unable to classify or interpret the available data.

- System technical alarms: technical alarms related to the main control system, patient monitoring and stimulation.
- Special technical alarms: technical alarms that occur when a critical failure happens. These alarms They require special attention and must be resolved immediately. For more information, see D.2.12 Special Technical Alarm Messages.

In addition to physiological and technical alarms, the equipment can also display some messages with information about the status of the system or the patient.

10.1.2 Alarm priority levels

Based on their severity, alarms are classified with the following priority levels:

ÿ High priority alarms: indicate a life-threatening situation or a serious device malfunction. High priority alarms require an immediate response.

ÿ Medium priority alarms: These indicate abnormal vital signs or a device malfunction. Medium priority alarms require a rapid response.

ÿ Low priority alarms: indicate a nuisance situation, a device malfunction, or a Improper functioning. Low priority alarms require confirmation that the situation is known.

ÿ Direction messages: provide additional information about the patient or equipment.

10.1.3 Alarm indications

When an alarm is triggered, the equipment alerts the user through visual or audible alarm indications.

Detailed instructions are included in the following table.

Alarm indication	High priority alarm	average	Low priority alarm	Warning message
Alarm light	Red, with a blink frequency of 1.4 to 2.8 Hz, duty cycle of 20 to 60%	Yellow, with a flicker frequency of 0.4 to 0.8 Hz, duty cycle of 20 to 60%	Yellow, non-flickering, 100% work ratio	None

Alarm indication		High priority alarm	average	Low priority alarm	Warning message
Pattern of audible tone	Special alarm sound	High-pitched single beep repeating pattern	None	None	None
	ISO	Repeating pattern of triple + double + triple + double beep	Triple beep repeat pattern	Single beep repeat pattern	None
	ISO2	Repeating pattern of triple + double + triple + double beep	Triple beep repeat pattern	Single beep repeat pattern	None
Alarm message		White text inside a red box	Black text inside a yellow box	Black text inside a yellow box	White text
Alarm priority		!!!	!!	!	None
Numerical value of the parameter		White text inside a flashing red box	Black text inside a flashing yellow box	Black text inside a flashing yellow box	None

NOTE

- **When several alarms of different priority levels are activated simultaneously, the equipment selects the highest priority alarm to turn on the indicator light and activate the tone corresponding to that alarm.**
- **When several alarms of different priority levels are triggered simultaneously and must**
  When displayed in the same area, the device only shows the highest priority alarm messages.
- **When several physiological alarms of different priority levels are activated simultaneously and these must be displayed in the same area, the equipment displays the high priority alarm, while the medium and low priority alarms are displayed cyclically.**
- **When several alarms of the same priority level are activated simultaneously, all the**
  Alarm messages are displayed cyclically.
- **The alarms for life-threatening arrhythmia, apnea, and SpO2 desaturation are exclusive high-priority alarms.**
  When these alarms are triggered, the device only displays messages from the exclusive alarms. Other high-priority alarms will not be displayed. When multiple exclusive alarms are triggered simultaneously, the alarm messages are displayed cyclically.

10.1.4 State of alarm symbols

Except for the alarm indications described in 10.1.3 Alarm indications, the following symbols in the alarm status area indicate the alarm status:

Pause of the alarm:	It indicates that all alarms are paused.
Alarm deactivated:	This indicates that individual measurement alarms are disabled or that the system is in the disabled alarm state.
Sound pause:	This indicates that audible alarm tones are paused.
Audio deactivated:	It indicates that audible alarm tones have been deactivated.
Reset alarm signal:	indicates that the alarm system has been reset.

10.2 Alarm security information

WARNING

- **Using different alarm presets and configuration presets on the same or similar equipment in the same area (e.g., an intensive care unit or a cardiology operating room) can be dangerous.**

- **The equipment located in the care area may have different alarm settings to adapt to the patient. Before starting monitoring, check that the alarm settings are appropriate for the patient. Always verify that the necessary alarm limits are active and configured according to the patient's clinical condition.**
- **If the alarm limits are set to extreme values, the alarm system may not be effective. For example, high oxygen levels can be a trigger for retrolental fibroplasia in premature infants. Setting the SpO2 alarm upper limit to 100% is equivalent to disabling the SpO2 alarm.**

- **When the alarm sound is deactivated, the device will not emit any alarm tone, nor** even when a new alarm occurs. Therefore, the activation or deactivation of the alarm sound should be carefully considered. When the alarms are deactivated or the sound of

  If the alarm is paused, either temporarily or indefinitely, observe the patient frequently.
- **During the monitoring of patients who are not continuously attended by an operator Clinically, configure the alarm system correctly and set the alarm settings according to the patient's condition.**
- **Do not rely solely on audible alarms for patient monitoring. Setting the alarm volume low or turning off the alarm sound can pose a risk to the patient. Always check that the alarm volume is appropriate for your clinical environment. Monitor the patient closely and continuously.**

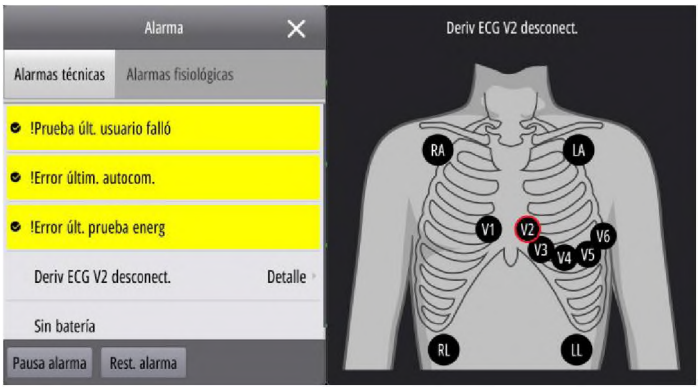
NOTE

- **In the event of a temporary power failure, the equipment will save the alarms that were triggered before the failure. The information in the saved alarms will not change after the power failure.**

10.3 Alarm Display

If **"..."** is displayed in the alarm information area , there is more than one alarm active at the same time. You can view the alarms in the alarm list. To do this, follow these steps:

1. Select the alarm information area to access the **Alarms window.**
2. Select the tab for the desired alarm category.
3. Select the desired alarm from the alarm list. Alarm messages followed by **"Details"** include help messages or images to help you identify the problem.



10.4 Modifying alarm settings

10.4.1 Start of automatic alarm limits

The device includes an automatic alarm limit function to automatically adjust alarm limits based on the patient's vital signs. When the automatic limits function is activated, the device automatically calculates safe limits based on the most recent measured values. To obtain accurate automatic alarm limits, you must collect a set of measured vital signs as a baseline.

To initiate automatic alarm limits, follow this procedure:

1. Select the shortcut key **Menu main** ÿ in the Alarm column select **Limits.**
2. Select **Limit. auto** at the bottom.
3. Select **Ok.**

The device will automatically calculate alarm limits based on the latest measured values. Before applying these automatically generated alarm limits, confirm they are appropriate for the patient in the Alarm Limits settings menu. Otherwise, you can adjust them manually. These alarm limits will remain unchanged until you re-select the automatic limits or adjust them manually.

The system calculates automatic limits according to the following rules:

Module	Parameter Patient Category		Lower limit	Upper limit	Automatic limit interval
ECG	HR/FP (ppm)	Adults	FC × 0.8 or 40 (the higher value)	FC × .25 or 240 (the lower value)	From 35 to 240
		Children	FC × 0.8 or 40 (the higher value)	FC × .25 or 240 (the lower value)	From 35 to 240
		Newborn	(FC – 30) or 90 (the higher value)	(FC + 40) or 200 (the lower value)	From 55 to 225
Resp	FR (rpm)	Adults	FR × 0.5 or 6 (whichever is higher)	(FR × 1.5) or 30 (whichever is lower)	From 6 to 55
		Children	FR × 0.5 or 6 (whichever is higher)	(FR × 1.5) or 30 (whichever is lower)	From 6 to 55
		Newborn	(FR × 10) or 30 (the higher value)	(FR + 25) or 85 (the lower value)	From 10 to 90
SpO2	SpO2 (%)	All	The same as the default alarm limit	The same as the default alarm limit	The same as the measurement interval
PANI	PANI-S (mmHg)	Adults	(SIS × 0.68 + 10)	(SIS × 0.86 + 38)	From 45 to 270
		Children	(SIS × 0.68 + 10)	(SIS × 0.86 + 38)	From 45 to 185
		Newborn	(SIS - 15) or 45 (whichever is higher)	(SIS + 15) or 105 (the lower value)	From 35 to 115
	PANI-D (mmHg)	Adults	(Day × 0.68 + 6)	(Day × 0.86 + 32)	From 25 to 225
		Children	(Day × 0.68 + 6)	(Day × 0.86 + 32)	From 25 to 150
		Newborn	(Day – 15) or 20 (the higher value)	(Day + 15) or 80 (the lower value)	From 20 to 90
	PANI-M (mmHg)	Adults	(Mean × 0.68 + 8)	(Mean × 0.86 + 35)	From 30 to 245
		Children	(Mean × 0.68 + 8)	(Mean × 0.86 + 35)	From 30 to 180
		Newborn	(Average – 15) or 35 (the higher value)	(Mean + 15 or 95) (the lower value)	from 25 to 105

Module Parameter	Patient Category	Lower limit	Upper limit	Automatic limit interval
CO2	EtCO2 (mmHg)	All	From 0 to 32: remains the same From 33 to 35: 29 From 36 to 45: (EtCO2 - 6) From 46 to 48: 39 >48: remains the same	From 0 to 32: remains the same From 33 to 35: 41 From 36 to 45: (EtCO2 + 6) From 46 to 48: 51 >48: remains the same	The same as the measurement interval
	FiCO2	All	None	The same as the default alarm limit	The same as the measurement interval
	FRVa (rpm)	Adults	FRVa × 0.5 or 6 (the higher value)	FRVa × 1.5 or 30 (the lower value)	From 6 to 55
		Children			From 6 to 55
		Newborn			From 10 to 90

10.4.2 Configuring the properties of parameter alarms

To configure the parameter alarm properties, follow this procedure:

1. Select the shortcut key **Menu main** ȳ in the **Alarm** column select **Limits.**
2. Select a parameter tab and set the alarm properties as desired.

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

10.4.3 Restoring the default alarm settings

To reset all alarm settings to their default values, follow this procedure:

1. Select the shortcut key **Menu main** ȳ in the **Alarm** column select **Limits.**
2. Select **Default** at the bottom.

10.4.4 Adjusting the properties of alarm tones

10.4.4.1 Alarm Volume Modification

To change the volume of the alarms, follow this procedure:

1. Select the shortcut key **Menu principal** ȳ in the **Alarm** column select **Set.**
2. Set the **alarm volume.** The optional alarm volume is between X and 10, where X is the minimum volume, depending on the minimum alarm volume setting, and 10 is the maximum volume.
3. Set the **Vol. al. prior. alta.**
4. Set the **alert volume.**

NOTE

- **When Alarm Volume is set to 0, the alarm sound is turned off and**  **it is shown in the area of state of alarm.**
- **You cannot set the volume of high priority alarms if Alarm Volume is set to 0.**

10.4.4.2 Password-protected audible alarm settings

The following alarm settings are password protected:

ȳ Minimum alarm volume

ȳ Sound pattern icons

ȳ Alarm interval

ÿ Sound increase and alarm delay switch

These settings can only be changed in setup mode. For more information, see section 22.7.3 Alarm Settings Menu.

10.4.4.3 Activation of the special alarm sound

To activate the special alarm sound, set **Alarm Sound** to **ISO2.** The **Alarm Sound** activation setting can only be changed in setup mode. For more information, see section 22.7.3 Alarm Settings Menu.

When any of the following alarms are triggered, the equipment emits a special alarm sound to indicate that the patient's condition may be critical.

y Lethal arrhythmias, including Asystole, Ventricular Fibr./Ventr. Tachy., Ventricular Tachy., Ventricular Bradycardia, Extreme Tachy. and Bradycardia extreme

ÿ SpO2 Desatr.

ÿ Apnea

10.4.5 Adjusting the alarm delay time

For continuously measured parameters, a delay time for the alarm can be set. If the alarm situation is resolved within the delay time, the device will not sound an alarm. The **Alarm Delay** setting can only be changed in configuration mode. For more information, see section 22.7.3, Alarm Settings Menu.

The **Alarm Delay** setting does not apply to apnea alarms or ST alarms. You can configure **Apnea Delay** and **ST Alarm Delay** separately. The **ST Alarm Delay** setting can only be changed in configuration mode. For more information, see section 22.7.3 Alarm Settings Menu.

To adjust the apnea delay time, follow this procedure:

1. Select the shortcut key **Menu principal** ÿ in the **Alarm column,** select **Set.**
2. Select **Apnea Delay** to adjust the apnea alarm delay time.

WARNING

- **The alarm delay time can be set to a maximum of 15 seconds. Changing this setting to an inappropriate level may endanger the patient.**

10.4.6 Alarm Activation Setting Desat. SpO2 desac

You can choose whether to allow the SpO2 Desat Alarm to be deactivated. The **SpO2 Desat Alarm** setting is disabled. This can only be changed in setup mode. For more information, see section 22.7.3 Alarm Settings Menu.

WARNING

- **If you disable the SpO2 Desat alarm, the device will not indicate any alarm when the SpO2 value The patient's blood pressure may be extremely low. This could pose a danger to the patient. Monitor the patient closely and continuously.**

10.4.7 Apnea Alarm Activation Setting

You can choose whether to allow the apnea alarm to be disabled. The **Apnea Alarm Off** setting can only be changed in setup mode. For more information, see section 22.7.3 Alarm Settings Menu.

WARNING

- **If you disable the apnea alarm, the device will not sound an apnea alarm if an apnea occurs. This can be dangerous for the patient. The patient must be closely monitored.**

10.4.8 Adjustment of the length of the printed waves

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

1. Select the shortcut key **Menu principal** ÿ in the **Alarm column,** select **Set.**
2. Set **Print Duration.**

10.5 Alarm Pause

10.5.1 Definition of the Paus alarm function

If the pause function is set to pause alarms, selecting **"Pause Alarm"** from the alarm list will temporarily disable the alarm indicators. The **pause** setting can only be changed in setup mode. For more information, see section 22.7.3, "Alarm Settings Menu."

When alarms are paused, the following rules apply:

ÿ No physiological alarm is present.

ÿ Except for special technical alarms, the sounds of other technical alarms are paused, but the Lights and alarm messages continue to be displayed.

ÿ The remaining alarm pause time is displayed in the alarm information area.

ÿ  It is displayed in the state of alarm area.

Once the alarm pause time has elapsed, the paused state is automatically deactivated. You can also cancel the alarm pause state by selecting **"Pause Alarm"** in the alarm list.

WARNING

- **Pausing alarms can pose a danger to the patient.**

10.5.2 Password-protected alarm pause settings

The following Paus alarm settings are password protected.

ÿ Alarm pause time

ÿ Priority alarm pauses

These settings can only be changed in setup mode. For more information, see section 22.7.3 Alarm Settings Menu.

NOTE

- **Extending the alarm pause time does not affect the alarm pause time setting.**

10.6 Deactivation of all alarms

If the pause function is set to pause alarms and the **pause time** is set to **Permanent,** selecting **Pause Alarm** from the alarm list will permanently disable all alarms. The **Pause** and **pause time** settings can only be changed in setup mode. For more information, see section 22.7.3 Alarm Settings Menu.

When the alarms are deactivated, the following rules apply:

ÿ The physiological alarms are deactivated. The alarm light does not flash and the alarm tone does not sound.

ÿ Except for special technical alarms, the sounds of other technical alarms are deactivated, but the lights
They blink and the alarm messages continue to be displayed.

ÿ The message **"Alarm desac."** with a red background is displayed in the alarm information area.

ÿ  It is displayed in the state of alarm area.

To exit Alarm desac state, reselect **Alarm Pause** from the alarm list.

WARNING

• Deactivating the alarms can be dangerous for the patient.

10.7 Pause of alarm sounds

10.7.1 Definition of the alarm sound pause function

If the pause function is set to **Audio Pause,** selecting **Audio Pause** from the alarm list will pause the alarm tones. When alarm tones are paused, the following rules apply:

ÿ The sound of all physiological alarms is deactivated.

ÿ Except for special technical alarms, the sounds of other technical alarms are deactivated.

ÿ The remaining audio pause time is displayed in the alarm information area.

ÿ  It is displayed in the state of alarm area.

Once the audio pause time has elapsed, the audio pause state is automatically deactivated.
You can also cancel the audio pause state by selecting **Audio Pause** in the alarm list.

WARNING

• Pausing alarm sounds can pose a danger to the patient.

10.7.2 Pause settings for password-protected alarm sounds

The following alarm sound pause settings are password protected.

ÿ Time to pause the alarm tone

ÿ Priority alarm pauses

These settings can only be changed in setup mode. For more information, see section 22.7.3 Alarm Settings Menu.

10.8 Deactivating alarm sounds

If the pause function is set to **Audio Pause,** and **Pause Time** is set to **Permanent,** selecting **Audio Pause** will permanently mute all alarm sounds. The **Pause** and **Pause Time** settings can only be changed in setup mode. For more information, see section 22.7.3 Alarm Settings Menu.

When alarm sounds are deactivated, the following rules apply:

ÿ The sound of all physiological alarms is deactivated.

ÿ Except for special technical alarms, the sounds of other technical alarms are deactivated.

ÿ The message **"Alarm desac."** with a red background is displayed in the alarm information area.

ÿ  It is shown in the sound symbol area.

To exit the Audio Off state, reselect **Audio Pause** from the alarm list.

WARNING

• **Turning off the alarm sounds can be dangerous for the patient.**

10.9 Alarm Reset

Selecting **"Reset Alarm"** from the alarm list will reset the alarm system. When the alarm system is reset,  It is displayed in the state of alarm area.

NOTE

• **If a new alarm is triggered after the alarm system has been reset,**  **will disappear, the Alarm light indicators, alarm tone, and alarm messages will be reactivated.**

10.9.1 Resetting physiological alarms

Physiological alarms use other alarm indicators when the alarm system is reset:

ÿ The alarm sound is silenced.

ÿ The ÿ symbol appears before the alarm message.

ÿ The background color of a numeric parameter value corresponds to the alarm priority, but the The numeric parameter does not blink.

10.9.2 Resetting technical alarms

Technical alarms use other alarm indications when the alarm system is reset:

ÿ Some technical alarms have disappeared. The equipment is not displaying any alarm indications.

ÿ Some technical alarms have been replaced with warning messages.

ÿ Except for some special technical alarms, all other technical alarms are silenced and a ÿ appears before the alarm message.

For detailed information on the indications of technical alarms when the alarm system, see D.2 Technical alarm messages.

10.10 Alarms with lock

The physiological alarm lock setting defines the behavior of the alarm indicators if the alarms are not reset.

ÿ If you do not "block" the physiological alarms, the corresponding alarm indications will disappear when the state of emergency ends.

ÿ If you "block" the physiological alarms, all visual and audible alarm indications will remain until you reset the alarms. On alarms with a lock, the time the alarm was last activated is displayed behind the alarm message.

You can block the visual prompts separately or block both the visual and audible prompts simultaneously.

ÿ When visual indicators are blocked, these visual indicators, including the alarm light, the alarm message and its background, remain when the alarm situation ends.
Additionally, the time the alarm was last activated appears behind the alarm message.

ÿ When the audible indicators are blocked, the equipment emits alarm sounds when the state of alarm.

Alarm lock settings can only be changed in setup mode. For more information, see section 22.7.3 Alarm Settings Menu.

NOTE

Changing **an alarm's priority can affect its lock status. If you change an alarm's priority, determine whether you need to reset its lock status.**

- **When the alarm system is reset, the blocked physiological alarms are cleared.**

10.11 Alarm Check

The unit automatically performs a self-check at startup. Check that an alarm tone is heard, the alarm light illuminates red, then turns yellow, and then goes out. This indicates that the visual and audible alarm indicators are functioning correctly.

10.12 Actions in case of alarm activation

When an alarm is triggered, follow these steps and take appropriate action:

1. Check the patient's condition.
2. Confirm the alarm parameter or alarm category.
3. Identify the cause of the alarm.
4. Take the appropriate actions to eliminate the alarm situation.
5. Check that the alarm situation has been corrected.

For more information, see D Alarm Messages.

11 ECG Monitoring

11.1 Introduction to ECG

The electrocardiogram (ECG) measures and records the electrical activity of the heart. The equipment provides ECG monitoring via ECG electrodes (3-lead, 5-lead, 12-lead), external electrodes or paddles, and also provides arrhythmia analysis, ST segment analysis, and QT/QTc measurements.

ECG monitoring is designed for adult and pediatric patients.

11.2 ECG Safety Information

WARNING

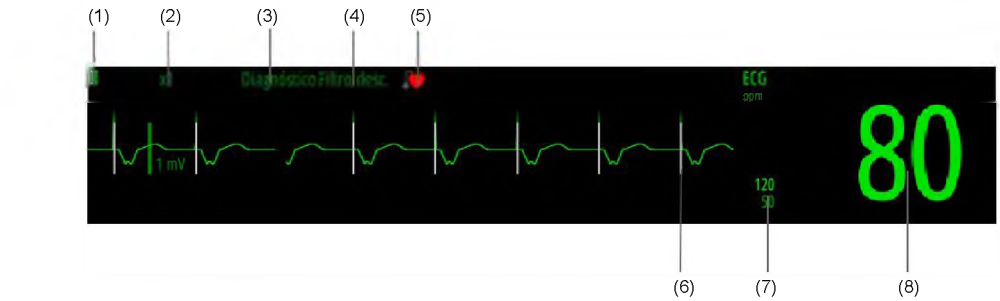
- **The ECG monitoring provided by this device is not intended for your application direct cardiac output.**
- **Ensure that the conductive parts of the electrodes and associated connectors, including the neutral electrode, do not come into contact with any other conductive parts, including the ground connection.**
- **Use defibrillator-resistant ECG leads during defibrillation.**
- **Do not touch the patient or other metallic devices connected to the patient during the defibrillation.**
- **To reduce the risk of burns during high-frequency surgical procedures, Make sure that the cables and transducers connected to the equipment never come into contact with the electrosurgical unit (ESU).**
- **To reduce the risk of burns during the use of the high-frequency surgical unit (ESU), the EEG electrodes should not be placed between the surgical area and the ESU return electrode.**

CAUTION

- **Periodically inspect the electrode application area to check skin integrity. If skin quality changes, replace the electrodes or change the application site.**
- **Interference from ungrounded instruments near the patient and interference from electrosurgery can produce noise and artifacts in the waveform.**
- **If the selected lead cannot provide valid ECG signals, a dash will be displayed in the ECG waveform area.**

11.3 ECG display

The following images show the waves and numerical data areas of the ECG.



(1) ECG lead label

(2) ECG waveform gain

(3) ECG filter mode

(4) Notch filter status

(5) Pacemaker status: If the **With pacemaker** option has been set to **Yes,** it will show  .

If the " **With marker"** option has been set to **"No",** it will be displayed  .

(6) Pacemaker pulse marker: If the **With marker** option is set to **Yes,** pacemaker pulse markers "|" are displayed in relation to the pacemaker pulse detected on each ECG waveform.

(7) HR alarm limits

(8) FC Value

NOTE

- **The numerical data area and the ECG waveform area are configured to be different depending on the different lead types and ECG settings.**

11.4 Preparation for ECG monitoring

You can use ECG electrodes, electrodes, or external paddles for ECG monitoring. This section only describes ECG monitoring using ECG electrodes. For detailed information about the

For preparation with electrodes and external paddles, see 4 Therapy Preparation.

NOTE

- **External paddles are not recommended for ECG monitoring.**

11.4.1 Patient preparation for electrode application

The skin must be properly prepared to ensure that the electrode area receives a good quality signal, as the skin is not a good conductor of electricity.

To properly prepare the skin, follow this procedure:

1. Shave the hair from the areas of skin where the electrodes will be placed.
2. Gently rub the skin surface of the selected areas to remove dead cells.
3. Thoroughly clean the area with soapy water.
4. Dry the skin completely before placing the electrodes.

CAUTION

- **The skin must be properly prepared so that the electrode area receives a good quality signal, since the skin is not a good conductor of electricity.**

11.4.2 Application of ECG electrodes

To connect the ECG electrodes, follow this procedure:

1. Check that the electrode packaging is intact and that the ECG electrodes have not Expired. Check that the electrode gel is moist. If using snap-on lead wires, attach the ECG electrodes to the lead wires before placing the electrodes on the patient.
2. Place the ECG electrodes on the prepared areas. Ensure all electrodes make proper contact. good skin contact.
3. Connect the lead wires to the patient cable, if they are not already connected.
4. Connect the patient cable to the ECG connector.

NOTE

• Store electrodes at room temperature. • Only open the

electrode package immediately before use. • Never mix patient electrodes of different

types or from different manufacturers. They could
problems may arise due to the impedance difference.

• When applying the electrodes, avoid bony areas, obvious layers of fat, and major muscles. Muscle movement can cause electrical interference. Applying the electrodes over major muscles, such as the chest muscles, could trigger a false arrhythmia alarm due to excessive muscle movement.

11.4.3 Electrode color coding

The following table shows the electrode color codes according to AHA and standards IEC:

Derivation	IEC		AHA	
	Label	Color	Label	Color
Right arm	R	Red	AR	White
Left arm	L	Yellow	THE	Black
Right leg (neutral)	N	Black	RL	Green
Left leg	F	Green	LL	Red
Thorax 1	C1	White/Red	V1	Brown/red
Thorax 2	C2	White/yellow	V2	Brown/yellow
Thorax 3	C3	White/green	V3	Brown/green
Thorax 4	C4	White/brown	V4	Brown/blue
Thorax 5	C5	Black/white	V5	Brown/orange
Thorax 6	C6	White/violet	V6	Brown/violet

11.4.4 Placement of ECG electrodes

This section illustrates the placement of the electrodes using the AHA nomenclature convention.

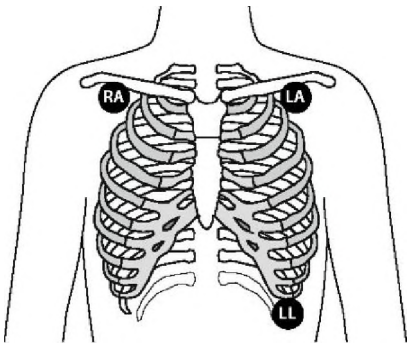
11.4.4.1 Placement of 3-lead electrodes

The placement of the 3-lead electrodes is performed as follows:

ÿ RA: directly below the collarbone and near the shoulder right.

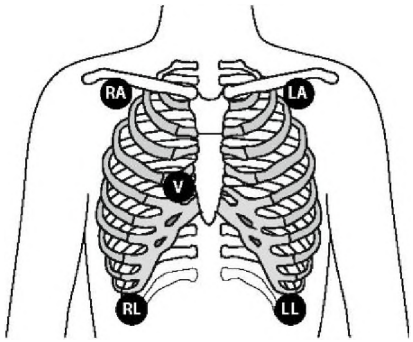
ÿ LA: directly below the collarbone and near the left shoulder.

ÿ LL: below the lower left border of the rib cage.



11.4.4.2 Placement of 5-lead electrodes

The placement of the 5-lead electrodes is performed as follows:



ÿ RA: directly below the collarbone and near the shoulder right.

ÿ LA: directly below the collarbone and near the left shoulder.

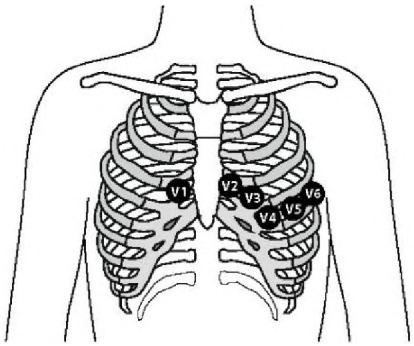
ÿ RL: below the lower right border of the rib cage.

ÿ LL: below the lower left border of the rib cage.

ÿ V: any of V1 to V6 in the thorax.

11.4.4.3 Placement of precordial electrodes

The precordial electrode can be placed in the following positions:



ÿ V1: in the fourth intercostal space, on the right border of the breastbone.

ÿ V2: in the fourth intercostal space, on the left border of the breastbone.

ÿ V3: halfway between V2 and V4.

ÿ V4: in the fifth intercostal space, in the midclavicular line left.

ÿ V5: on the left anterior axillary line, at the same horizontal level with V4.

ÿ V6: on the left mid-axillary line, at the same horizontal level as V4 and V5.

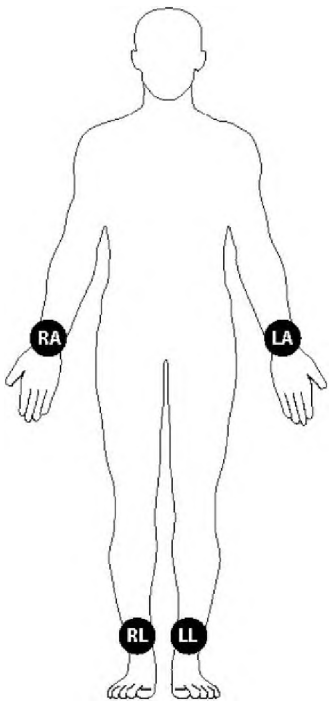
NOTE

- **In the 5-lead electrode configuration, the precordial electrode can be placed according to the doctor's preference.**

11.4.4.4 Placement of 12-lead electrodes

12-lead ECG monitoring uses ten electrodes, which are placed on the patient's four limbs and chest.

The image on the right shows the placement of the electrodes on the limbs. However, you can place the limb electrodes anywhere on the limbs.



ÿ RA: on the right wrist, on the inside of the right arm and below the

ÿ elbow.

ÿ LA: on the left wrist, on the inside of the left arm and below the elbow.

ÿ RL: over the right ankle, on the inner part of the right leg and below the knee.

ÿ LL: over the left ankle, on the inside of the left leg and below the knee.

Precordial electrodes can be placed according to the physician's preference. For detailed information on electrode placement, see [link to relevant section].

Precordial electrodes, see 11.4.4.3 Placement of precordial electrodes.

11.4.4.5 Placement of shunts for surgical patients

The surgical area must be considered when placing electrodes on a surgical patient. For example, for open-heart surgery, precordial electrodes can be placed on either side of the chest or on the back. To reduce artifacts and interference with electrosurgical units, limb electrodes can be placed near the shoulders and on the lower abdomen, and chest electrodes on the left side at the level of the mid-thoracic line. Do not place electrodes on the upper arm. Otherwise, the ECG waveform will be too small.

WARNING

- **To reduce the risk of burns during the use of the electrosurgical unit (ESU), the EEG electrodes should not be placed between the surgical area and the ESU return electrode.**
- **Do not tangle the electrosurgical unit cable with the ECG cable.**
- **If using the ESU, do not place the ECG electrodes near the ESU grounding plate. Otherwise, interference with the ECG signals may occur.**

11.4.5 Choice of ECG lead type

To define the type of ECG leads, follow this procedure:

1. Select the numeric data area or the ECG waveform area to access the **ECG menu.**
2. Select the **Settings tab.**
3. Define **Conjunt deriv** according to the type of derivations you will use. The default derivation type It is **Automatic.** In this case, the equipment automatically detects the type of branch.

11.4.6 Pacemaker status check

You must check the patient's pacemaker status before ECG monitoring. **If "marc."** is set to **Yes,** pacemaker  It shows if **With** pulse markers "|" will be displayed on the ECG waveform when the patient has a pacemaker signal. If " **marc."** is set to **No ,** or if the patient's pacemaker status has not been selected, it will be displayed on the ECG in the waveform area.

To change the pacemaker status, follow this procedure:

1. Select the numeric data area or the ECG waveform area to access the **ECG menu.**
2. Select the **Pacemaker tab.**
3. Set **with mark..**

If the pacemaker status is not determined, the device will emit a warning tone when it detects a pulse. stimulation. At the same time,  The message **"Check if the patient has a"** flashes and appears. **"pacemaker"** in the ECG waveform area. Check the patient's pacemaker status and define it accordingly.

WARNING

- **When monitoring a patient with an implanted pacemaker, be sure to select the Ensure the pacemaker is functioning correctly. Otherwise, pacing pulses could be counted in the event of cardiac arrest or certain arrhythmias. Do not rely solely on heart rate readings or heart rate alarms. Monitor the patient closely and continuously.**
- **For patients with pacemakers, set "With pacemaker" to "Yes." Otherwise, the monitor may mistake pacemaker impulses for QRS complexes and fail to trigger an alarm when the ECG signal is very weak. In patients with ventricular pacemakers, episodes of ventricular tachycardia cannot always be detected. Do not rely solely on the system's automatic arrhythmia detection algorithm.**
- **With some pacemakers, false alarms of low heart rate or asystole may be generated due to pacemaker artifacts, such as when the electrical overmodulation of the pacemaker is superimposed on the true QRS complexes.**
- **When monitoring patients with pacemakers, do not rely entirely on heart rate monitor alarms. Closely monitor the patient continuously.**

- **In the case of patients without a pacemaker, you should set With pacemaker to No.**

11.4.7 Pacemaker rejection activation adjustment

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

1. Select the numeric data area or the ECG waveform area to access the **ECG menu.**
2. Select the **Pacemaker tab.**
3. Adjust the activation of the **Rech. brand.**

NOTE

- **When pacemaker impulses are detected, the impulse markers are displayed. Pacemaker "|" on ECG waveforms. Adjusting the pacemaker rejection setting has no effect on the display of pacemaker pulse marks "|".**
- **Pacemaker rejection can only be activated when the With pacemaker option is set to Yes. If Con marc. is set to No, the Rech. marca. setting is disabled.**

11.5 Modification of ECG settings

11.5.1 Adjusting ECG alarm properties

To set the ECG alarm properties, follow this procedure:

1. Select the numeric data area or the ECG waveform area to access the **ECG menu.**
2. Select the **Alarm tab.**
3. Configure the alarm properties as desired.

11.5.2 Analysis mode adjustment

Multi-lead analysis improves detection sensitivity and reduces false alarms. However, when most leads are noisy or of low amplitude, it is recommended to select the optimal lead as the calculation lead and perform single-lead analysis.

To set the ECG analysis mode, follow this procedure:

1. Select the numeric data area or the ECG waveform area to access the **ECG menu.**
2. Select the **Settings tab.**
3. Set **Analysis Mode.**
   - **Multiple leads:** Four leads (ECG1 to ECG4) are used as calculation leads.
   - **One lead:** one lead (ECG1) is used as the calculation lead.

NOTE

- **It is difficult for the team to differentiate a heartbeat with aberrant conduction from a ventricular heartbeat. A heartbeat with aberrant conduction may be misclassified as a ventricular heartbeat. In this case, select the lead with a narrow R wave for ECG1 and select One Lead.**
- **When using a 3-lead ECG cable, the equipment always uses one lead as the calculation lead and the analysis mode option is not available.**

11.5.3 Modifying ECG waveform settings

11.5.3.1 Selection of the ECG leads shown

To select the labels for the ECG waveform leads displayed, follow this procedure:

1. Select the numeric data area or the ECG waveform area to access the **ECG menu.**

2. Select the **Settings tab.**

3. Select **ECG** to configure the lead label for each ECG waveform.

4. If more than three ECG waveforms are displayed, select the **More leads** tab , and then select **ECG** to define lead labels for other ECG waveforms.

The waveform of the selected lead should have the following characteristics:

ÿ The QRS complex should be tall and narrow.

ÿ The QRS complex is completely above or below the initial value. It should not be biphasic.

ÿ The amplitudes of the P and T waves are less than 0.2 mV.

CAUTION

- **Ensure you have selected the optimal leads with the best wave amplitude and highest signal-to-noise ratio. Selecting the optimal leads is important for heart rate detection, heart rate classification, and detecting ventricular fibrillation.**

11.5.3.2 ECG waveform design adjustment

To configure the ECG waveform design, follow this procedure:

1. Select the numeric data area or the ECG waveform area to access the **ECG menu.**

2. Select the **Settings tab.**

3. Set **Wave Design.**

   • **Standard:** the wave sequence is I, II, III, aVR, aVL, aVF, V1, V2, V3, V4, V5, V6.

   • **Cabrera:** the wave sequence is aVL, I, -aVR, II, aVF, III, V1, V2, V3, V4, V5, V6.

11.5.3.3 Change in ECG wave size

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

1. Select the numeric data area or the ECG waveform area to access the **ECG menu.**

2. Select the **Settings tab.**

3. Select **ECG Gain** to configure the lead label for each ECG waveform.

4. If more than three ECG waves are displayed, select the **More Deriv.** tab , and then select **Gain.**

   ECG to change the size of other ECG waveforms. If you select **Auto,** the device will automatically adjust the size of the ECG waveforms.

11.5.3.4 Modification of ECG wave velocity

To change the ECG waveform speed, follow this procedure:

1. Select the numeric data area or the ECG waveform area to access the **ECG menu.**

2. Select the **Settings tab.**

3. Set **Speed.**

11.5.3.5 ECG filter adjustment

To configure the ECG waveform filtering mode, follow this procedure:

1. Select the numeric data area or the ECG waveform area to access the **ECG menu.**

2. Select the **Settings tab.**

3. Set **Filter.**

   • **Diagnostic:** used when diagnostic quality ECG waveforms are required.

   • **Monitor:** used in ECG monitoring.

- **Therapy:** It is used if ECG signals are distorted due to low or high frequency noise.
  In the operating room, setting **the Filter** to **Therapy** can reduce ESU interference. However, under normal ECG monitoring conditions, selecting **Therapy** may suppress some QRS complex information or features.
- **ST:** Recommended for ST monitoring.

11.5.3.6 Adjusting the activation of the Nozzle Filter

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

1. Select the numeric data area or the ECG waveform area to access the **ECG menu.**
2. Select the **Settings tab.**
3. Adjust the Nozzle Filter activation .

NOTE

- **Nozzle filter can only be enabled or disabled if Filter is set to Diagnostic. In other filtering modes, Nozzle filter is always enabled.**

11.5.4 Smart Shunt Activation Adjustment

The device includes an intelligent lead disconnection function. When the lead for the first ECG waveform is disconnected, but another lead is available, the device automatically switches to the available lead to recalculate the heart rate and to analyze and detect any arrhythmias. When you reconnect the disconnected leads, the device will automatically switch back to the original lead.

To activate the smart branch disconnection function, follow this procedure:

1. Select the numeric data area or the ECG waveform area to access the **ECG menu.**
2. Select the **Settings tab.**
3. Adjust the activation of **Intelligent Derivation.**

11.5.5 QRS Volume Adjustment

To adjust the QRS volume, follow this procedure:

1. Select the numeric data area or the ECG waveform area to access the **ECG menu.**
2. Select the **Settings tab.**
3. Set **QRS Volume.**

When valid SpO2 measurements are available, the device will adjust the QRS tone based on the SpO2 value.

11.6 Arrhythmia monitoring

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

11.6.1 Safety information on arrhythmias

WARNING

- **Heart rate readings can be affected by cardiac arrhythmias. When Monitor patients with arrhythmia; do not rely entirely on heart rate alarms. Monitor the patient closely and continuously.**
- **The arrhythmia analysis program may incorrectly identify the presence or absence of arrhythmias. Therefore, a physician should analyze arrhythmia information in conjunction with other clinical findings.**
- **The atrial fibrillation (AF) detection function is not designed for pediatric patients nor neonatal.**

CAUTION

- **Since the sensitivity and specificity of the arrhythmia detection algorithm is lower than 100% accuracy is not guaranteed; however, false arrhythmias can sometimes be detected, and some genuine arrhythmia events may go undetected. This is especially true when the signal is noisy.**
- **The size of the ECG affects the sensitivity for detecting arrhythmias and calculating the heart rate. cardiac.**
- **If the QRS amplitude is low, the equipment may not be able to calculate the heart rate and false reports of asystole are detected.**
- **During the algorithm's learning phase, arrhythmia detection may not be possible. available. Therefore, you will need to closely monitor the patient's condition during the learning phase and for several minutes afterward until the algorithm reaches optimal detection performance.**

11.6.2 Arrhythmia Events

This section details all arrhythmia events and their criteria.

11.6.2.1 Fatal arrhythmia events

Arrhythmia message	Description
Asystole	No QRS complex is detected during the defined time interval, with absence of ventricular fibrillation or chaotic signal.
Fibr.ventr /Taq.ventr	Fibrillation wave for six consecutive seconds. The dominant rhythm of contiguous CVP and ventricular rate is higher than the ventricular tachycardia velocity limit.
Tachyventr.	The number of consecutive CVPs is equal to or greater than the CVP limit for ventricular tachycardia, and the ventricular rate is equal to or greater than the tachycardia rate limit. ventricular.
Ventricular bradycardia	The number of consecutive CVPs is equal to or greater than the CVP limit for ventricular bradycardia, and the ventricular rate is less than the rate limit for ventricular bradycardia.
Extreme Taq	The heart rate is higher than the limit of extreme tachycardia.
Extreme Brady	The heart rate is lower than the limit of extreme bradycardia.

11.6.2.2 Non-fatal arrhythmia events

Arrhythmia message	Description
R in T	CVP R has been detected in T.
Run CVP	More than two consecutive CVPs, but less than the CVP limit for ventricular bradycardia, and the ventricular rate is less than the limit for ventricular tachycardia velocity.
Doublet	A pair of CVPs were detected between normal heartbeats.
CVP multif.	Multiform CVPs detected in the multiform CVP window (which can be adjusted).
CVP	A CVP has been detected between normal heartbeats.
Bigeminy*	Dominant rhythm of N, V, N, V, N, V.
Trigeminism*	Dominant rhythm of N, N, V, N, N, V, N, N, V.
Taq.	The heart rate is higher than the tachycardia threshold.
Bradic.	The heart rate is lower than the bradycardia threshold.
Marcap does not capture	No QRS complex is detected during the 300 milliseconds following the pacemaker pulse (for patients with pacemakers only).

Arrhythmia message	Description
Marcap. does not stimulate	No pacemaker pulse in R wave intervals of 1.75 on average after a QRS complex (for pacemaker patients only).
Lost heartbeats	At least 3 consecutive Ns and The current FR interval is 1.5 times higher than the previous FR interval, and The next FR interval is 1.5 times lower than the mean FR interval, and The HR is less than 100 and the current RR interval is greater than 1.75 times the mean RR interval, or the HR is greater than or equal to 100 and the current RR interval is greater than 1000 ms.
Non-sustained ventricular tachycardia	The number of consecutive CVPs is equal to or less than the CVP limit for ventricular tachycardia but greater than 2, and the ventricular rate is equal to or greater than the rate limit for ventricular tachycardia.
Ventilation rhythm	The number of consecutive CVPs is equal to or greater than the CVP limit for ventricular bradycardia, and the ventricular rate is equal to or greater than the rate limit for ventricular bradycardia but less than the tachycardia velocity limit.
Pause	No QRS complex has been detected within the defined pause time threshold.
Irregular rhythm	Constant irregular rhythm (N, the change in the irregular FR interval is greater than 12.5%)
Fibr. A.	The P wave is absent and normal heart rate intervals are irregular.
CVP/min	The CVP/min value exceeds the upper limit.
Pauses/min	Pauses/min exceeds the upper limit.
End of irregular rhythm	An irregular rhythm has ceased to be detected during the irregular rhythm end delay time.
Ear fib. end	Atrial fibrillation has ceased to be detected during the atrial fibrillation termination delay time.
SVT	The number of consecutive SVCs is equal to or greater than the SVT SVC limit and the supraventricular HR is equal to or greater than the SVT HR limit.
CVP/min	The SVC/min value exceeds the upper limit.
*: N refers to normal heartbeat; V refers to ventricular heartbeat.	

11.6.3 Visualization of arrhythmia information

Arrhythmia information can be displayed in the numeric data area. To do this, follow this procedure:

1. Select the shortcut key **Menu principal** ÿ in the **Display column,** select **Display settings.**
2. Select the **Tile Design tab.**
3. Select the numeric value area for the desired parameter, and then select **ECG** ÿ **Arrhythmia.**

11.6.4 Modification of arrhythmia settings

11.6.4.1 Modifying the arrhythmia alarm settings

To set the arrhythmia alarm properties, follow this procedure:

1. Select the numeric data area or the ECG waveform area to access the **ECG menu.**
2. Select the **Arrhythmia** tab ÿ select the **Alarm tab.**
3. Configure the alarm properties as desired.

NOTE

• **The priority of life-threatening arrhythmia alarms is always high. It cannot be changed.**

11.6.4.2 Modification of arrhythmia alarm thresholds

The thresholds for some arrhythmia alarms can be modified. When an arrhythmia exceeds its threshold, an alarm will be triggered. To do this, follow this procedure:

1. Select the numeric data area or the ECG waveform area to access the **ECG menu.**
2. Select the **Arrhythmia** tab ÿ **Threshold tab.**
3. Set the threshold for the arrhythmia alarms you want.

NOTE

- **The asystole delay time is related to ECG relearning. When the heart rate is below 30 bpm, it is recommended to adjust the asystole delay to 10 seconds.**

11.6.4.3 Arrhythmia threshold

Arrhythmia	Threshold range
Bradic.(low heart rate)	From 16 lpm to 120 lpm
Taq. (High HR)	From 60 lpm to 295 lpm
Extreme Taq	From 65 lpm to 300 lpm
Extreme Brady	From 15 to 115 lpm
Delayed asystole	From 3 to 10 seconds
Multi-function CVP window	From 3 to 31 beats
Velocity, tachymetry, and wind speed	From 100 lpm to 200 lpm
CVP tachyventricular	From 3 to 99 beats
Vel. bradic. vent.	From 15 lpm to 60 lpm
CVP bradic. ventric.	From 3 to 99 beats
Threshold of pauses	1.5 s, 2.0 s, 2.5 s, 3.0 s
CVP/min	From 1 to 100
Pauses/min	From 1 to 15
SVC SVT	From 3 to 99 beats
FC SVT	From 100 lpm to 300 lpm
CVP/min	From 1 to 100
Irregular end of auricular fibrotic rhythm	0 min, 1 min, 2 min, 3 min, 4 min, 5 min, 10 min, 15 min, 30 min

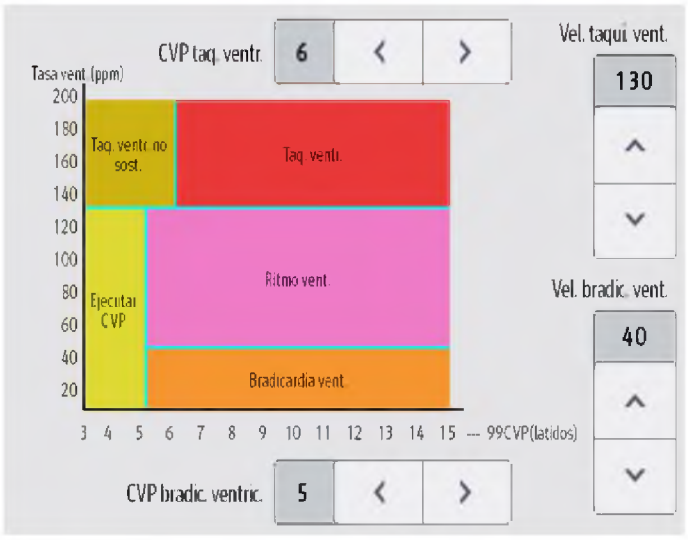
11.6.4.4 Adjustment of CVP-related alarm thresholds

The equipment detects CVP-related alarms based on the frequency of CVP and the number of consecutive CVPs.

To adjust the necessary thresholds for CVP-related alarms, follow this procedure:

1. Select the numeric data area or the ECG waveform area to access the **ECG menu.**
2. Select the **Arrhythmia** tab ÿ select the **More Thresholds tab.**
3. Adjust **CVP tach. ventr., Velo. tach. vent., CVP bradic. ventric., Velo. bradic. vent.** to set the desired CVP-related alarm threshold.

The following figure illustrates the conditions under which CVP alarms will be generated if **CVP tach. ventr.** is set to 6, **tach. vent. velocity** is set to 130, **CVP brady. ventric.** is set to 5 and **brady. vent. velocity.** It is defined at 40.



ÿ If the number of consecutive CVPs is equal to or greater than the CVP tach. ventr. limit (6) and the ventricular rate (Vt. Rate) is equal to or greater than the tach. ventr. rate limit (130), a tach. ventr. alarm will be activated.

ÿ If the number of consecutive CVPs is less than the CVP tach. ventr. limit (6), but greater than 2, and the ventricular rate is greater than or equal to the Velo. tach. vent. limit (130), a non-sustained tach. ventr. alarm is activated.

ÿ If the number of consecutive CVPs is greater than or equal to the limit of bradic. ventricular CVP (5) and the frequency If the ventricular rate is below the tachyventricular rate limit (130) but above or equal to the bradyventricular rate limit (40), a ventricular rhythm alarm is activated.

ÿ If the number of consecutive CVPs is less than the bradic. ventric. CVP limit (5), but greater than 2, and the ventricular rate is less than the tachy. vent. velocity limit (130), an Execute CVP alarm is activated.

ÿ If the number of consecutive CVPs is greater than or equal to the limit of CVP bradic. ventric. (5) and the ventricular rate is less than the bradic. ventric. velocity (40), a ventricular bradycardia alarm is activated.

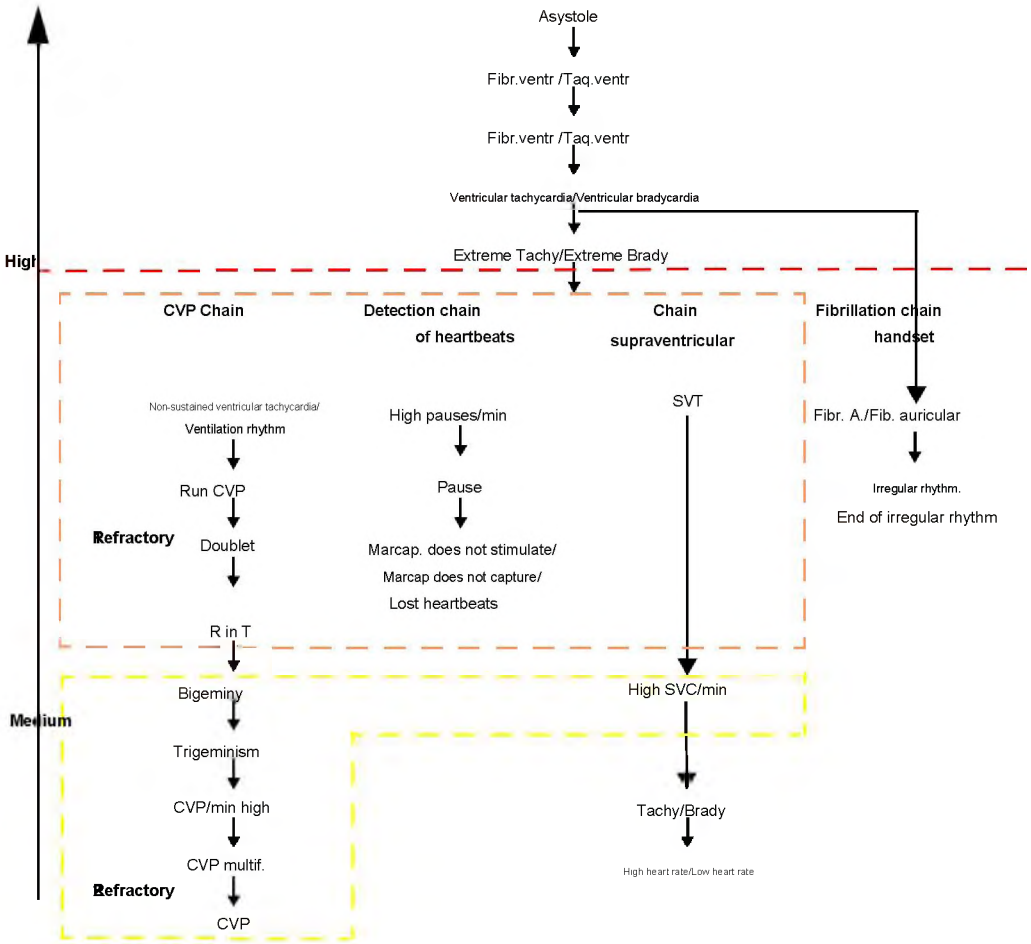
11.6.5 Arrhythmia alarms deactivated

The device typically sounds an alarm when an arrhythmia is detected. However, the device can be configured to disable some arrhythmia alarms and to turn off the alarm light and tone for a specified period of time when certain arrhythmia alarms are detected. For more information, see 11.6.5.1 Arrhythmia Alarm Chains and 11.6.5.2 Arrhythmia Protection Period.

11.6.5.1 Arrhythmia alarm chains

If multiple arrhythmias occur simultaneously, the notification of all detected alarm conditions can be confusing. This can lead to serious situations being overlooked. Therefore, arrhythmia alarms are prioritized using alarm chains.

There are five arrhythmia alarm chains: one high-priority chain and four medium-priority chains, which include the CVP chain, the heartbeat detection chain, the supraventricular chain, and the atrial fibrillation chain.



11.6.5.2 Arrhythmia protection period

The arrhythmia algorithm can disable the alarm light and tone for a specified period of time when certain arrhythmia alarms are detected. This period is called the arrhythmia protection period. The **Arrhythmia Deactivation Time** setting can only be changed in setup mode. For more information, see section 22.7.3 Alarm Settings Menu.

NOTE

- **The arrhythmia protection period has no impact on high heart rate, low heart rate, tachycardia, bradycardia, or end-stage heart rate. Fib. atrial nor in Fin irregular rhythm.**
- **The alarm protection period only applies to alarms in the medium priority chains and the atrial fibrillation chain. For alarms in the high priority chain, the alarm tone and light appear as soon as the alarm situation is detected.**

11.6.5.3 Rules on the protection of arrhythmia alarms

The following table explains how the audible and visual alarms are indicated during the arrhythmia protection period.

Previous alarm	Current alarm	Alarm indication
High priority chain alarm	High priority chain alarm	Alarm light and tone
	Medium priority chain alarm During the protection period, the light and tone	The alarm lights are deactivated. When the protection period ends, the alarm light and tone are reactivated.
Medium priority chain alarm	High priority chain alarm	Alarm light and tone
	Alarm from the same medium priority chain, but with a higher priority	Alarm light and tone
	The same alarm occurs again. During the protection period, the light and tone	The alarm lights are deactivated. When the protection period ends, the alarm light and tone are reactivated.
	Alarm from the same medium priority chain, but with a lower priority	During the protection period, the light and alarm tone are deactivated. When the protection period ends, the light and alarm tone are reactivated.
	Alarm from another medium priority chain	Alarm light and tone

11.6.5.4 Establishment of refractory periods of arrhythmias

In the case of some arrhythmias in the medium-priority chain, an arrhythmia and lower-priority arrhythmias in the same alarm chain may be deactivated for a certain period. This period is called the refractory period. When an arrhythmia is detected, the refractory period starts automatically. During the refractory period, the same alarm state will not trigger an alarm. If a lower-priority arrhythmia state appears in the same alarm chain, the device will also not generate an alarm.

To establish the refractory periods of arrhythmias, follow this procedure:

1. Select the numeric data area or the ECG waveform area to access the **ECG menu.**
2. Select the **Arrhythmia** tab ÿ select the **Threshold tab.**
3. Establish **Refractory Period 1** and **Refractory Period** 2.

The default refractory period 1 is 3 minutes. The default refractory period 2 is 10 minutes. To disable a refractory period, set it to **Off.**

For detailed information on the application of arrhythmias to **Refractory Period 1** and **Refractory Period** 2, refer to the arrhythmia alarm chain image in 11.6.5.1 Arrhythmia Alarm Chains.

NOTE

- **Refractory periods only apply to arrhythmias of the medium priority chains.**
- **Refractory periods have no impact on Taq., Brady., High HR, Low HR, Atrial Fibr./End of atrial fibrillation, Irr. rhythm/End of irregular rhythm.**

11.7 ST segment monitoring

ST monitoring is indicated for adult, pediatric, and neonatal patients.

11.7.1 Safety information on ST

WARNING

- **ST values can be affected by factors such as drugs or metabolic or other disorders driving.**
- **ST deviation is usually calculated with a fixed displacement from the J point. Changes in heart rate can affect the ST.**
- **The accuracy of the ST deviation measurement algorithm has been tested. The importance of the Changes in the ST segment should be determined by a doctor.**
- **The device provides information on changes in ST segment deviation. The clinical significance of this information should be determined by a physician.**

11.7.2 Activation of ST monitoring

ST monitoring is disabled by default. Before starting ST monitoring, you must enable the ST function. To do this, follow this procedure:

1. Select the numeric data area or the ECG waveform area to access the **ECG menu.**
2. Select the **ST** tab y select the **Adjust tab.**
3. Active **ST Analysis.**

ST monitoring may be inaccurate or impossible to perform in the following situations:

y It is impossible to obtain a derivation if it does not generate noise.

y Arrhythmias, such as atrial fibrillation or flutter, can cause an irregular initial value.

y The patient always has a ventricular pacemaker.

y The patient has a left ventricular hemiblock.

In these cases, you may want to consider disabling ST monitoring.

11.7.3 Display of ST Numerical Values

To display the numerical values of ST, follow this procedure:

1. Select the shortcut key **Menu principal** y in the **Display column,** select **Display settings.**
2. Select the **Tile Design tab.**
3. Select the numeric value area of the desired parameter, and then select **ECG** y **ST.**

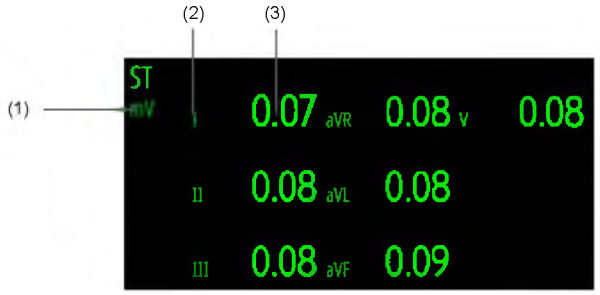
The display of the ST numerical value area differs depending on the type of leads:

y If 3-lead ECG cables are used, the ST segment numerical value area is not displayed. an ST value in the numerical ECG values area.

y If 5-lead ECG cables are used, the ST values displayed in the ST numeric values area are ST-I, ST-II, ST-III, ST-aVR, ST-aVL, ST-aVF, ST-V.

y If 12-lead ECG cables are used, the ST 12 values displayed in the ST numeric values area are ST-I, ST-II, ST-III, ST-aVR, ST-aVL, ST-aVF, ST-V1, ST-V2, ST-V3, ST-V4, ST-V5, ST-V6.

The following image shows the ST numerical value area when using a 5-lead ECG cable:



(1) ST alarm symbol deactivated

(2) Derivation labels

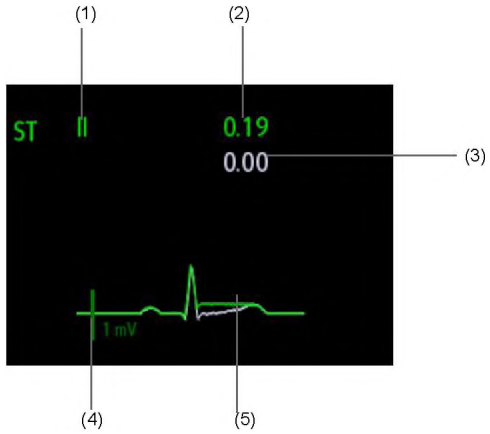
(3) ST numerical data: a positive value indicates an elevation of the ST segment; a negative value indicates a depression of the ST segment.

11.7.4 Visualization of ST segments

You can view the ST segments in the parameter's waveform area. To do this, follow this procedure:

1. Select the shortcut key **Menu principal** y in the **Display column,** select **Display settings.**
2. Select the **Tile Design tab.**
3. Select the desired parameter waveform area, and then select **ECG** y **ST.**

The current and initial ST segments are displayed in the parameter waveform area. The current and initial ST values are also shown. In the image below, the current ST segment and value are shown in green, while the initial ST segment and value are shown in white.



(1) ST lead

(2) Current ST value

(3) Initial ST value

(4) 1 mV scale

(5) Current ST segment (green) and initial ST segment (white)

11.7.5 Accessing the ST View Window

The ST View displays a complete QRS segment for each ST lead. The color of the current ST segments and ST values is consistent with the ECG waveform color, typically green. The color of the initial ST segments and ST values is white.

To access the **ST View window,** follow this procedure:

1. Select the numeric data area or the ECG waveform area, or the ST numeric values area to access the **ECG menu.**
2. Select the **ST tab.**
3. Select **ST View** at the bottom

11.7.6 Save the current ST as initial

ST deviation is typically monitored as a relative change from a baseline value. Set a baseline value of ST when ST values are stable. If you did not set the initial ST value, the device automatically saves the initial value when valid ST values appear for 5 minutes. To adjust the initial ST value, follow this procedure:

In the **ST View window,** select **Set Initial Value** to set the current ST segments and values as initial.

In the **ST View** window you can also perform the following operations:

y Select **Show initial value** or **Hide initial value** to configure the display of the initial value of ST.

y Select **Show Marker** or **Hide Marker** to configure the display of the positions of the ISO point, point J and point ST.

CAUTION

- **The initial ST update affects ST alarms.**

11.7.7 Accessing the ST Graphic Window

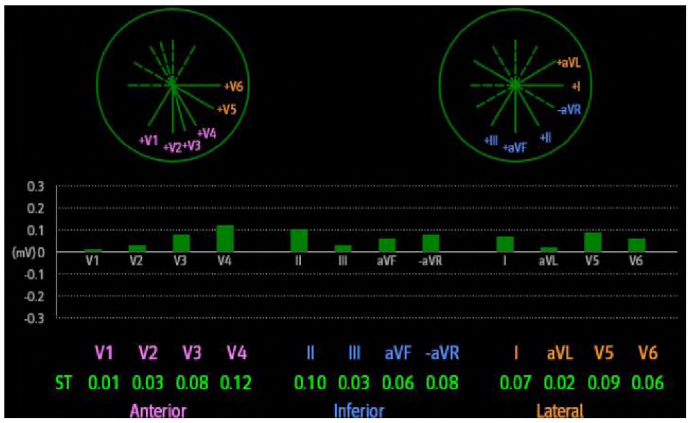
To access the **ST Graphic window,** follow this procedure:

1. Select the numeric data area or the ECG waveform area, or the ST numeric values area to access the **ECG menu.**

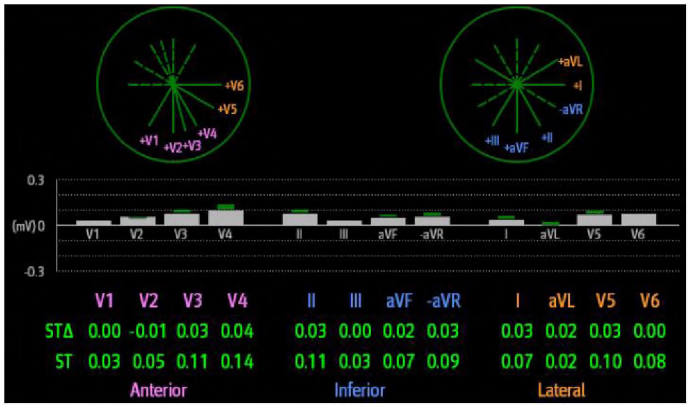
2. Select the **ST tab.**

3. Select **ST Graphic** at the bottom.

The following image shows the **ST Graphic** window when **ST Alarm Mode** is set to **Absolute.** The height of the bar indicates the ST value of the corresponding ST lead. The color of the bar indicates the ST alarm status: green indicates that the corresponding ST value is within the alarm limits; cyan, yellow, and red indicate that the ST value exceeds the alarm limits. The color corresponds to the ST alarm priority.



The following image shows the **ST Graphic** window when **ST Alarm Mode** is set to **Relative.** The height of the gray bar indicates the initial ST value, and the green bar (cyan, yellow, or red if an alarm occurs) indicates yST.



11.7.8 Modification of ST settings

11.7.8.1 Adjusting ST alarm properties

To set the ST alarm properties, follow this procedure:

1. Select the numeric data area or the ECG waveform area, or the ST numeric values area to access the **ECG menu.**

2. Select the **ST** tab ÿ select the **Alarm tab.**
3. Set **ST Alarm Mode.**
   - **Absolute:** allows you to configure the properties of each ST alarm separately.
   - **Relative:** allows you to set the priorities of **single ST** and **double ST** alarms .
4. Set the ST alarm properties.

11.7.8.2 Leads with changes for ST presentation

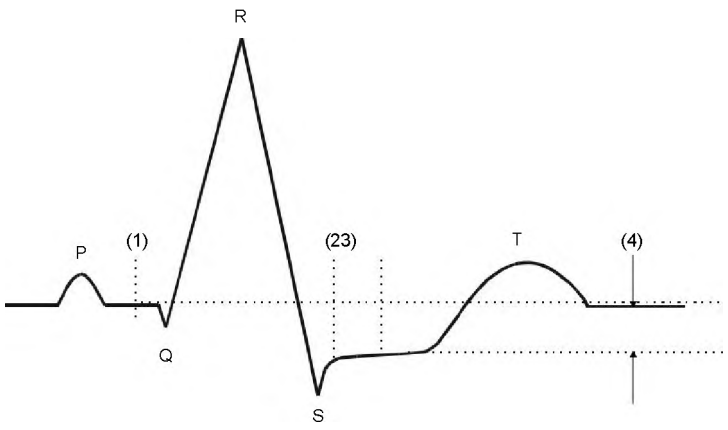
The device automatically selects the three leads with the greatest discrepancies to display the ST segment. You can also manually select the leads. To do this, follow this procedure:

1. Select the numeric data area or the ECG waveform area, or the ST numeric values area to access the **ECG menu.**

2. Select the **ST** tab ÿ select the **Adjust tab.**
3. Select **ST Segment** and set the desired lead.

11.7.9 Adjustment of the positions of the ST point, the ISO point and the J point

The following image shows the positions of point ST, the isoelectric point (ISO), and point J:



(1) ISO point: located between the end of the P wave and the beginning of the QRS complex. The ISO point provides the starting value for ST deviation measurement.

(2) J point: located at the end of the QRS complex. The distance between the J point and the ST point is fixed. Therefore, it helps to correctly position the S point.

(3) ST point: is located at the midpoint of segment ST.

(4) ST deviation (ST elevation or depression): potential difference between the ISO point and the ST point.

11.7.9.1 Adjustment of the ST point position

Verify that the ST point position is correctly set for the patient. Incorrect ST point setting can cause ST deviation artifacts. Adjust the ST point before starting monitoring or if the patient's heart rate or ECG morphology changes alarmingly.

To adjust the position of the ST point, follow this procedure:

1. Select the numeric data area or the ECG waveform area, or the ST numeric values area to access the **ECG menu.**

2. Select the **ST** tab ÿ select the **Adjust tab.**

3. Set **ST Point.** The ST point is placed at a fixed distance from point J. If you select **J+60/80ms,** the The ST point is set at 80 ms (heart rate of 120 bpm or less) or at 60 ms (heart rate greater than 120 bpm) with respect to the J point.

11.7.9.2 Start of automatic adjustment of the ISO point and J point positions

The **Auto Adjust** parameter defines the method for adjusting the ISO point and J-point. The Auto Adjust function is enabled by default. In this case, the ISO point and J-point positions have been automatically adjusted accordingly.

To initiate automatic adjustment of the ISO point and J point positions, follow this procedure:

1. Select the numeric data area or the ECG waveform area, or the ST numeric values area to access the **ECG menu.**

2. Select the **ST** tab ÿ select the **Adjust tab.**

3. Activate **Automatic Adjustment.**

11.7.9.3 Manual adjustment of the ISO point and J point positions

If **Auto Adjust** is disabled, you need to manually adjust the ISO point and J point positions.
To do this, follow this procedure:

1. Select the numeric data area or the ECG waveform area, or the ST numeric values area to access the **ECG menu.**

2. Select the **ST** tab ÿ select the **Adjust tab.**

3. Turn off **Automatic adjustment.**

4. Select the arrows to the right of **ISO** and **J** to manually adjust the positions:

   • Place the ISO point in the center of the flattest part between the P and Q waves.

   • Place the J point at the end of the QRS complex and at the beginning of the ST segment.

11.8 Monitoring of the QT/QTc interval

The QT interval is the time from the beginning of the Q wave to the end of the T wave. QTc is the QT interval corrected for heart rate. Monitoring the QT interval helps in the detection of long QT syndrome.

QT/QTc interval monitoring is indicated for adult, pediatric, and neonatal patients.

11.8.1 Limitations of QT/QTc interval monitoring

QT/QTc monitoring may be inaccurate or impossible to perform in the following situations:

ÿ The amplitude of the R wave is too low.

ÿ Ventricular extrasystoles occur frequently.

ÿ The FR intervals are unstable.

ÿ The P wave tends to invade the end of the preceding T wave due to high heart rates.

ÿ The T wave is very flat or not well defined

ÿ The end of the T wave is difficult to define due to the presence of U waves.

ÿ QTc measurements are not stable.

ÿ In the presence of noise, asystole, ventricular fibrillation, atrial fibrillation, or ECG leads disconnected.

In these cases, you should select a lead with good T wave amplitude and no visible flutter activity, and without a predominant U or P wave.

Some conditions, such as hypertrophy or right or left bundle branch block, can cause widening of the QRS complex. If a prolonged QTc interval is observed, it should be checked to ensure it is not due to QRS widening.

Since normal heartbeats followed by ventricular beats are not included in the analysis, no QT measurement will be generated in the presence of a bigeminal rhythm.

If the heart rate is extremely high (over 150 bpm in adults and over 180 bpm in children and neonates), the QT interval will not be measured. When the heart rate changes, the QT interval may take several minutes to stabilize. To obtain a reliable QTc measurement, it is important to avoid taking measurements when the heart rate changes.

11.8.2 Activation of QT/QTc monitoring

The QT monitoring function is disabled by default. Before you can begin QT monitoring, you must enable the QT function. To do this, follow these steps:

1. Select the numeric data area or the ECG waveform area to access the **ECG menu.**
2. Select the **QT** tab ÿ select the **Adjust tab.**
3. Active **QT Analysis.**

11.8.3 Display of the numerical values of QT/QTc

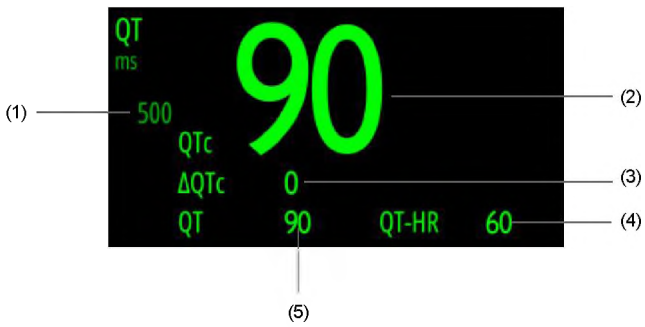
To display the numerical values of QT/QTc, follow this procedure:

1. Select the shortcut key **Menu principal** ÿ in the **Display column,** select **Display settings.**
2. Select the **Tile Design tab.**
3. Select the numeric value area of the desired parameter, and then select **ECG** ÿ **QT/QTc.**

NOTE

- **QTc values are calculated based on QT and HR (QT-HR), not the ECG HR. To obtain For more information, see 11.8.4 Accessing the QT View Window.**

The following image shows the area of numerical values of QT.



(1) QTc alarm limit (2) QTc value

(3) yQTc value (the difference between the current and initial QTc values)

(4) QT-FC value (5) QT value

NOTE

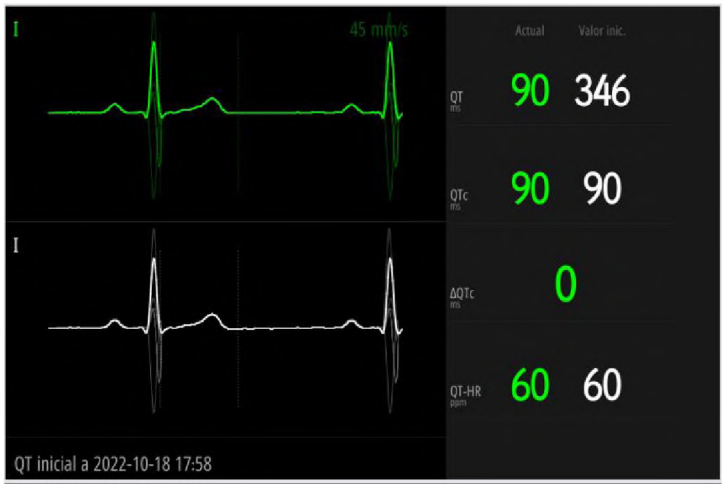
- **The display of the QT numeric value area is different if the settings are changed.**
  related.

11.8.4 Accessing the QT View Window

The QT View displays the current and initial values of the QT parameters and waveforms. To access the **QT View window,** follow this procedure:

1. Select the QT numerical values area, the ECG numerical data area, or the waveforms area.
   ECG to access the **ECG menu.**
2. Select the **QT tab.**
3. Select **QT View** at the bottom.

The following image shows the **Vista QT screen.**



ÿ The current waveform is shown in the upper half in green.

ÿ The initial wave is shown below in white.

ÿ The beginning of the QRS complex and the end of the T wave are marked with a vertical line.

ÿ Under certain conditions, it is not possible to calculate any QT measurement. In such cases, the reason why the QT measurement failed is displayed at the bottom of the QT numeric value area, and the message **"QT cannot be analyzed"** is displayed in the alarm information area.

Select the left or right arrow to change the leads. The corresponding waveform will be highlighted.

11.8.5 Save the current QTc as initial

To quantify changes in the QTc value, you can set a baseline QTc value. If you do not set a baseline for the patient within the first five minutes after obtaining valid QT values, the device will automatically set a baseline. To set the current values as the baseline, follow this procedure:

In the **QT View window,** select **Set initial value** and then select **Ok** to calculate ÿQTc as the initial value.

If you set a new initial value, the previous initial value is no longer used.

In the **QT View window,** you can select **Show Initial Value** or **Hide Initial Value** to set the display of the initial value waveform.

CAUTION

- **Updating the initial QTc value affects the ÿQTc value and alarm.**

11.8.6 Modifying QT settings

11.8.6.1 Adjusting QT alarm properties

To set the alarm properties of QT, follow this procedure:

1. Select the QT numeric values area to enter the **QT menu.**
2. Set the alarm priorities for QTc and ÿQTc.

11.8.6.2 Selection of leads for QT calculation

To calculate QT, you can select one lead or all of them. To do this, follow this procedure:

1. Select the QT numeric values area to enter the **QT menu.**
2. Select the **Settings tab.**
3. Set **QT Leads.** The All option is selected by default. This
   This means that all leads will be used for the QT calculation.

11.9 ECG Relearning

Changes in the ECG template can generate incorrect arrhythmia alarms or an inaccurate heart rate. ECG relearning allows the device to learn the new ECG template to correct arrhythmia alarms and the heart rate value. Once learning is complete, the dominant QRS complex is saved as a reference template. The reference template is used as the normal morphology for that patient and is compared to incoming heartbeats to identify potential arrhythmias.

11.9.1 Start of ECG machine relearning

Automatic arrhythmia relearning occurs in the following situation:

ÿ The ECG lead type or lead label has been changed.

ÿ The ECG leads were disconnected and not reconnected within 60 seconds.

ÿ The patient's pacemaker status has been changed.

11.9.2 Manual initiation of ECG relearning

If you suspect abnormal arrhythmia alarms are occurring, you may need to manually initiate ECG relearning. To do this, follow this procedure:

1. Select the numeric data area or the ECG waveform area to access the **ECG menu.**
2. Select **Relearn** at the bottom.

CAUTION

- **Only initiate ECG relearning during periods of predominantly normal rhythm and when the ECG signal is virtually noise-free. If ECG relearning is performed during an arrhythmia, premature ventricular contractions (PVCs) may be mistaken for normal QRS complexes. This could result in subsequent arrhythmia events going undetected.**

11.10 ECG Calibration

The ECG signal may be inaccurate due to hardware or software issues. As a result, the ECG wave amplitude may increase or decrease. In this case, the ECG module needs to be calibrated. To do this, follow this procedure:

1. Select the numeric data area or the ECG waveform area to access the **ECG menu.**
2. Select the **Settings tab.**
3. Set **Calibrate** at the bottom.

11.11 ECG Troubleshooting

This section includes a list of problems that may occur. If you experience problems while using the equipment or accessories, consult the table below before requesting assistance. If the problem persists after taking the corrective actions indicated, contact service personnel.

NOTE

- **For information on technical and physiological alarm messages, see D Alarm messages.**

Problem	Corrective measures
The values area is not displayed on the main screen. numerical values nor the ECG wave area	1. Verify that ECG is set in the **Display Settings** menu so that it appears on the screen. For more information, see 9.2.3 Setting the Normal Display. 2. Check that the ECG parameter is enabled. If it is not, enable it. ECG measurement . For more information, see 9.2.2 Setting up the activation of a parameter. 3. Check that the ECG electrode cable connections and leads are tight. Replace the ECG electrode or leads if necessary.
Noise in the ECG tracing	1. Check that the electrodes have not come loose or dried out. Replace them with new and moist electrodes if necessary. 2. Check that the branch cables are not faulty. Replace the cables if necessary. 3. Check that the patient cable or lead wires are not placed too close to other electrical devices. Keep the patient cable or lead wires away from electrical devices.
Excessive interference electrosurgical	Use ESU-proof ECG cables. For more information, see F.1 ECG Accessories.
Muscle noise	Poor skin preparation, tremors, tension in the patient, or poor electrode placement. 1. Prepare the skin again and reposition the electrodes. For further information, see 11.4.1 Patient preparation for electrode application and 11.4.2 Application of ECG electrodes. 2. Use new, moist electrodes. Avoid muscle areas.
Flashing signal	1. Check that the cables are correctly connected. 2. Check that the electrodes have not come loose or dried out. Repeat the Prepare the skin as described in 11.4.1 Patient preparation for electrode application and use new, moist electrodes. 3. Check that neither the patient cable nor the lead wires are damaged. Replace them if necessary.
Excessive alarms: frequency cardiac, shunt failure	1. Check that the electrodes are not dry. Prepare the skin again and reapply the electrodes. For further information, see 11.4.1 Patient preparation for electrode application and 11.4.2 Application of ECG electrodes. 2. Check for excessive patient movement or muscle tremors. Reposition the electrodes. Replace with fresh, moistened electrodes if necessary.
Low amplitude ECG signal	1. Check that the ECG gain is not too low. Adjust the gain as needed. For more information, see 11.5.3.3 Changing the ECG Wave Size. 2. Prepare the skin again and reposition the electrodes. For further information, see 11.4.1 Patient preparation for electrode application and 11.4.2 Application of ECG electrodes. 3. Check the electrode application points. Avoid areas with bone or muscles. 4. Check that the electrodes are not dry and have not been in use for too long. Replace them with new, moist electrodes if necessary.

Problem	Corrective measures
There is no ECG waveform	1. Check that the ECG gain is not too low. Adjust the gain as needed. For more information, see 11.5.3.3 Changing the ECG Wave Size. 2. Check that the patient leads and cables are correctly connected connected. 3. Check that neither the patient cable nor the lead wires are damaged. Replace them if necessary.
Deviation from the initial value	1. Check for excessive patient movement or muscle tremors. Secure the lead wires and the patient lead. 2. Check that the electrodes have not separated or dried out and replace them with new, moistened ones if necessary. For further information, see 11.4.1 Patient preparation for electrode application and 11.4.2 Application of ECG electrodes. 3. Check the ECG filter settings. Set the ECG filter mode to **Monitor** to reduce the reference values on the screen.

12 Resting 12-lead ECG analysis

12.1 Introduction to the analysis of 12-lead resting ECGs

Twelve-lead ECG monitoring acquires information from 12 leads of the patient simultaneously. If the equipment is configured with the Glasgow 12-lead ECG analysis algorithm, a diagnosis and analysis can also be provided after the test. Resting 12-lead ECG analysis is used to identify and diagnose patients with cardiac disorders and is useful in the early detection and timely treatment of patients with ST-segment elevation myocardial infarction (STEMI).

The 12-lead resting ECG analysis is designed for adult, pediatric, and neonatal patients.

For more information on the Glasgow algorithm, see the Physician's Guide to the 12-lead ECG interpretation program.

WARNING

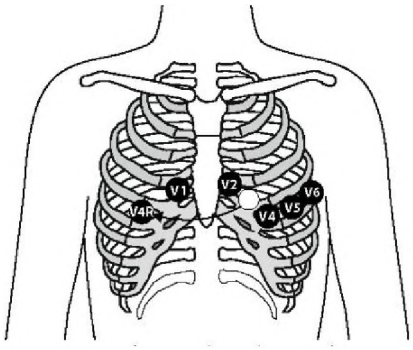
- **The 12-lead resting ECG analysis provided by this device is not indicated for direct cardiac application.**

12.2 Preparation for 12-lead ECG measurement

To properly prepare for a 12-lead ECG analysis, follow this procedure:

1. Prepare the patient's skin. For more information, see 11.4.1 Patient preparation for electrode application.

2. Apply the ECG electrodes to the patient.
   - For adult patients, connect the patient cable and apply the ECG electrodes. For further information, see 11.4.2 Application of ECG electrodes, 11.4.4.3 Placement of precordial electrodes and 11.4.4.4 Placement of 12-lead electrodes.
   - For patients under 16 years of age, connect the patient cable and place the limb electrodes. For further information, see 11.4.2 Applying ECG Electrodes and 11.4.4.4 Placing 12-Lead Electrodes. The precordial electrodes should be placed at V4R, V1, V2, V4, V5, and V6, and the V3 electrode should be placed at the V4R position as shown below.



3. Once the electrodes have been applied, instruct the patient to position themselves as follows:
   - Arms and legs should be stretched out
   - The patient should be relaxed and lying comfortably.
   - The patient must remain still and silent.
   - The patient should breathe normally, without chewing or clenching their teeth.

12.3 Access to the 12-lead ECG window

To access the 12-lead ECG window, select the shortcut key **12 der.**

12.4 12-lead ECG capture

To capture a 12-lead ECG, select **Screenshot** below the 12-lead ECG window. The screenshot function is set to capture the screen by default. **Screenshot** settings can only be changed in setup mode. For more information, see section 22.7.5, 12-lead ECG Settings.

When the screenshot preview window is displayed, you can perform the following operations.

- **Send:** transmits a screenshot and generates an event.
- **Central Station:** transmits a screenshot to the desired CMS. If **Pers.** is selected, it must Manually enter the IP address of the desired CMS. For information on connecting to the CMS, see 21.5 Connecting to the CMS.
- **FTP:** Transmits a screenshot to the desired FTP server. If **Pers.** is selected, you must manually enter the IP address of the desired FTP server. For information about connecting to the FTP server, see 21.8 Data transmission via FTP protocol.

For information on event review, see 18.7 Event Review.

12.5 Modifying the 12-lead ECG configuration

12.5.1 Verification of patient information

Certain patient information can directly affect the 12-lead ECG analysis. Having complete and accurate patient information is essential for determining an accurate diagnosis and treatment plan.

To verify patient information, follow this procedure:

1. Select any location on the 12-lead ECG waveforms.
2. Check that the patient information entered is complete and correct.
3. If necessary, enter or edit the patient information. **Patient ID and Name** settings **Patient, Age** and **Sex** are relevant for the **Patient Management** menu settings .
4. Select **Save.**

NOTE

- **In patients under 16 years of age, it is recommended to place V3 in V4R and the precordial electrodes in V4R, V1, V2, V4, V5, V6. This is standard practice for patients of this age.**

12.5.2 Adjustment of the 12-lead ECG waves

To configure the 12-lead ECG waveforms, follow this procedure:

1. Select any location on the 12-lead ECG waveforms.
2. Select the **Settings** tab and change the settings as desired.
3. Select ✕ to save the changes.

Except for **Muscle Motion Artifact Filter, Displayed Rhythm Lead, Tachycardia** and **Bradycardia,** the rest of the settings are relevant to those in the **ECG menu.**

The following table lists the related options, default values, and descriptions.

Menu item	Default Description	
Derivation of the rhythm shown	II	It allows you to set the rhythm derivation that should be shown on the first line.
Speed	25 mm/s	It allows you to set the ECG wave speed
ECG Gain	x1	It allows you to set the size of the ECG waveform.
Rhythm format	A derivation	It allows you to set the number of measured rhythm leads.
Muscle movement artifact filter	Des	The muscle motion artifact filter attenuates noise in the wave by restricting the included frequencies. The muscle motion artifact filter is a low-pass filter. Signals exceeding the set frequency are filtered out. • **35 Hz:** only signals at 35 Hz or less are displayed. • **20 Hz:** only signals at 20 Hz or less are displayed. • **Dis:** signals at 350 Hz or less are displayed.
Elimination. Basal deviation	Act	The baseline deviation removal process eliminates most of the deviation interference from the initial value and is also able to preserve the fidelity of the ST segment level.
Tachycardia	100 lpm	It allows you to set the tachycardia threshold. This adjustment is only effective for patients in cases of more than 180 days.
Bradycardia	50 lpm	It allows you to set the bradycardia threshold. This adjustment is only effective for patients in the case of more than 2191 days.
Wave design	Standard	It allows you to set the ECG waveform design. • **Standard:** the wave sequence is I, II, III, aVR, aVL, aVF, V1, V2, V3, V4, V5, V6. • **Cabrera:** the wave sequence is aVL, I, -aVR, II, aVF, III, V1, V2, V3, V4, V5, V6.

NOTE

- **Eliminating the baseline deviation introduces a delay of approximately 1 second. It is recommended to activate Basal Deviation Elimination unless the delay is unacceptable.**

12.5.3 12-lead ECG report configuration

To configure the 12-lead ECG report, follow this procedure:

1. Select any location on the 12-lead ECG waveforms.
2. Select the **Report** tab and change the settings as desired.
3. Select ✕ to save the changes.

The following table lists the related options, default values, and descriptions.

Menu item	Default Description	
Medium complexity	Des	It allows you to determine whether the median complex information will be included in the 12-lead ECG analysis report. The median complex displays a median complex waveform for each of the 10-second leads in 3x4 format

Menu item	Default Description	
Measurement matrix	Des	It allows you to determine whether the information from the measurement matrix will be included in the 12-lead ECG analysis report. The measurement matrix provides 32 measurements for each lead, including Pon (ms), Pdur (ms), QRSon (ms), QRSdur (ms), Qdur (ms), Rdur (ms), Sdur (ms), R'dur (ms), S'dur (ms), P+dur (ms), QRSti. d. in. (ms), P+amp (ÿV), P-amp (ÿV), QRSpap (ÿV), Qamp (ÿV), Increm (ÿV), Samp (ÿV), R'amp (ÿV), S'amp (ÿV), STamp (ÿV), 2/8STT (ÿV), 3/8STT (ÿV), T+amp (ÿV), T-amp (ÿV), QRSarea (ÿV*ms), Rnotch, Pr. (%), STslope (grad), Ton (ms), Tdur (ms), T+dur (ms), QTint (ms).
Measurements	Act	It allows you to determine whether the measurement results will be included in the 12-lead ECG analysis report. The measurement results include Heart Rate, PR Interval, QRS Duration, QT/QTc Interval, P/QRS/T Axes, RV5/SV1 and RV5+SV1.
Interpretation	Act	It allows you to determine whether the diagnosis will be included in the 12-lead ECG analysis report.
Interpretive summary	Act	Allows you to set whether the summary of interpretations will be included in the 12-lead ECG analysis report. **The interpretation summary is included in the report only if Interpretation and Interpretation Summary are activated.**
RV5/SV1	Act	Allows you to set whether RV5/SV1 information will be included in the 12-lead ECG analysis report. RV5/SV1 information is included in the report only if they are activated **Measurements** and **RV5/SV1.**
Amplitude	10 mm/mV	Allows setting the wave amplitude of the printed ECG.
Speed	25 mm/s	It allows you to set the ECG waveform printing speed.
Format 12 derivac.	3x4	Allows you to set the waveform format of the 12-lead ECG analysis report. Let's take the example of **3x 4+1:** the ECG waves are shown in 3 lines and 4 columns followed by a rhythm lead wave.
Rhythm derivation 1	II	• Allows setting the rhythm derivation if **Format 12 derivac.** It is set at **3x4+1.** • Allows setting the rhythm derivation for rhythm measurements and manuals.
Rhythm derivation 2	V2	
Rhythm derivation 3	V5	
Format sequence	Sequential	It allows you to set the printing speed of the ECG waves. • **Simultaneous:** prints the ECG waves simultaneously. • **Sequential:** sequentially prints the ECG waves shown in 3 lines and 4 columns, with 2.5 seconds of ECG data in each column.

12.6 Start of 12-lead ECG measurement

The 12-lead resting ECG analysis provides three measurements, including automatic measurement, manual measurement, and rhythm measurement.

12.6.1 Automatic Measurement

Automatic measurement automatically acquires and analyzes 10 seconds of ECG data.

To start an automatic measurement, follow this procedure:

1. Change the relevant settings for automatic measurement. For more information, see 12.5 Modifying the 12-lead ECG settings.
2. Select **Analyze** below the 12-lead ECG window and wait for the automatic diagnostic results.

• If any connection problems occur, you must take corrective action. For more information, see 12.6.4 Actions when taps are disconnected.

• If the patient information is incomplete, the **Patient Demographic Data menu is displayed.** After selecting **"Don't remember next time," the Patient Demographic Data** menu will not be displayed for subsequent measurements. The Patient Info activation setting **for Input Indication Message** can only be changed in configuration mode. For more information, see section 22.7.5, 12-Lead Menu Setting.

3. After acquiring 10 seconds of ECG data, the 12-lead ECG analysis report is automatically printed. You can choose whether to acquire 10 seconds of 12-lead ECG data before starting the automatic measurement. The **Pre-Acquisition** activation setting can only be changed in setup mode. For more information, see section 22.7.5, 12-Lead Settings Menu.

During the measurement, you can select **Stop** below the 12-lead ECG window to interrupt it at any time.

Extended automatic recording is disabled by default. If enabled, a rhythm measurement is automatically initiated when any of the critical values "extreme tachycardia," "extreme bradycardia," or "significant arrhythmia" are detected at the end of the automatic measurement. The **Extended Recording** activation setting can only be changed in configuration mode. For more information, see section 22.7.5, 12-lead Settings Menu.

NOTE

- **Ensure that the patient information is correct before starting the automatic 12-lead ECG measurement.**

12.6.2 Manual measurement

Manual measurement continuously acquires real-time ECG waveforms from selected rhythm leads. Manual measurement only provides a printed report without measurement or diagnostic results. The report cannot be saved or transmitted.

To start a manual measurement, follow this procedure:

1. Change the relevant settings for manual measurement. For more information, see 12.5 Modifying the 12-lead ECG settings.

2. Select **Manual.** If any connection problems occur, you must take corrective action. For more information, see 12.6.4 Actions when taps are disconnected.

3. Select **Stop** below the 12-lead ECG window. The measurement stops and the 12-lead ECG waveforms are automatically printed.

12.6.3 Rhythm Measurement

Rhythm measurement acquires and prints 60 seconds of ECG data for the rhythm lead. Rhythm measurement only provides a printed report without measurement or diagnostic results. The report cannot be saved or transmitted.

To begin a rhythm measurement, follow this procedure:

1. Change the relevant settings for rhythm measurement. For more information, see 12.5 Modifying the 12-lead ECG settings.

2. Select **Rhythm.** A countdown timer for waveform acquisition is displayed. If any connection problems occur, corrective action must be taken. For more information, see 12.6.4 Actions When Leads Disconnect.

3. After acquiring 60 seconds of ECG data, the measurement stops and the rhythm waves are automatically printed.

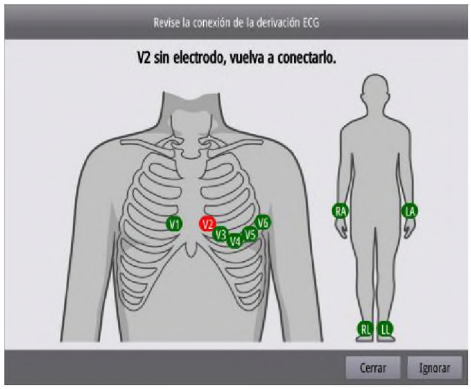
During the measurement, you can select **Stop** below the 12-lead ECG window to interrupt it at any time.

12.6.4 Actions when the branches are disconnected

If the electrodes become disconnected, if any of the leads are incorrectly connected to the electrode, or if the patient cable becomes disconnected from the device, the " **Check ECG Lead Connection" window will appear.** In this case, you should check that all electrodes are securely attached to the patient, that the leads are correctly connected to the electrodes, and that the patient cable is properly connected to the device.

y If any of the limb electrodes are disconnected, the message **"electrode XX (RA/R, LA/L, RL/N, LL/F) disconnected, reconnect it."** You must clear the connection fault as indicated and then restart the measurement.

y If any of the precordial electrodes become disconnected, the message **"electrode XX (V1 to V6/C1 to C6) disconnected, reconnect it" appears.** You can select **Ignore** to continue the measurement or clear the connection failure as indicated, and then restart the measurement.

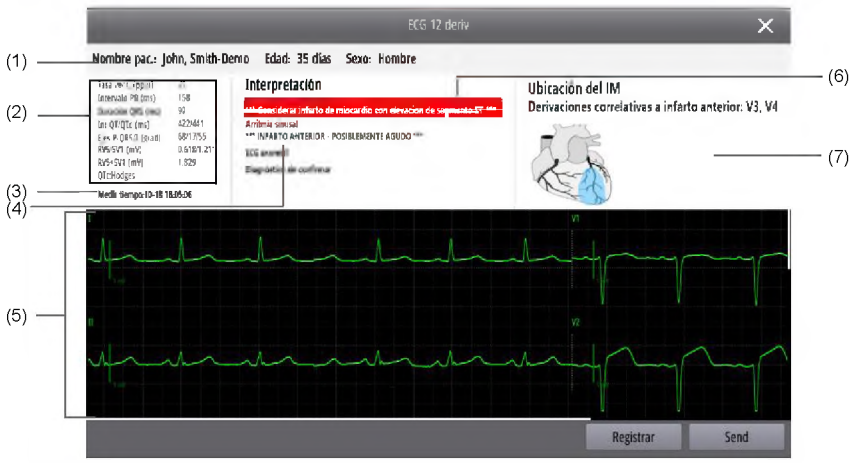


12.7 12-lead ECG analysis report

When the automatic 12-lead ECG measurement is complete, the **12-lead ECG** window is automatically displayed . At the same time, a report of the 12-lead ECG analysis is automatically saved, and Next, a 12-lead ECG analysis event is generated.

12.7.1 Consult the 12-lead ECG report

The following image shows the 12-lead ECG analysis report.



(1) Patient information: includes the patient's name, age, and sex.

(2) Measurements: includes Heart Rate, PR Interval, QRS Duration, QT/QTc Interval, P/QRS/T Axes and QTc Formula.

(3) Time of analysis

(4) Diagnostic results

(5) 12-lead ECG waveforms

(6) Critical values: includes acute ST-segment elevation myocardial infarction, acute ischemia/MI, extreme tachycardia, extreme bradycardia, and significant arrhythmia.

(7) Myocardial infarction (MI) location diagram: graphically indicates the location of the MI, including inferior infarction, lateral infarction, anterior septal infarction, anterior infarction, septal infarction, anterior lateral infarction, and extensive infarction.

12.7.2 Review of the 12-lead ECG analysis report

To review the 12-lead ECG analysis report, select **Review** below the 12-lead ECG window. For more information, see section 18.9 Reviewing the 12-lead ECG analysis.

12.7.3 Transmission of the 12-lead ECG analysis report

You can transmit a 12-lead ECG analysis report to an FTP or CMS server. To do this, select **Send** in the **12-lead ECG** window after the automatic 12-lead ECG measurement is complete and make the following adjustments:

y **Central Station:** Transmits the 12-lead ECG analysis report to the desired CMS. If **Pers.** is
Selected, you must manually enter the IP address of the desired CMS. For information on connecting to the CMS, see 21.5 Connecting to the CMS.

y **FTP:** Transmits the 12-lead ECG analysis report to the desired FTP server. If **Pers.** is
If you have selected the desired FTP server, you must manually enter its IP address. For information on connecting to the FTP server, see section 21.8 Data Transmission via the FTP Protocol.

The format of the 12-lead ECG analysis report transmitted to the CMS is XML.

Default. The **ECG Report** setting can only be changed in configuration mode. For more information, see 22.7.5 Menu Setting 12 leads.

12.7.4 Printing the 12-lead ECG analysis report

After selecting " **Analyze** in Auto Measurement Mode," the 12-lead ECG analysis report is printed automatically. The **Auto Recording** activation setting can only be changed in setup mode. For more information, see section 22.7.5, 12-Lead Settings Menu.

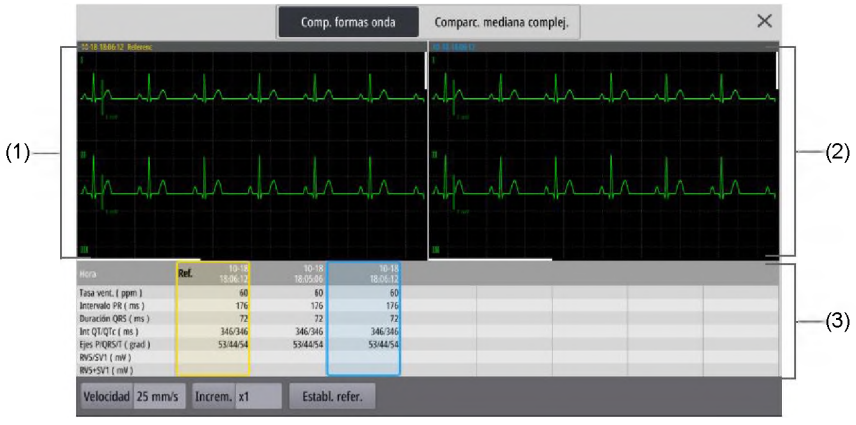
After the automatic 12-lead ECG measurement is complete, you can select **Record** in the **12-lead ECG** window to manually print the 12-lead ECG analysis report.

12.7.5 Comparison of 12-lead ECG analysis reports

If multiple 12-lead ECG analysis reports are saved, you can select two reports for comparison. To do this, follow these steps:

1. Select **Comparac** below the 12-lead ECG window.
2. Select the desired report in the report history area and select **Reference Establishment** to set it as the reference report.
3. Select the other report to be compared in the report history area.
4. Select **Speed** and **Increment** to set the wave comparison display.
5. Select the **Complex Median Comparison** tab to view the complex median comparison.

The following image shows a comparison of the waveforms from 12-lead ECG analysis reports.



(1) Reference waveform area: Displays the 12-lead ECG waveforms from the reference report. The reference report is indicated with **"Reference"** and the measurement time in yellow in the upper left corner.

(2) Comparison waveform area: Displays the 12-lead ECG waveforms from the report to be compared. The measurement time from the report is shown in blue.

(3) Report History Area: Displays the measurement time and results of all saved reports. The reference report is indicated with **"Ref."** in the yellow box, and the comparison report is indicated in the blue box.

12.8 12-lead ECG window output

To exit the 12-lead ECG window, select **Exit 12-lead** below the 12-lead ECG window.

13 Respiratory (Resp) Monitoring

13.1 Introduction to the Resp parameter

Impedance respiration is measured across the chest. When a patient is breathing or receiving ventilation, the volume of air in the lungs changes, resulting in changes in impedance between the electrodes. The respiratory rate (RR) is calculated from these changes in impedance, and a respiratory waveform is generated on the screen.

Respiratory monitoring is indicated for adult, pediatric, and neonatal patients.

13.2 Safety information on the Resp parameter

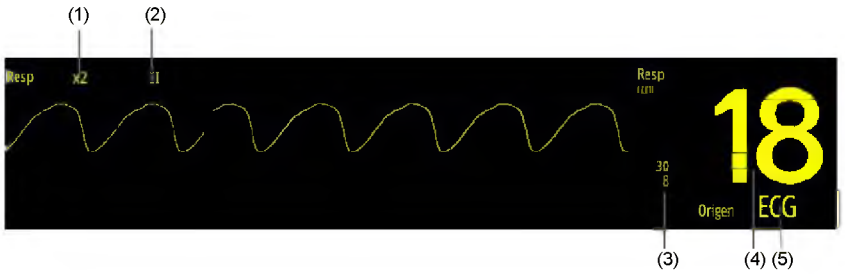
WARNING

- **During patient respiration monitoring, ECG leads should not be used.**
  of electrosurgical units.
- **If you do not correctly set the detection level for breathing in manual detection mode, the device may not detect apnea. If you set the detection level too low, the device is more likely to detect cardiac activity and mistake cardiac activity for respiratory activity in the event of apnea.**
- **Respiration monitoring does not identify the cause of apnea. An alarm is only triggered if no breathing is detected after a pre-set time has elapsed since the last detected breath. Therefore, it cannot be used for diagnostic purposes.**
- **If used under conditions that do not comply with the EMC standard IEC 60601-1-2 (radiation immunity of 3 V/m), field strengths above 3 V/m may cause erroneous measurements at various frequencies. Therefore, it is recommended to avoid using electrically emitting radiation equipment too close to the respiration measurement unit.**
- **Impedance respiration measurement can cause rate changes in pacemakers that respond to minute ventilation rate. Turn off pacemaker rate response mode or disable impedance respiration measurement on the device.**
- **When using the electrosurgical unit (ESU), ensure that the contact between the ESU return electrode and the patient is correct to avoid burns at the measurement points.**
  Also, check that the ESU return electrode is close to the operating area.

CAUTION

- **Respiratory monitoring should not be used in highly active patients, as this will cause false alarms.**

13.3 Screen Response



(1) Response waveform gain
(2) Label of the Resp derivation
(3) Alarm limits
(4) Respiratory rate (RR)
(5) Origin of FR

NOTE

- **If ESU-proof ECG cables are used, the message will be displayed in the Resp waveform area "Compression of derivatives." Replace the ECG cable if necessary.**

13.4 Preparation for Resp monitoring

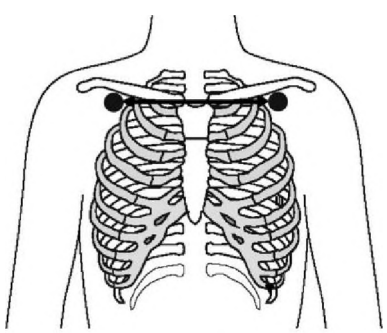
13.4.1 Patient preparation for electrode application

Before starting Resp monitoring, you must prepare the skin properly. For more information, see 11.4.1 Patient preparation for electrode application.

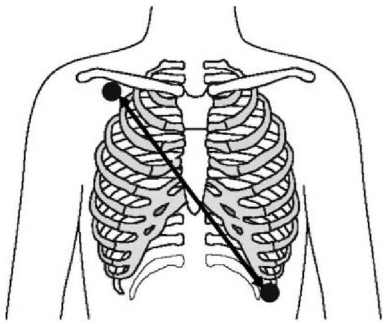
13.4.2 Electrode placement

Because respiration measurement uses standard ECG electrode placement, different ECG leads can be used. Since the respiration signal is measured between two ECG electrodes, if standard ECG electrode placement is used, 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 Placement of ECG electrodes.



Derivation I



Derivation II

CAUTION

- **To reduce cardiovascular artifact, position the respiratory electrodes so that the liver area and cardiac ventricles are not in line with them. This is especially important for neonatal patients.**
- **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.**
- **To optimize respiratory waves in patients with primarily abdominal breathing, place the LL electrode on the left side of the abdomen at the point of maximum abdominal expansion.**
- **In the case of patients who expand their chest laterally (normally patients (neonatal), to avoid negative intrathoracic pressure and optimize respiratory waves, place the electrodes respectively in the right mid-axillary area and in the left lateral areas of the chest at the point of maximum movement during respiration.**
- **Periodically inspect the electrode application area to check skin quality. If skin quality changes, replace the electrodes or change the application site.**

NOTE

- **Store the electrodes at room temperature. Open the electrode package immediately before use.**
- **Check that the electrode packs are intact and have not expired. Check that the electrode gel is moist.**

13.5 Modification of Resp settings

13.5.1 Adjusting the alarm properties of Resp

To set the Resp alarm properties, follow this procedure:

1. Select the numeric data area or the Resp waveform area to access the **Resp menu.**
2. Select the **Alarm tab.**
3. Configure the alarm properties as desired.

NOTE

- **The apnea alarm can only be deactivated when the Apnea Alarm Off setting is activated. For more information, see 10.4.7 Apnea Alarm Off Activation Setting.**

13.5.2 Adjustment of the FR origin

To define the origin of FR, follow this procedure:

1. Select the numeric data area or the Resp waveform area to access the **Resp menu.**
2. Select the **Settings tab.**
3. Establish **FR Origin.**

When **FR Source** is set to **Auto,** the FR source is automatically selected based on priority. The **FR Source** priority is **CO2** first , then **ECG.** If the current FR source is unavailable, **FR Source** automatically switches to **Auto.**

13.5.3 Selection of the breathing shunt

To adjust the breathing shunt, follow this procedure:

1. Select the numeric data area or the Resp waveform area to access the **Resp menu.**
2. Select the **Settings tab.**
3. Establish **Deriv. Resp.**

If you cannot achieve an optimal Resp waveform or suspect that the Resp value is incorrect after selecting the Resp lead, you may need to optimize electrode placement.

13.5.4 Adjusting the Resp Wave Size

To establish the size of the Resp waveform, follow this procedure:

1. Select the numeric data area or the Resp waveform area to access the **Resp menu.**
2. Select the **Settings tab.**
3. Set **Increm.**

13.5.5 Adjustment of the Resp Wave Speed

To adjust the Resp waveform speed, follow this procedure:

1. Select the numeric data area or the Resp waveform area to access the **Resp menu.**
2. Select the **Settings tab.**
3. Set **Speed.**

13.5.6 Start of automatic detection for the Resp wave threshold

You can proceed with automatic detection for the threshold or detection level of the Resp waveform. To do this, follow this procedure:

1. Select the numeric data area or the Resp waveform area to access the **Resp menu.**
2. Select the **Settings tab.**
3. Active **Automatic threshold detection.**

Once **Automatic Threshold Detection** is activated, if ECG is disabled when respiration is monitored, the device cannot compare the ECG and respiratory rate to detect cardiovascular artifacts. To prevent cardiovascular artifacts from being interpreted as respiration, the respiration threshold is automatically adjusted higher.

13.5.7 Manual adjustment of the Resp wave threshold

It is recommended to manually adjust the Resp wave threshold in the following situations:

ÿ The patient is on synchronized intermittent ventilation.

ÿ The patient's breathing is weak.

y The patient's respiratory rate is close to the heart rate.

To manually adjust the Resp wave threshold to the desired level, follow this procedure:

1. Select the numeric data area or the Resp waveform area to access the **Resp menu.**
2. Select the **Threshold tab.**
3. Turn off **Auto threshold detection.**
4. Select below **Line up** and **Line down** to define the threshold of the Resp wave

Once you set the Resp wave threshold, it will not automatically adapt to different breathing depths. Remember to always change the detection level if the breathing depth changes.

If the Resp wave threshold is manually adjusted, cardiovascular artifacts can be misinterpreted as breathing in certain situations. This can lead to an increased respiratory rate or undetected apnea. If the respiratory rate reading is suspicious, adjust the Resp wave threshold to increase the detection level. If you cannot adjust the threshold because the Resp wave is too small, consider changing the electrode placement.

13.6 Troubleshooting Response

If you encounter these problems while using the equipment or accessories, check the following table in D Alarm Messages before requesting assistance. If the problem persists, contact service personnel.

14 Monitoring of oxygen saturation by pulse oximetry (SpO2)

14.1 Introduction to SpO2

Pulse oximetry (SpO2) monitoring is a non-invasive technique used to measure blood oxyhemoglobin levels and pulse rate based on the absorption of specific light waves. Light generated at the side of the probe emitter is partially absorbed as it passes through the monitored tissue. The amount of transmitted light is detected at the side of the probe detector. When the pulsatile portion of the light signal is examined, the amount of light absorbed by hemoglobin is measured, and pulse oximetry oxygen saturation is calculated. The device is supplied calibrated to display functional oxygen saturation.

SpO2 monitoring is indicated for adult, pediatric, and neonatal patients.

The following SpO2 types can be configured:

ÿ Mindray SpO2 : the connector is blue and does not include any logo on the device.

ÿ Nellcor SpO2 : The connector is gray and the Nellcor logo is included on the device.

ÿ Masimo SpO2 : The connector is purple and the Masimo SET logo is included on the device.

NOTE

- **The SpO2 extension cable must be compatible with the SpO2 connectors. In other words, the Mindray SpO2 extension cable can only be connected to Mindray SpO2 connectors.**
- **Verification of measurement accuracy: The accuracy of SpO2 has been verified in human experiments by comparing it to the reference of an arterial blood sample measured with a co-oximeter. Pulse oximeter measurements are statistically distributed, and it is expected that approximately two-thirds of these measurements will fall within the specified accuracy range, compared to measurements made with a co-oximeter.**
- **A functional tester or SpO2 simulator can be used to determine the accuracy of the pulse rate.**
- **A functional tester or SpO2 simulator cannot be used to determine accuracy of SpO2.**

14.2 Safety information on SpO2

WARNING

- **If you observe that the patient has a tendency towards deoxygenation, analyze blood samples with a laboratory co-oximeter to fully understand the patient's condition.**
- **Do not use the SpO2 equipment or sensors during an MRI scan or in an MRI environment. The induced current could cause burns. The equipment may affect the MRI image, and the MRI unit may affect the accuracy of SpO2 measurements.**
- **Prolonged continuous monitoring may increase the risk of unwanted changes in skin characteristics, such as irritation, redness, blisters, or burns. Inspect the sensor site every two hours and reposition it if skin quality has changed. Change the application site every four hours. In newborns or patients with poor peripheral blood circulation or sensitive skin, the sensor site should be inspected more frequently.**
- **If alarm limits are set to extreme values, the alarm system may not be effective. For example, high oxygen levels can trigger retrolental fibroplasia in premature infants. Setting the SpO2 alarm upper limit to 100% is equivalent to disabling the SpO2 alarm.**

- **Do not place the equipment or accessories in any position that could cause them to fall. patient.**
- **Do not start or use the equipment until you have verified that the configuration is correct.**
- **Do not coil patient cables too tightly or around the device, as this**
  It could damage them.
- **If the sensor is too tight because the application site is very thick or increases in size due to edema, excessive pressure for prolonged periods can lead to venous congestion distal to the application site and thus to interstitial edema and tissue ischemia.**
- **When patients undergo photodynamic therapy, they may be sensitive to light sources. Pulse oximetry should only be used under careful clinical supervision for short periods of time to minimize interference with photodynamic therapy.**
- **SpO2 is empirically calibrated in healthy adult volunteers with normal levels of carboxyhemoglobin (COHb) and methemoglobin (MetHb).**
- **To avoid electric shock, always remove the sensor and completely disconnect the pulse oximeter before bathing the patient.**
- **The device's pulse oximeter function should not be used for apnea monitoring.**
- **The device's pulse oximeter function should not be used to analyze arrhythmias.**

CAUTION

- **Change the application site or replace the patient sensor or cable if a persistent "Low SpO2 Signal Quality" message is displayed on the device. These messages may indicate that the patient monitoring time has expired on the patient cable or sensor.**
- **Replace the cable or sensor when a message of "SpO2 sensor disconnected", "No SpO2 sensor" or "Low SpO2 signal quality" appears consistently during monitoring of consecutive patients after performing the steps in this manual.**
- **The variation in measurements can be significant and may be affected by the technique used. Sampling, as well as the patient's physiological condition, are important factors. Results inconsistent with the patient's clinical status should be repeated or supplemented with additional test data. Blood samples should be analyzed in a laboratory before clinical decisions are made to fully understand the patient's condition.**
- **Do not place the pulse oximeter where the patient can adjust the controls. • If**

using the pulse oximeter sensor during whole-body irradiation, keep it out of the irradiation field. Exposure of the sensor to radiation may result in inaccurate readings or a zero reading during the active irradiation period.

NOTE

- **Additional information specific to the Masimo sensors compatible with the device can be found in the sensor's user manual (DFU), including information on parameter performance or measurement during movement and low perfusion.**
- **Masimo cables and sensors are equipped with X-Cal™ technology to minimize the risk of inaccurate readings and unexpected loss of patient monitoring. Refer to the sensor or cable's instructions for use to determine the specified patient monitoring duration.**

14.3 Limitations of SpO2 measurement

The following factors may affect the accuracy of SpO2 measurement:

ÿ Physiological characteristics of the patient:

- Cardiac arrest
- Hypotension
- Dark pigmented skin
- Download

- Severe vasoconstriction
- Hypothermia
- Severe anemia
- Ventricular septal defect (VSD)
- Venous pulsations
- Poor perfusion
- Dysfunctional hemoglobin, such as carboxyhemoglobin (COHb) and methemoglobin (MetHb)
- Elevated bilirubin levels
- Vasospastic disease, such as Raynaud's disease and peripheral vascular disease
- Hemoglobinopathies and synthesis disorders such as thalassemias, hemoglobin s, hemoglobin c, sickle cell disease, etc.
- Hypocapnic or hypercapnic conditions
- Birthmarks, tattoos, skin discoloration, skin moisture, deformed fingers or anomalous, etc.

ÿ Substances that cause interference:

- Intravascular dyes (such as indocyanine green, methylene blue, indigo carmine, etc.).
- Dyes at the measuring point, such as nail polish.

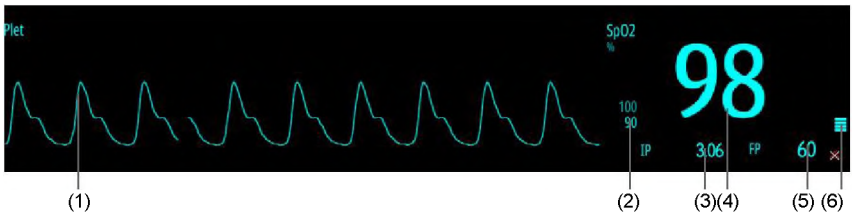
ÿ Environmental conditions:

- Excessive ambient light
- Electrosurgical equipment
- Defibrillation (may cause inaccurate readings for a short period of time)
- Excessive patient/sensor movement
- Electromagnetic field
- Arterial catheters and intra-aortic balloon

ÿ Others

- Incorrect placement of the SpO2 sensor or incorrect use of the SpO2 sensor.
- Blood pressure cuff or measuring device on the same limb as the sensor SpO2.

14.4 SpO2 Display



(1) Plethysmographic waveform: indicates the blood pulse at the measurement point. The waveform does not normalize.

(2) Alarm limits

(3) Perfusion Index (PI) (for Mindray SpO2 and Masimo SpO2): Indicates the percentage of pulsatile signal relative to the non-pulsatile signal. The perfusion index value is an indicator of pulse strength. Additionally, this value can be used to assess SpO2 signal strength.

- Above 1 is optimal.
- Between 0.3 and 1 is acceptable.
- A reading below 0.3 indicates low perfusion. Reposition the SpO2 sensor or find a better location. If the low perfusion level persists, use another method to measure oxygen saturation if possible.

(4) Arterial blood oxygen saturation (SpO2): indicates the percentage of oxygenated hemoglobin in relation to total hemoglobin.

(5) Pulse rate: indicates the number of beats per minute.

(6) Perfusion indicator: the pulsatile component of the measured signal originating from the arterial pulse. The larger the bar, the better the perfusion quality.

NOTE

- **The PI value is available for Mindray SpO2 or Masimo SpO2.**

14.5 Preparation for SpO2 monitoring

In preparation for SpO2 monitoring , follow this procedure:

1. Select an appropriate sensor based on the module type, placement location, patient category, and the weight.
2. Clean the contact surface of the reusable sensor.
3. Clean the measuring area, such as removing nail polish.
4. Apply the sensor to the patient according to the sensor's instructions for use.
5. Select a suitable extension cable according to the connector type and plug this cable into the connector of SpO2.
6. Connect the sensor to the extension cable.

CAUTION

- **Select an appropriate SpO2 sensor based on the placement site. Tightening the sensor too much can severely obstruct circulation and lead to inaccurate measurements. A loose fit can expose the measurement site to ambient light.**
- **Do not place the SpO2 sensor on the same limb as the NIBP cuff, arterial catheter, or the intravascular route.**
- **When monitoring SpO2 in high ambient temperatures, to avoid burns at a placement site that is not well perfused, be careful with prolonged application of the SpO2 sensor.**

14.6 Modification of SpO2 settings

14.6.1 Modification of SpO2 alarm properties

To change the SpO2 alarm properties, follow this procedure:

1. Select the numeric data area or the SpO2 waveform area to access the **SpO2 menu.**
2. Select the **Alarm tab.**
3. Configure the alarm properties as desired.

NOTE

- **The SpO2 alarm can only be deactivated when it is activated. (SPO2 Alarm Deactivated)**
  For more information, see 22.7.3 Alarm settings menu.

14.6.2 Simultaneous monitoring of SpO2 and NIBP

When monitoring SpO2 and NIBP in the same limb simultaneously, you can activate the **simultaneous NIBP** option to lock the SpO2 alarm status until the NIBP measurement is complete. If you deactivate the **simultaneous NIBP option,** the low perfusion caused by the NIBP measurement may result in inaccurate SpO2 readings and, therefore, false physiological alarms.

To configure **simultaneous PANI,** follow this procedure:

1. Select the numeric data area or the SpO2 waveform area to access the **SpO2 menu.**
2. Select the **Alarm tab.**
3. Establish **simultaneous PANI.**

14.6.3 Nellcor Saturation Seconds Alarm Management

In traditional alarm management, high and low alarm limits are set for oxygen saturation monitoring. During monitoring, an audible alarm sounds immediately as soon as an alarm limit is exceeded. When the patient's SpO2 value fluctuates near an alarm limit, the alarm sounds every time the limit is exceeded. This frequent alarm activation can be distracting. Nellcor's Sat Seconds alarm management technique is used to reduce these disruptive alarms.

The Sat. Seconds function is available with the Nellcor SpO2 module to reduce the likelihood of false alarms triggered by motion artifacts. When managing the Sat. Seconds alarm, the high and low alarm limits are defined in the same way as in traditional alarm management.
Similarly, a Sat Seconds limit is established. The Sat Seconds limit controls the amount of time that SpO2 saturation must be outside the established limits for the alarm to sound.

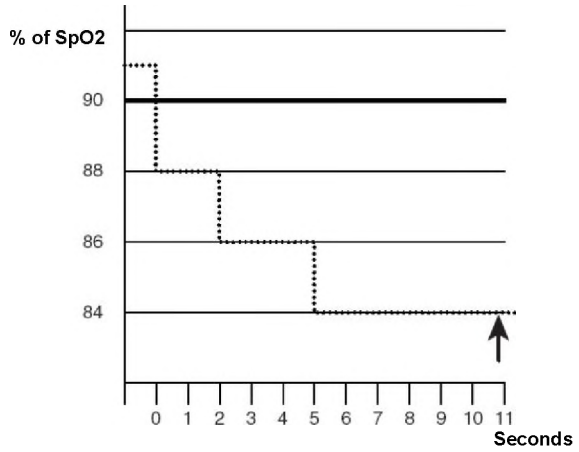
The calculation method is as follows: the percentage points of SpO2 saturation that fall outside the alarm limit are multiplied by the number of seconds they remain outside the limit. This is represented in the equation:

Saturation time in seconds = Points × Seconds

Only when the Sat Seconds limit is reached does the monitor sound a Sat Seconds alarm. For example, the figure below shows the alarm response time with a Sat Seconds limit set to 50 and a low SpO2 limit set to 90%. In this example, the patient's SpO2 value drops to 88% (2 points) and remains there for 2 seconds. It then drops to 86% (4 points) for 3 seconds, and finally to 84% (6 points) for 6 seconds. The Sat Seconds are:

% of SpO2	Seconds	Seconds of sat
2×	2=	4
4×	3=	12
6×	6=	36
Seconds of sat		52

After approximately 10.9 seconds, a "Seconds of Sat" alarm would sound, as the 50 Seconds of Sat limit would have been exceeded.



Oxygen saturation may fluctuate instead of remaining stable for several seconds. Often, the patient's SpO2 value may fluctuate above and below an alarm limit, re-entering the alarm-free range several times. During this fluctuation, the device integrates the number of SpO2 points, both positive and negative, until the saturation limit is reached or until the patient's SpO2 value re-enters and remains within the alarm-free range.

NOTE

- The "SpO2 **too low" or "SpO2** too high" **alarm is displayed if the SpO2 value**
  It exceeds the alarm limits 3 times in one minute even if the Sat Seconds setting is not reached.

14.6.4 Adjusting SpO2 Sat Seconds (for Nellcor SpO2)

To set the value of Sat. Seconds, follow this procedure:

1. Select the numeric data area or the SpO2 waveform area to access the **SpO2 menu.**
2. Select the **Alarm tab.**
3. Set **Sat Seconds.**

14.6.5 Adjusting SpO2 sensitivity (for Masimo SpO2)

For Masimo SpO2 , set **Sensitivity** according to signal quality and patient movement.

Normal sensitivity is recommended for patients who are more susceptible to being affected by blood flow or perfusion. It is recommended for care areas where patients are frequently observed, such as the intensive care unit (ICU).

Adaptive Probe Disconnect Detection (APOD) sensitivity is the recommended sensitivity mode where there is a high probability of the sensor becoming detached. It is also the recommended mode for care areas where patients are not continuously monitored visually. This mode provides greater protection against erroneous pulse rate and arterial oxygen saturation readings when a sensor accidentally becomes detached from a patient due to excessive movement.

It is recommended to use maximum sensitivity in patients with weak signals (e.g., high ambient noise or patients with very low perfusion) and also during procedures or when contact between the qualified healthcare professional and the patient is continuous, such as in the most critical situations.

To define the sensitivity of the SpO2 sensitivity, follow this procedure:

1. Select the numeric data area or the SpO2 waveform area to access the **SpO2 menu.**
2. Select the **Settings tab.**
3. Set **Sensitivity.**

CAUTION

- **When the maximum sensitivity is set, the detection performance may be affected "Sensor disconnected." may be compromised. If the equipment and sensor become detached from the patient, false readings may occur due to ambient noise such as light and vibration.**

14.6.6 Activation of FastSAT (for Masimo SpO2)

FastSAT allows for rapid monitoring of changes in arterial oxygen saturation, data that may be necessary in emergency situations. When FastSAT is activated, the averaging algorithm evaluates all SpO2 values and provides an average SpO2 value that better represents the patient's current oxygen saturation.

FastSAT reliability depends on the average time and input signal settings. FastSAT is disabled by default. To enable it, follow these steps:

1. Select the numeric data area or the SpO2 waveform area to access the **SpO2 menu.**
2. Select the **Settings tab.**
3. Active **SAT fast.**

14.6.7 SQI Display Configuration (for Masimo SpO2)

The Signal Quality Indicator (SIQ) appears below the plethysmographic waveform. The SIQ consists of vertical bars. The height of the toolbar provides an assessment of the reliability of the SpO2 value. shown. The SpO2 SIQ can also be used to identify the presence of a patient pulse.

The following image shows the SpO2 SIQ:

(1) Signal Quality Indicator (SIQ)

To configure the SpO2 SIQ display, follow this procedure:

1. Select the numeric data area or the SpO2 waveform area to access the **SpO2 menu.**
2. Select the **Settings tab.**
3. Adjust the Show SIQ activation .

14.6.8 Modification of the mean time (for Masimo SpO2)

The SpO2 value displayed on the screen is the average of the data collected over a specific period. The shorter the average time, the faster the device will respond to changes in the patient's oxygen saturation level. Conversely, the longer the average time, the longer it will take the device to respond to changes in the patient's oxygen saturation level. However, the SpO2 measurement is more stable. In critically ill patients, selecting a shorter average time will help to better understand the patient's condition.

To establish the average time, follow this procedure:

1. Select the numeric data area or the SpO2 waveform area to access the **SpO2 menu.**
2. Select the **Settings tab.**
3. Set **Average.**

14.6.9 Sensitivity modification (for Mindray SpO2)

The SpO2 value displayed on the screen is the average of the data collected over a specific period. The shorter the average time, the faster the device will respond to changes in the patient's oxygen saturation level. Conversely, the longer the average time, the longer it will take the device to respond to changes in the patient's oxygen saturation level. However, the SpO2 measurement is more stable. In critically ill patients, selecting a shorter average time will help to better understand the patient's condition.

To establish the average time, follow this procedure:

1. Select the numeric data area or the SpO2 waveform area to access the **SpO2 menu.**
2. Select the **Settings tab.**
3. Set **Sensitivity.**

14.6.10 PI Screen Adjustment

You can choose whether or not to display PI in the SpO2 parameters area. To do this, follow this procedure:

1. Select the numeric data area or the SpO2 waveform area to access the **SpO2 menu.**
2. Select the **Settings tab.**
3. Adjust the Show PI activation .

14.6.11 Change in the speed of the plethysmographic wave

To adjust the plethysmographic waveform sweep speed, follow this procedure:

1. Select the numeric data area or the SpO2 waveform area to access the **SpO2 menu.**
2. Select the **Settings tab.**
3. Set **Speed.**

14.7 Modification of FP settings

14.7.1 Modifying FP alarm properties

To change the properties of the FP alarm, follow this procedure:

1. Select the numeric data area or the SpO2 waveform area to access the **SpO2 menu.**
2. Select the **FP** tab ÿ select the **Alarm tab.**
3. Configure the alarm properties as desired.

14.7.2 Modification of QRS volume

If **Alarm Origin** is set to **FP,** the QRS tone is obtained from the FP measurements. To adjust the QRS volume, follow this procedure:

1. Select the numeric data area or the SpO2 waveform area to access the **SpO2 menu.**
2. Select the **FP** tab ÿ select the **Adjust tab.**
3. Set **QRS Volume.**

If the SpO2 value is accurate, the device also adjusts the QRS tone according to the SpO2 value.

14.7.3 Definition of FP adjustment

The current pulse source is displayed in the FP numeric value area. The current source FP is monitored as a system pulse and generates alarms when FP is selected as the alarm source.

To define the origin of the pulse frequency (PF), follow this procedure:

1. Select the numeric data area or the SpO2 waveform area to access the **SpO2 menu.**
2. Select the **FP** tab ÿ select the **Adjust tab.**
3. Establish **FP Origin.**

The **FP Source** list displays available FP sources from top to bottom in order of priority. When **FP Source** is set to **Auto,** the first option is automatically selected as the FP source. If the current FP source is unavailable, **FP Source** is automatically changed to **Auto.**

14.7.4 FP Screen Adjustment

You can choose whether or not to display the FP value in the SpO2 parameter area. To do this, follow these steps:

1. Select the numeric data area or the SpO2 waveform area to access the **SpO2 menu.**
2. Select the **FP** tab ÿ select the **Adjust tab.**
3. Adjust the Display FP activation .

14.8 Troubleshooting SpO2

This section includes a list of problems that may occur. If you encounter these problems while using the equipment or accessories, check the following table before requesting assistance. If the problem persists, contact service personnel.

NOTE

- **For information on technical and physiological alarm messages, see D Alarm messages.**

Problem	Solution
The main screen does not display the numeric values area or the waveform area. SpO2	1. Verify that the SpO2 parameter is configured in the **Display Settings** menu to appear on the screen. For more information, see 9.2.3 Setting the Normal Display. 2. Check that the SpO2 parameter switch is on. If it is not, turn on SpO2 measurement. For more information, see 9.2.2 Setting up a parameter. 3. Check that the SpO2 sensor cable and extension cable connections are tight. Replace the SpO2 sensor or extension cable if necessary.
Number dashes are instead displayed.	1. Check that the SpO2 sensor cable and extension cable connections are tight. Replace the SpO2 sensor or extension cable if necessary. 2. Reconnect the SpO2 sensor if the **"SpO2 Sensor"** alarm appears **"dis"** 3. Check the PI value. If the PI value is too low, adjust the SpO2 sensor or place the sensor in a location with better perfusion. 4. Place the sensor in a location with less light or cover the sensor with a piece of fabric if the **"SpO2 sensor disconnect"** alarm appears
Low amplitude SpO2 signal	1. The SpO2 sensor and the NIBP cuff have been placed in the same limb. Change one of the monitoring points if necessary. 2. Check the PI value. If the PI value is too low, adjust the SpO2 sensor or place the sensor in a location with better perfusion. 3. Check the sensor and its placement location.
The SpO2 value is inaccurate.	1. Check the patient's vital signs. 2. Check for situations that may cause incorrect SpO2 readings . For more information, see 14.3 Limitations of SpO2 measurement. 3. Check that the SpO2 equipment or module is functioning correctly.

14.9 Information from Nellcor

y Nellcor Patents

This device may be protected by the following United States patents and equivalent patents in other countries: 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.

y No implied license

Possession or purchase of this device does not grant the user any express or implied license to use the device with unauthorized replacement parts that may, by themselves or in combination with the device, conflict with one or more patents relating to it.

14.10 About Masimo

Masimo's Patents

This publication serves as notice under Section 287(a) of Title 35 of the United States Code for Masimo's patents: http://www.masimo.com/patents.htm.

No implied license

Possession or purchase of this device does not grant the user any express or implied license to use the device with unauthorized sensors or cables that may, alone or in combination with the device, conflict with one or more patents related to said device.

14.11 Masimo End User License Agreement

THIS DOCUMENT IS A LEGAL AGREEMENT BETWEEN YOU ("BUYER") AND SHENZHEN MINDRAY. If you do not agree to the terms of this agreement, please return the entire package, including all accessories, in its original packaging, along with your sales receipt, to SHENZHEN MINDRAY for a full refund.

1. Grant of License. In consideration for the payment of the license fee, which is part of the price paid for the product, Shenzhen Mindray grants the buyer a limited and non-transferable license, without the right to sublicense, to use one copy of the embedded software or firmware and documentation related to the buyer's use of Masimo products for the stated purposes.

   Shenzhen Mindray reserves all rights not expressly granted to the buyer.

2. Ownership of the software or firmware. Ownership, title, and all rights and interests in
   Any Masimo software or firmware and documentation, as well as all copies thereof, belong at all times to Masimo Corporation, licensor of Shenzhen Mindray and do not pass to the purchaser.

3. Assignment. The buyer may not assign or transfer this license, in whole or in part, by legal or other means, without the prior written consent of Shenzhen Mindray; any attempt to assign, without such consent, any right, duty or obligation arising from this agreement shall be void.

4. Copying Restrictions. The software or firmware, rights to integrated circuit layout designs, circuit board designs, and accompanying written materials are protected by copyright. Unauthorized copying of the software, including software that has been modified, merged, or bundled with other software or written materials, is expressly prohibited. You may be held legally liable for any copyright infringement you cause or incur through your failure to comply with the terms of this license. Nothing in this license provides rights beyond those provided in Section 117 of Title 17 of the United States Code.

5. Use Restriction. As the purchaser, you may physically transfer the products from one location to another, provided that the software or firmware is not copied. You may not electronically transfer the product's software or firmware to any other device. You may not disclose, publish, translate, distribute copies of, modify, reverse engineer, decompile, disassemble, or create derivative works based on the Masimo product, software, firmware, or written materials without Masimo's prior written consent. Masimo sensors designated for single use are licensed under Masimo patents for use in a single patient and are not for sale. There is no license, implied or otherwise, permitting the use of Masimo single-use sensors beyond their intended single use.

   After use of Masimo single-use sensors, there is no further license granted by Masimo for the use of the sensors and they must be disposed of.

6. Transfer Restrictions. The purchaser holds a license to the software or firmware, which may not be transferred to anyone except other end users without the prior written consent of Shenzhen Mindray. Under no circumstances may the purchaser transfer, assign, rent, lease, sell, or otherwise dispose of the software or firmware or the products temporarily.

7. Beneficiary. Masimo Corporation is one of the beneficiaries of this agreement and has the right to enforce its provisions.

U.S. Government Rights: If you acquire software (including related documentation) on behalf of any part of the U.S. Government, the following provisions will apply: The software is considered "commercial software" and "commercial computer software documentation," respectively, pursuant to DFAR Section 227.7202 FAR 12.212, as applicable. Any use, modification, reproduction, publication, performance, display, or disclosure of the software (including related documentation) by the U.S. Government or any of its agencies will be governed exclusively by the terms of this agreement and is prohibited except to the extent expressly permitted by the terms of this agreement.

15 Non-invasive blood pressure monitoring

(PANI)

15.1 Introduction to PANI

The device measures non-invasive blood pressure (NIBP) using oscillometry. NIBP measurement is based on the principle that the pulsatile blood flow through an artery creates oscillations in the arterial wall.
Oscillometry measures the mean pressure, and determines the systolic and diastolic pressures.

NIBP monitoring is indicated for adult, pediatric, and neonatal patients.

NOTE

- **Blood pressure measurements made with this device are equivalent to those obtained by a qualified observer using the cuff/auscultation method with a stethoscope or by means of an intra-arterial blood pressure measuring device, within the limits established by the American National Standard Institute for manual, electronic and automatic sphygmomanometers.**

- **NIBP measurement can be performed during electrosurgery and electroconvulsive therapy.** defibrillator.

15.2 Safety information about PANI

WARNING

- **Before taking the NIBP measurement, check that you have selected the correct patient category. Do not apply the higher adult settings to children or newborns. Doing so could result in a dangerous situation.**
- **Do not perform NIBP measurements in patients with sickle cell anemia.**
- **To avoid further injury, do not apply the PANI sleeve to a limb with a wound.**
- **Use clinical judgment to determine whether frequent unsupervised blood pressure measurements should be performed in patients with severe clotting disorders, due to the risk of bruising in the limb wearing the cuff.**

- **To avoid the risk of causing injury to the patient, do not place the NIBP cuff on a** The limb with a catheter or intravenous infusion. If possible, place the cuff on another limb.

- **Do not use the cuff on the arm on the side of the mastectomy or lymph node removal** lymphatics.
- **Continuous pressure from the sleeve due to bends in the connecting tube could cause** interference with the bloodstream and painful injuries to the patient.
- **NIBP readings can be affected by the measurement site, patient position, exercise, or the patient's physiological state. If you have any doubts about the NIBP readings, determine the patient's vital signs by other means and check that the monitor is functioning correctly.**
- **NIBP measurements exert pressure on the patient's tissue. This can cause purpura, ischemia, and neuropathy. Periodically check the cuff site and the extremity distal to the cuff for normal color, temperature, and sensation. If there are any signs of skin changes or inadequate distal circulation, reposition the cuff on another extremity or stop NIBP measurements. Perform more frequent checks at shorter intervals when using STAT or automatic mode. Automatic NIBP measurements at one- or two-minute intervals are not recommended.**

  prolonged periods of time.
- **The diagnostic significance of PANI should be decided by the physician.**

CAUTION

- **The use of BCIA may cause NIBP measurements, including FP, to be inaccurate or fail.**
- **The accuracy of NIBP measurement depends on the use of a cuff of the correct size**
  Correct. It is essential to measure the circumference of the limb and choose a cuff of the appropriate size.

15.3 Limitations of NIBP measurement

NIBP measurement may be inaccurate or impossible to perform in the following situations:

ÿ The patient is connected to extracorporeal circulation.

ÿ Regular blood pressure pulses are difficult to detect.

ÿ The patient has cardiac arrhythmias.

ÿ The patient's blood pressure changes drastically.

ÿ The patient has poor circulation due to severe tremors or hypothermia.

ÿ The PANI cuff is placed on an edematous limb.

ÿ The PANI sleeve is compressed due to excessive movement, such as, for example, produced due to tremors, epileptic seizures, or convulsions.

ÿ The patient's blood pressure is outside the measurement range.

NOTE

- **The effectiveness of this sphygmomanometer has not been established in pregnant women, including preeclamptic patients.**

15.4 Measurement modes

The available NIBP measurement modes are listed below:

ÿ Manual mode: measurement is performed on demand.

ÿ Automatic mode: repeated measurements are taken at the set time interval.

ÿ STAT mode: rapid and continuous series of measurements over a period of five minutes.

ÿ Sequence mode: continuous automatic measurement with set duration and intervals.

15.5 PANI Screen

The PANI screen only displays numerical data.

(1) Systolic pressure

(2) Time of the last PANI measurement

(3) Time until next measurement (for automatic mode and sequence mode)

(4) Measurement mode: For automatic NIBP measurements, the interval is displayed; for the mode of sequence; the interval and current phase are shown

(5) Diastolic pressure

(6) Average pressure (displayed once the measurement is complete) or cuff pressure (displayed during the measurement)

(7) PANI quick key: starts or stops PANI measurements.

(8) Pulse rate

(9) Diastolic blood pressure alarm limits

NOTE

- **If an error occurs during NIBP measurement, "XX" is displayed; if the NIBP measurement does not It is performed, "--" is shown.**
- **The highlighted NIBP values indicate that the measurement has exceeded the NIBP waiting time. Therefore, it is not recommended to use these NIBP values as a reference. The NIBP waiting time expired setting can only be changed in configuration mode. For more information, see section 22.7.4.8 NIBP setting tab.**

15.6 Preparation for NIBP measurements

15.6.1 Patient preparation for NIBP measurements

Under normal conditions, perform the NIBP measurement with the patient in the following position:

y Comfortably seated

y Uncrossed legs

y Soles of the feet on the ground

y Back, arm and feet supported

NOTE

- **It is recommended that the patient relax as much as possible before taking the measurement and not speak during the measurement.**
- **It is recommended to wait until the patient has been sitting quietly for several minutes before taking the measurement.**
- **Other factors that have been shown to cause an overestimation of blood pressure are Difficulty breathing, full bladder, pain, etc.**

15.6.2 Placement of the PANI cuff

To place the PANI cuff, follow this procedure:

1. Verify that the patient category setting is correct. If not, select the patient category symbol and change the **Patient Category setting.**
2. Connect the air tubes to the PANI connector.
3. Measure the circumference of the patient's limb.
4. Select an appropriate cuff based on the limb circumference indicated on the cuff. The width of the cuff should be equal to 40% of the limb circumference (50% in newborns) or 2/3 of the length of the upper arm or thigh. The inflatable portion of the cuff should cover at least 50 to 80% of the limb.
5. Place the cuff on the patient's upper arm or thigh and verify that the y mark on the cuff aligns with the location of the artery. The cuff should fit snugly, but with enough room to insert two fingers between the cuff and the patient's arm (in adults) and looser in neonates, with little or no air inside. If the cuff is too tight, it can cause discoloration and ischemic injury to the distal extremity. Ensure that the index line on the cuff is within the cuff's range markings.

6. Check that the center of the cuff is at heart level. If not, correct the measurement using the measurement correction formula. For more information, see 15.8.10 Correction of NIBP Measurements.

7. Connect the sleeve to the air tube. Check that the air tubes are not bent or compressed and that air can pass through them without restriction.

CAUTION

- **The use of an incorrectly sized sleeve or a sleeve with a twisted air chamber and Bent tubes can produce incorrect measurements.**
- **Do not touch or apply external pressure against the cuff or air tube during measurement PANI. This could lead to inaccuracies in blood pressure readings.**
- **Use caution if you place the cuff on a limb used for monitoring other patient parameters.**

15.7 Start and stop of PANI measurements

NIBP measurements can be started and stopped by selecting or through the **PANI menu.**

Task		By hotkey	From the PANI menu
Start of measurements PANI	A manual measurement	Select	Select **Start PNI.**
	Automatic measurements	Adjust the NIBP interval y select	Select the **Adjust** tab y set **Interval** y select **Start NIBP.**
	Sequential measurement	Adjust the sequence of PANI y select	Select the **Sequence** tab y establish the PANI sequence y Select **Start PNI.**
	STAT Measurements	/	Select **STAT.**
Stop measurements of PANI	Current measurement	Select	Select **Stop PNI.**
	STAT Measurements	Select	• Select **Stop PNI.** • Select **Stop all PANI.**
	All measurements (automatic and sequential measurements)	/	Select **Stop all PANI.**

15.8 Modification of PANI settings

15.8.1 Adjusting the PANI alarm properties

To set the PANI alarm properties, follow this procedure:

1. Select the PANI numeric data area to enter the **PANI menu.**
2. Select the **Alarm tab.**
3. Configure the alarm properties as desired.

15.8.2 Adjusting the initial cuff inflation pressure

To adjust the initial inflation pressure of the cuff, follow this procedure:

1. Select the PANI numeric data area to enter the **PANI menu.**
2. Select **Initial Pressure** and choose the appropriate setting.

NOTE

- **In the case of patients with known hypertension, the initial cuff pressure should be defined in a higher value to reduce measurement time.**

15.8.3 Adjustment of the NIBP interval

To perform automatic NIBP measurements, you must set the interval between NIBP measurements. To set the NIBP interval, follow this procedure:

1. Select the PANI numeric data area to enter the **PANI menu.**
2. Establish **Interval.**

15.8.4 Selecting the PANI Startup Mode

The startup mode defines how PANI's automatic mode operates. To set the startup mode, follow this procedure:

1. Select the PANI numeric data area to enter the **PANI menu.**
2. Set **Startup Mode.**
   - **Clock:** After the first measurement, the device automatically synchronizes the measurements Automatic NIBP measurements with real-time clock. For example, if the interval is set to **20 minutes** and automatic NIBP measurement starts at 2:03 PM, the next measurement will be taken at 2:20 PM, then at 2:40 PM, then at 3:00 PM, and so on.
   - **Interval:** After the first measurement, the device automatically repeats the measurements at intervals. function of the set interval. For example, if **Interval** is set to **20 min** and an automatic NIBP measurement starts at 14:03, the next measurement will be taken at 14:23, then at 14:43, then at 15:03 and so on.

15.8.5 PANI Final Tone Activation Adjustment

The device may emit a tone to alert you when the NIBP measurement is complete. To adjust the activation of the final NIBP tone, follow this procedure:

1. Select the PANI numeric data area to enter the **PANI menu.**
2. Adjust the **PANI Final Tone** activation .

15.8.6 NIBP Sequence Adjustment

Sequential NIBP measurement includes a maximum of five phases. The duration and interval of each phase can be configured individually.

To configure the PANI sequence, follow this procedure:

1. Select the PANI numeric data area to enter the **PANI menu.**
2. Select the **Sequence tab.**
3. Establish the **Duration** and **Interval** of each phase.

15.8.7 Adjust the PANI display format

To configure the PANI display format, follow this procedure:

1. Select the PANI numeric data area to enter the **PANI menu.**
2. Set **Visual Format.**

15.8.8 Adjusting the NIBP Alarm Limits Display

You can choose whether to display the alarm limits for diastolic NIBP and mean NIBP. To do this, follow these steps:

1. Select the PANI numeric data area to enter the **PANI menu.**

2. Adjust the activation of **Display alarm limits.**

15.8.9 FP Screen Adjustment

You can choose whether or not to display the FP in the PIN parameters area. To do this, follow this procedure:

1. Select the PANI numeric data area to enter the **PANI menu.**
2. Adjust the Display FP activation .

15.8.10 Correction of PANI measurements

The center of the cuff should be at the level of the right atrium. If the limb is not at the level of the heart, the measurement must be corrected:

- Add 0.75 mmHg (0.10 kPa) to the indicated value for each centimeter higher.
- Subtract 0.75 mmHg (0.10 kPa) from the indicated value for each centimeter that is lower.

15.9 Venipuncture assistance

You can use the NIBP cuff to create subdiastolic pressure that blocks venous blood vessels, thus facilitating venipuncture. To assist with venipuncture, follow this procedure:

1. Select the PANI numeric data area to enter the **PANI menu.**
2. Set **Venipuncture Pressure.**
3. Select **Venipuncture** at the bottom.
4. Perform the venipuncture and draw a blood sample.
5. Select  to deflate the cuff. If you do not deflate the cuff, the cuff will deflate automatically after a period of time (170 seconds for adult and pediatric patients, 85 seconds for neonatal patients).

During venipuncture, pay attention to the cuff pressure and the remaining time indicated in the NIBP numerical values area.

15.10 Maintenance of the PANI measurement unit

PANI maintenance includes PANI leak testing and PANI accuracy testing. This should be performed annually or whenever there are doubts about the accuracy of PANI measurements. PANI maintenance should only be performed by qualified Mindray service personnel.

15.11 NIBP Troubleshooting

If you encounter these problems while using the equipment or accessories, check the following table in D Alarm Messages before requesting assistance. If the problem persists, contact service personnel.

16 Monitoring of carbon dioxide (CO2)

16.1 Introduction to CO2

CO2 monitoring is a continuous, non-invasive technique for determining the concentration of CO2 in a patient's airways by measuring the absorption of infrared (IR) light at specific wavelengths. CO2 has unique absorption characteristics, and the amount of light that passes through the gas probe depends on the measured CO2 concentration . When a specific band of IR light passes through respiratory gas samples, the CO2 molecules absorb some of the IR light. The amount of IR light transmitted after passing through the respiratory gas sample is measured by a photodetector. The CO2 concentration is then calculated from the amount of IR light measured.

CO2 monitoring is indicated for adult, pediatric, and neonatal patients.

16.2 CO2 Safety Information

WARNING

- **Position all tubes away from the patient's throat to avoid strangulation.**

CAUTION

- **Remove the sampling tube from the patient's airway when nebulized medications are being administered.**
- **EtCO2 values measured from the CO2 module may differ from those obtained with the blood gas analysis.**

NOTE

- **The CO2 module automatically suppresses physiological alarms until respiratory waves are detected. Ensure the patient is properly connected when monitoring with the CO2 module.**

16.3 Limitations of CO2 measurement

The following factors may affect the accuracy of the measurement:

ÿ Leaks or internal ventilation of the gas sample.

ÿ Mechanical shocks.

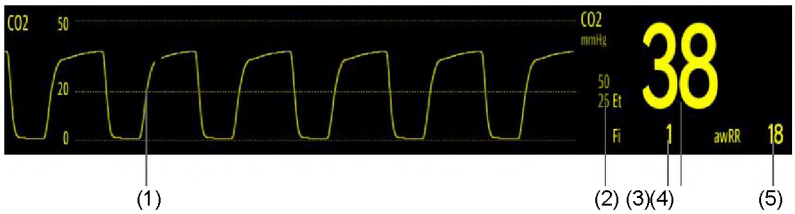
ÿ Cyclic pressure up to 10 kPa (100 cmH2O)

ÿ Other sources of interference, if any

The accuracy of the CO2 lateral flow module measurement can be affected by respiratory rate and the inspiration/expiration (I/E) ratio. For more information, see A.8.7 CO2 Specifications.

16.4 CO2 Screen

The numerical values and CO2 waveform areas display the FiCO2 measurement, EtCO2 measurement, FRVa measurement, and CO2 waveform.



(1) CO2 wave

(2) CO2 alarm limits

(3) Fraction of inspired CO2 (FiCO2): the lowest CO2 value measured during inspiration.

(4) End-tidal CO2 value (EtCO2): the highest CO2 value measured during expiration.

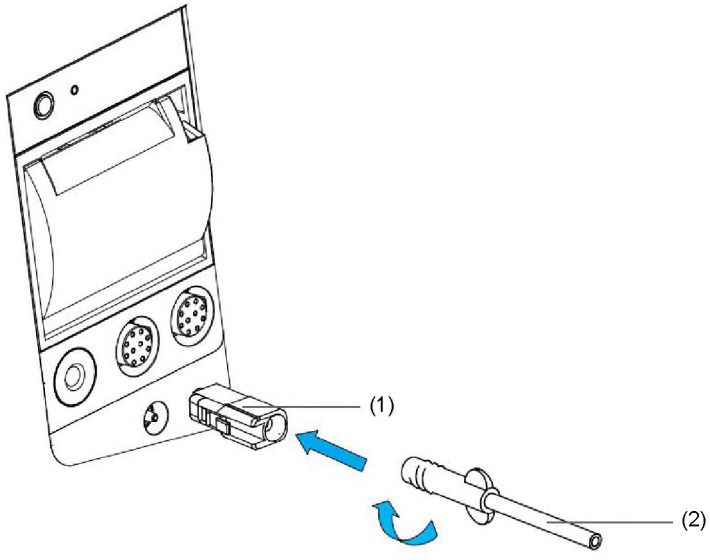
(5) Airway respiratory rate (FRVa)

16.5 **Sideflow CO2 Measurement**

16.5.1 Preparation for **sideflow CO2 measurement**

To prepare the CO2 module for measurement, follow this procedure:

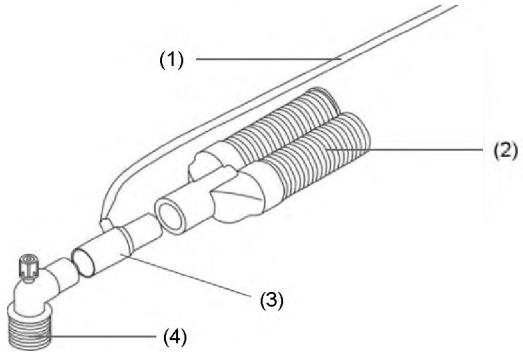
1. Select the appropriate sampling tube based on the type of patient.
2. Connect the sampling tube to the CO2 adapter installed on the equipment.



(1) CO2 Adapter (2) Sampling tube

3. Connect the other end of the gas sampling tube to the patient.

- In intubated patients requiring an airway adapter, install the adapter between the patient circuit and ventilator Y-piece.



(1) Sampling tube
(2) Connection to the respirator
(3) Airway adapter
(4) Connection with the patient

- In non-intubated patients, place the nasal cannula in the patient.

4. Connect the gas outlet to the gas evacuation system using an outlet pipe.

After turning on the equipment, the CO2 module enters the default measurement mode and indicates **"Starting CO2".** CO2 measurements can be taken once the start-up is complete.

CAUTION

- **Do not use pediatric or adult sampling tubes with newborn patients. Otherwise, the The patient could be harmed.**
- **Connect the gas outlet to the gas evacuation system when performing CO2 measurement** with the **side-flow CO2 module .**

NOTE

- **To extend the life of the sampling tube and CO2 module, set the operating mode to standby when CO2 monitoring is not required .**
- **Unless necessary, do not disconnect the CO2 adapter from the device after initial installation. This reduces the risk of losing or damaging the CO2 adapter.**
- **Under sample gas conditions at 37 °C, sample flow rate of 50 ml/min, At an ambient temperature of 23°C and 100% RH, the general type sampling tube should be replaced every 8 hours at most and the humidified type sampling tube should be replaced every 72 hours at most.**

16.5.2 Resetting the side-flow CO2 module

The side-flow CO2 module performs zero calibration automatically when required.
Once the zeroing calibration is complete, the CO2 module stops measuring and the indication **"Zeroing"** is displayed in the CO2 numerical values area .

When zero calibration is complete, the CO2 module resumes CO2 readings . During the reacquisition period, **"Zero Reacquisition"** is displayed in the CO2 numeric values area . Valid data reappears 30 seconds after the zero calibration begins. You can hide the "Zero Reacquisition" indicator , but the values displayed during the reacquisition period may not be accurate.

Automatic zero calibration will not start under the following conditions:

ÿ There are physiological alarms related to CO ÿ $_2$ active.

There is an active apnea alarm.

ÿ No breathing has been detected for more than 30 seconds.

You can also perform manual zero calibration. For more information, see 25.6.1 User Maintenance Settings.

NOTE

- **The CO2 module temporarily stops measurements during zeroing.**

16.6 Modification of CO2 module settings

16.6.1 Modification of CO2 alarm properties

To change the CO2 alarm properties , follow this procedure:

1. Select the numeric values area or the CO2 waveforms area to access the **CO2 menu.**
2. Select the **Alarm tab.**
3. Configure the alarm properties as desired.

16.6.2 Adjustment of CO2 waves

To adjust the CO2 waves, follow this procedure:

1. Select the numeric values area or the CO2 waveforms area to access the **CO2 menu.**
2. Select the **Settings tab.**
3. Separate adjustment **of Wave Type, Speed, Scale, Scale.**

16.6.3 Adjustment of the origin of FR

To determine the origin of respiratory rate (RR), follow this procedure:

1. Select the numeric values area or the CO2 waveforms area to access the **CO2 menu.**
2. Select the **Settings tab.**
3. Establish **FR Origin.**

If the current FR source does not have a valid measurement, the system will automatically change the **FR Source** to **Autom.**

16.6.4 Access to standby mode

You can configure the CO2 module in one of the following modes depending on the module's status:

ÿ Select **Measurement** mode when using the CO2 module for monitoring.

ÿ Select **Standby** mode when you are not going to use the CO2 module to extend the service life of the CO2 module.

The default operating mode is **Measurement.** If you are not using the CO2 module, put it into standby mode. This can extend the life of the CO2 module. To do this, follow this procedure:

1. Select the numeric values area or the CO2 waveforms area to access the **CO2 menu.**
2. Select the **Settings tab.**
3. Set **Mod. operation** to **Standby.**

16.6.5 Setting the time before automatic standby mode

You can configure the CO2 module to automatically enter standby mode after a designated period of time if no breath is detected since the last one. To set the time before automatic standby mode, follow this procedure:

1. Select the numeric values area or the CO2 waveforms area to access the **CO2 menu.**
2. Select the **Settings tab.**
3. Set **Auto Hold.**

16.6.6 Adjusting humidity compensation

The presence of moisture in the respiratory circuit can raise the CO2 reading. In the case of the CO2 module With sideflow, you can turn humidity compensation on or off to correct the CO2 reading according to the actual situation.

ÿ Body pressure and temperature (BTPS) or wet gas

ÿ Ambient pressure and temperature (ATPD) or dry gas

The partial pressure of CO2 is calculated as follows:

ÿ ATPD: PCO2(mmHg)=CO2(vol%) x Pamb/100

ÿ BTPS (lateral flow): PCO2(mmHg)=CO2(vol%) x (Pamb- 47)/100

Where, PCO2(mmHg)= partial pressure, vol% = CO2 concentration , Pamb= ambient pressure, and the unit is mmHg.

To configure humidity compensation, follow this procedure:

1. Select the numeric values area or the CO2 waveforms area to access the **CO2 menu.**
2. Select the **Settings tab.**
3. Establish **TCPS Compensation.**
   - Active TPCS.
   - Disable ATPD.

16.6.7 Gas Compensation Adjustment

The presence of interfering gases affects CO2 measurements . To obtain the best possible measurement results, gas compensation must be defined. The configured concentration of the interfering gas must be in line with its actual proportion.

WARNING

- **Ensure you use the correct compensations. Using incorrect compensations may result in inaccurate measurements and, therefore, an incorrect diagnosis.**

To adjust the gas compensation, follow this procedure:

1. Select the numeric values area or the CO2 waveforms area to access the **CO2 menu.**
2. Select the **Settings tab.**
3. Define the compensation according to the actual situation.

16.6.8 Modification of barometric pressure

The side-flow CO2 module includes an automatic barometric pressure compensation function (the system automatically measures the barometric pressure to which the equipment is exposed).

16.7 Performing the leak test

When measuring CO2 with the side-flow CO2 module , a leak test must be performed before each CO2 measurement . To perform the CO2 leak test , follow this procedure:

1. Connect the measuring accessories.
2. Wait until startup is complete. Completely block the gas inlet of the side-flow CO2 module. The alarm message **"CO2 Airways Occluded" will then be displayed.**
3. Block the gas inlet for another minute.
4. Select the numeric values area or the CO2 waveforms area to access the **CO2 menu.**
5. Select the **Maintenance tab.**
6. Check that the current usage frequency is less than 10m/min.
7. If the flow rate is 10 ml/min or higher, the module has a leak. Repeat the leak test. If the problem persists, contact service personnel.

16.8 CO2 Calibration

The side-flow CO2 module must be calibrated annually or whenever there is a significant deviation in the measured values. For information on performing the calibration, please contact service personnel.

CAUTION

- **Connect the gas outlet to the gas evacuation system when calibrating the** CO2 module.

16.9 CO2 Troubleshooting

This section includes a list of problems that may occur. If you encounter these problems while using the equipment or accessories, check the following table before requesting assistance. If the problem persists, contact service personnel.

NOTE

- **For information on technical and physiological alarm messages, see D Alarm messages.**

Problem	Solution
EtCO2 measurements too low	1. Ventilate the room if the ambient CO2 concentration is too high. 2. Check the sampling tube and connectors for leaks. 3. Check the patient's condition.

Part IV: System Functions and Others

17 Clinical assistance applications

17.1 Rescue training

The team provides rescue training for rescue procedures and CPR training.

Depending on the training scenario, you can choose between standalone training, using only the equipment, or online training by connecting the equipment and the rescue training system.

To access Training Mode, select the **Menu** key and select **Training Mode** in the **Mode column.**

For more information on rescue training, refer to the BeneHeart Series Rescue Training Operator's Manual.

WARNING

- **Therapy and patient monitoring are automatically interrupted when training mode is entered. The device restarts after exiting training mode.**

NOTE

- **A license is required for rescue training.**

17.2 Glasgow Coma Scale (GCS)

In 1974, Graham Teasdale and Bryan Jennett defined the Glasgow Coma Scale (GCS) as a way to determine the level of consciousness of patients with acute brain injury. The GCS score is the sum of the scores for three components: eye opening (E), verbal response (V), and motor response (M).

The available GCS scoring types are listed below:

y GCS score: applies to patients over two years of age.

y Pediatric Glasgow Coma Scale (P-GCS) score: applies to patients two years of age or younger.

The GCS scale is indicated for adult, pediatric, and neonatal patients.

CAUTION

- **The GCS scale is intended solely as a complementary element in the process of patient assessment, therefore it should be used in conjunction with the observation of clinical signs and symptoms.**
- **The GCS scale does not apply to patients who are sedated, have relaxed muscles, are connected to a mechanical ventilation unit, are drunk, or are having an epileptic seizure.**
- **The GCS scale is not applicable to deaf people or people with a mental disorder, nor to patients with a language barrier.**
- **When applied to children under five years of age or to elderly people with limited motor skills If the GCS scale score is low, the slowness may be a factor.**

NOTE

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

17.2.1 Accessing the GCS Window

To access the GCS window, select the shortcut key **Punt..**

The following image shows the GCS window when the P-GCS point is applied.

(1) Subscore (2) Time of confirmation (3) Total score

(4) Risk level: The risk level increases from top to bottom. The current level is indicated by a black box.

17.2.2 Configuring the GCS scoring type

Based on the **Patient Category** and **Age** settings in the **Patient Management menu,** the computer automatically changes the GCS score type.

y If the **Patient Category** option is set to **Adult, Score Type** is changed to **Score GCS.**

y If the **Patient Categ.** option is set to **Ped., Age** is not specified or is set to more than Two years, **Score type** is changed to **GCS Score.**

y If the **Patient Categ.** option is set to **Ped., Age** is set to two years or less, **Score Type** is changed to **P-GCS Score.**

y If the **Patient Categ.** option is set to **Neon., Score Type** is changed to **P-GCS.**

To manually change the GCS scoring type, set **Scoring Type** to the desired value in the GCS window.

NOTE

• **Manually configuring Score Type does not affect Patient Category and Age settings. the Patient Management menu.**

17.2.3 GCS scale scoring execution

To apply the GCS scale score, follow this procedure:

1. Select the items that represent the patient's condition in the columns **Eye Opening, Verbal Response ,** and **Motor Response.**
2. Select **Confirm** to accept the total score.
3. If you wish to discard the current score, select **Reset.**

The following table lists the GCS scoring criteria.

Risk level	Score range	Background color	Description
Mild	From 13 to 15	White	Normal or mild brain injury
Moderate	From 9 to 12	Yellow	Moderate or severe brain injury
Serious	From 3 to 8	Red	Patient dead or in a vegetative state

17.2.4 Review of GCS trends

To review GCS trends, select **Review Images** in the GCS window. A tabular trend is displayed with all measured data, as well as all calculated scores and subscores. For more information, see 18.5 Review Tabular Trends.

17.3 Early Warning Score (EWS)

Early Warning Scores (EWS) can help you recognize early signs of patient decline based on vital signs and clinical observations. Relevant recommendations will be displayed based on the calculated score.

The available scoring types are listed below:

ÿ Modified Early Warning Score (MEWS)

ÿ National Early Warning Score (NEWS)

ÿ National Early Warning Score 2 (NEWS2)

WARNING

- **EWS should not be used as the sole basis for diagnosis or treatment decisions. It is not intended to replace the judgment of a qualified healthcare professional.**
  EWS scores and recommended actions should be used in conjunction with observation of clinical signs and symptoms.

Neither **MEWS nor NEWS can be administered to pregnant women, patients with COPD (chronic obstructive pulmonary disease), or children under 16 years of age. NEWS2 cannot be administered to pregnant women or patients under 16 years of age.**

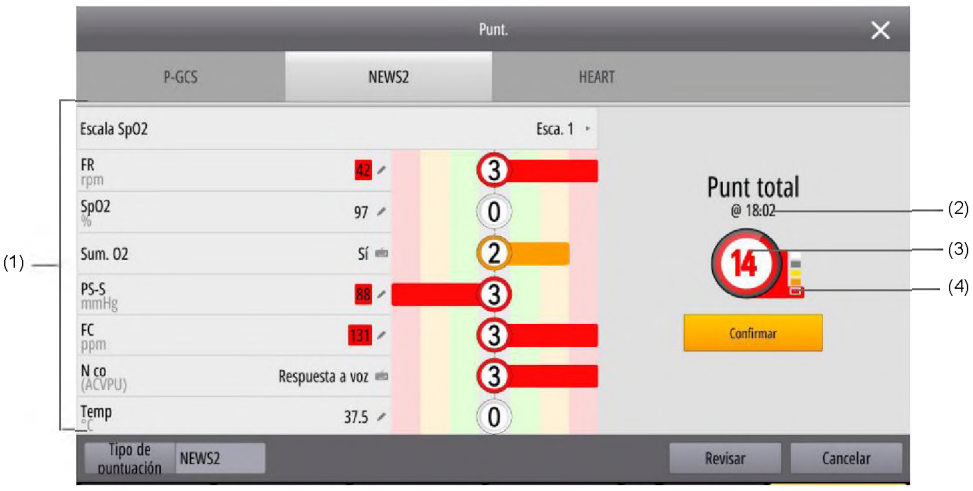
NOTE

- **An EWS license is required.**

17.3.1 Accessing the EWS Window

To access the EWS window, select the Punctuation key, and then select the EWS Punctuation Type tab.

The following image shows the EWS window when NEWS2 is applied.



(1) Subscore area: displays the subscores and measured data for each item of punctuation. indicates that the value has been entered manually.

(2) Scoring calculation time

(3) Total score

(4) Risk level: The risk level increases from top to bottom. The current level is indicated by a white box.

17.3.2 EWS scale scoring execution

To perform the scoring, follow this procedure:

1. If the previous score is not confirmed, select **Confirm** to save the score. You can also select **Reset** to clear the score and update the values of the monitored parameters and relevant sub-scores.

2. Define the **scoring type.** If NEWS2 is applied, you must set **SpO2 scale.**

   • **Esca.** 1: applies to patients without hypercapnic respiratory failure.

   • **Stage** 2: Applies to patients with an established oxygen saturation requirement of 88 to 92%. For example, patients with hypercapnic respiratory failure.

3. All measured values are displayed and updated automatically. The "Enter value" field indicates that the value has been manually. entered manually.

4. Select **Compute** to get the total score.

5. Select **Confirm** to accept the total score. Selecting **Cancel** will discard the score.

NOTE

- **The decision on whether to use SpO2 Scale 2 should be made by a competent person clinical decisions must be made and recorded in the patient's medical record.**
- **The total EWS score can only be calculated when all the necessary elements have been measured or entered.**

17.3.3 Review of EWS trends

To review EWS trends, select **Image Review** in the EWS window. A tabular trend is displayed showing all measured data, all confirmed scores, and the score type. For more information, see 18.5 Tabular Trend Review.

17.4 HEART Score

In 2008, Six AJ and Brackus BE defined the HEART score as a way to assess the risk of a cardiac event. The HEART score is the sum of scores from five components: medical history, ECG, age, risk factors, and troponin. The HEART score effectively evaluates patients with chest pain and identifies those at risk.

It identifies patients who present a low risk so that they can be safely discharged, and identifies patients who present a potentially high risk, to promote early intervention.

The HEART pun is intended for adults only.

NOTE

- **A license is required for the HEART punctuation.**

17.4.1 Accessing the Punt. HEART window

To access the HEART window, select the shortcut key **Punt,** and then select the **HEART tab.**

(1) Subscore (2) Time of confirmation (3) Total score

(4) Risk level: The risk level increases from top to bottom. The current level is indicated by a black box.

17.4.2 Performance of the HEART scale score

To apply the HEART measurement, follow this procedure:

1. Select the item that represents the patient's condition in the columns Anamnesis, ECG, Age, Risk factors and **Troponin.**
2. Select **Confirm** to accept the total score.
3. If you wish to discard the current score, select **Reset.**

The following table lists the HEART scoring criteria.

Risk level	Score range	Background color	Description
Mild	From 0 to 3	White	Discharge may be an option.
Moderate	From 4 to 6	Yellow	Further clinical observations and research are needed.
Serious	From 7 to 10	Red	Immediate invasive treatment is needed.

17.4.3 Review of HEART score trends

To review HEART score trends, select **Review Images** in the HEART Score window. A tabular trend is displayed with all measured data and calculated scores. For more information, see 18.5 Reviewing Tabular Trends.

17.5 Traumatic Brain Injury (TBI) Assessment

In 2016, the Brain Trauma Foundation (BTP) published Guidelines for the Management of Traumatic Brain Injury. The document provides recommendations on SpO2, SBP, and EtCO2 thresholds for the prehospital management of patients with traumatic brain injury (TBI). It also indicates that a low Glasgow Coma Scale (GCS) score may be indicative of a severe TBI.

In the case of patients in a coma (for example, intoxicated, intubated, or sedated patients), the GCS is not as accurate. In combination with vital sign monitoring and GCS, the traumatic brain injury (TBI) assessment shows parameter and GCS trends, and issues warnings when a possible TBI is detected.

The TBI assessment provides an evaluation of the patient's recovery following severe trauma (GCS score ȳ8) or cardiac arrest to ensure that the prognosis is appropriate.

TBI evaluation is indicated for adult, pediatric, and neonatal patients.

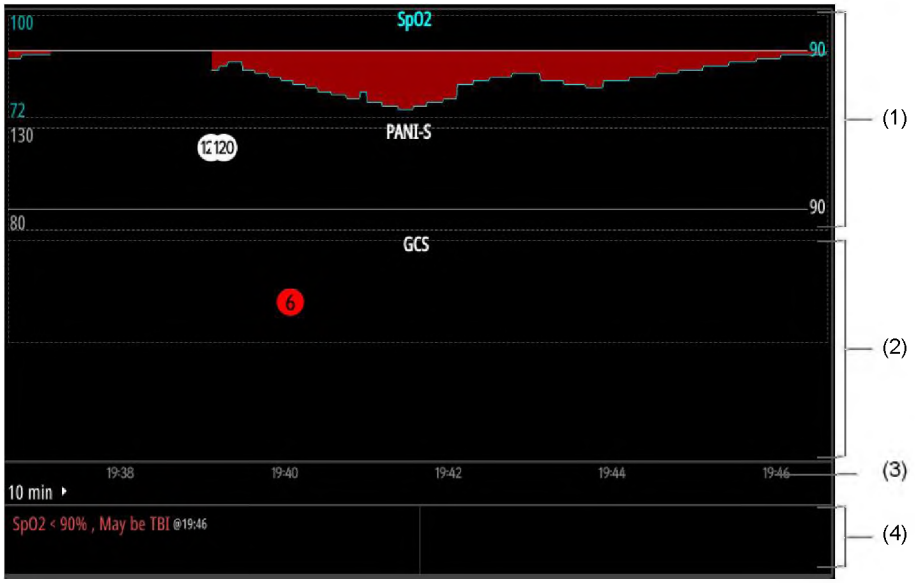
NOTE

- **A license is required for TBI evaluation.**

17.5.1 Access to the TBI Evaluation window

To access the TBI Evaluation window, select the TBI hotkey .

The following image shows the TBI Evaluation window.



(1) TBI parameter trends area: displays trends for SpO2, EtCO2 and systolic blood pressure (SBP).

If the PAS value is below the limit, it is indicated with a red background.

(2) GCS score trends area: Displays all confirmed GCS scores and subscores.

(3) Timeline

(4) TBI warning area: Displays TBI warnings.

17.5.2 Adjustment of the TBI trend interval

To set the trend interval, select the time interval in the TBI Evaluation window.

17.5.3 GCS scale scoring execution

To apply the GCS score, select **GCS Score** below the TBI Assessment window that appears. For more information, see 17.2.3 Running the GCS Scale Score.

17.5.4 Displaying TBI warnings

TBI warnings are given under the following conditions:

- The total GCS score is 8.
- **Patient category** is established in **Neon.,** the PAS value is below 60 mmHg.
- **Patient category** is set to **Pediatrics, Age** is not specified or is set to over 10 years, the value of PAS is below 90 mmHg.
- **Patient category** is established in **Pediatrics, Age** is established between 1 and 10 years, the PAS value is below of (70 + 2 x age) mmHg.
- **Patient category** is established in **Neon., Age** is established at 12 months or less, the PAS value is below 70 mmHg.
- **Patient category** is set to **Adult;** the systolic blood pressure (SBP) value is below the limit. The limits of the The TBI warning can only be changed in configuration mode. For more information, see section 22.7.6, TBI Warning Settings Menu.
- The SpO2 and EtCO2 values are below the limits. The TBI threshold can only be changed in the configuration mode. For more information, see 22.7.6 TBI Warning Configuration Menu.

17.5.5 TBI Event Review

When a TBI warning is issued, a TBI event is automatically generated. To review TBI events, select the TBI warnings area or select **Image Review** below the TBI Assessment window. For more information, see 18.7 Event Review.

17.5.6 Exit the TBI Assessment window

To exit the TBI Assessment window, select **Exit** below the TBI Assessment window.

This page has been intentionally left blank.

18 Revision

18.1 Introduction to the review

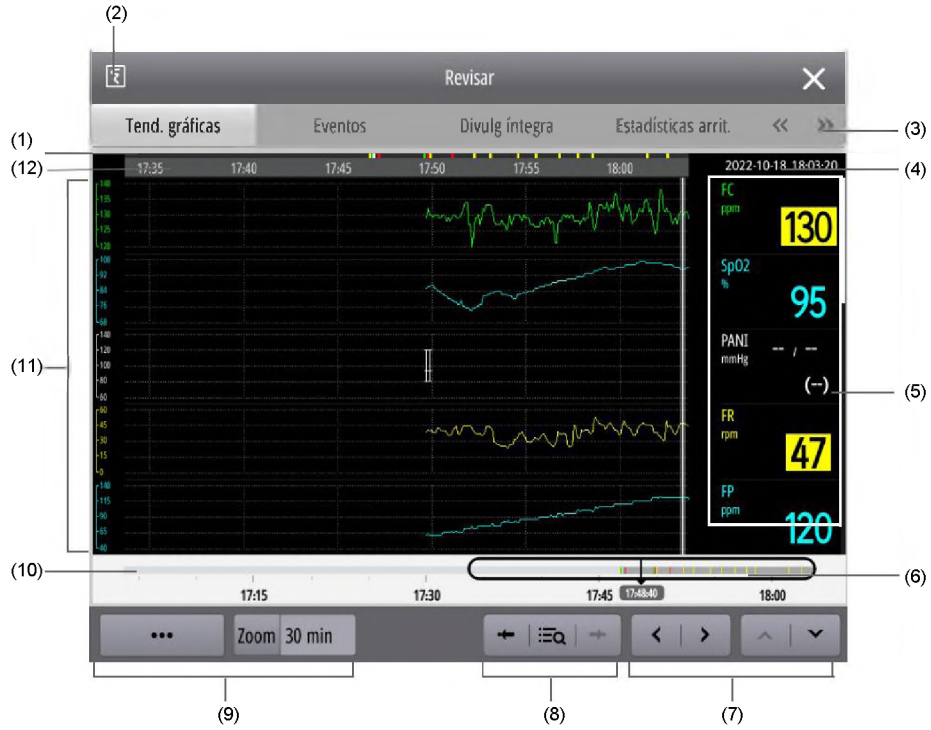
The **Review** window provides various types of trend data, such as graphs, tables, events, or full disclosures, that help you assess the development of the patient's condition.

18.2 Accessing the Review Window

To access the **Review window,** select the shortcut key **Main Menu** and select the desired tab in the **Review** column .

18.3 Review window screen

The review pages in the **Review** window have a similar structure. The following image shows the **Trends Charts review page.**



(1) Window timescale: Indicates the time within the **zoom** time interval set in the current window. A time highlighted in color indicates that an event occurred at that time.

(2) Recorder Key: Prints trend data via the recorder.

(3) Review tab: Provides access to the corresponding review page. Selecting "Show more tabs" or can will open the tab.

(4) Cursor time: The date and time specified by the cursor. If an event has occurred at this time, the highest priority alarm is displayed at the top.

(5) Numerical values area: displays the numerical values at the time indicated by the cursor.

(6) Slider: Indicates the position of the current window's time over the entire duration. The slider's size depends on the zoom interval **set** for the current window.

By moving the slider, you can locate trend data at a specified time and update the data accordingly in the current window.

(7) Page Key: Turns pages if trend data is displayed on more than one page.

(8) Event shortcut key: allows you to view and locate the event.

(9) Configuration item: Allows you to configure the display of the current window. Indicates if more than one item is available. Selecting it will display more configuration items.

(10) Trend scale: indicates the time scale for all trends.

- The dark gray part represents the duration of time of the trend data that can be reviewed.
- The light gray part represents the duration of time for trend data that is not available.

(11) Wave area: shows the trend curves.

(12) Cursor

18.4 General operations in the Review window

This section describes the general operations of all review pages.

18.4.1 Trend data query

To visualize trend data, choose one of the following options:

ÿ Move the cursor to view trend data within the Zoom time interval .

ÿ Swipe left or right on the current review page to see the trend in the Zoom time interval .

ÿ Move the slider to view the trend data that can be reviewed.

ÿ Scroll up and down the current review page to view trend data in more than one page.

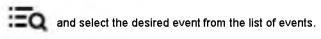
ÿ Select  to view trend data across more than one page.

ÿ Select to view trend data across more than one page.

18.4.2 Location of events

To view events, choose one of the following methods:

ÿ Select  to view the previous or next event.

ÿ Select  and select the desired event from the list of events.

18.5 Review of tabular trends

The **tabular Trends** review page displays trend data in tabular format.

To review tabular trends, follow this procedure:

1. Access the **tabular trends** review page in any of the following ways:
   - Select the shortcut key **Main Menu** ÿ in the **Review** column select **Tabular Trends.**
   - Select the parameter list from the numeric parameter value area.
   - Select **Review** in any scoring window.
2. Select ÿ **Trend Group,** define the content of the displayed trend data.
3. Select **Interval** and define the interval for the displayed trend data. A longer interval may provide more information or be suitable for situations where the patient's condition typically changes more gradually. A shorter interval is particularly suitable for applications where the clinical situation can change very rapidly. • **5 seconds, 30 seconds:** Displays a maximum of 4 hours of tabular trends at one hour.

   specified.

   • **1 min** to **3h:** Displays a maximum of 120 hours of tabular trends at a specified time.

   • **PANI:** Shows tabular trends when PANI measurements are acquired.

- **EWS, GCS, HEART:** Displays total scores and parameter measurements acquired at the time of scoring.

18.6 Review of graphic trends

The **Trends** review page displays trend data in graphical format.

To review the graphical trends, follow this procedure:

1. Select the shortcut key **Main Menu** ÿ in the **Review** column select **Trend Charts.**
2. Select ÿ **Trend Group,** define the content of the displayed trend data.
3. Select ÿ **Waves,** define the number of waves displayed.
4. Select **Zoom** and define the interval for the displayed trend data.
   - **8 min:** Displays a maximum of one hour of tabular trends at a specified time.
   - **30 min** to **4h:** Displays a maximum of 4 hours of tabular trends at a specified time.
   - **8 h, 12 h, 24 h, 48** h: Displays a maximum of 120 hours of one-hour tabular trends specified.

18.7 Event Review

The device records real-time events, including alarm events, manual events, and operational events. Operational events are generated when performing therapies (such as AEDs, manual defibrillation, CPR compressions, and pacing), rescue reports, TBI assessments, or ultrasounds, when taking a photograph or screenshot, or when using the system.

NOTE

- **A total loss of power does not affect saved events.**
- **Alarms will be saved as events and will be retained even if the equipment is powered off. The time the equipment is without power will not be recorded as an event and cannot be reviewed.**
- **Previous events will be overwritten by subsequent ones if the maximum storage capacity is reached.**

18.7.1 Displaying the Event List

The **Events** review page displays all events in a list. Events are shown in descending chronological order. The most recent event appears at the top.

The type of event is indicated by a different color to the left of each event.

ÿ Red: High priority alarm event

ÿ Yellow: Medium priority alarm event, low priority alarm event

ÿ Target: system event, TBI event, rescue statistical event

ÿ Green: manual event, therapy event, screenshot event

To view the list of events, follow this procedure:

1. Access the **Events** review page in any of the following ways:
   - Select the shortcut key **Main Menu** ÿ in the **Review** column select **Events.**
   - Select **Review** in any specified window (for example, the **Rescue Log** window or the 12-lead ECG window).
2. Select , Define the date and time of the displayed events.
3. Select **Filter,** then select the type of event you want from the pop-up list.
4. If only arrhythmia events with alarms disabled are needed, select **"arrhythmia alarms disabled".** and select **Show**

18.7.2 Viewing Event Details

When an event occurs, you can view all the numerical values of the related parameters at the time of the event and three waveforms related to the event in the 16 seconds before and after the event.
In the case of screenshot events, you can see the image details.

To view detailed waveforms and numerical parameter values, follow this procedure:

1. Access the event list review page.
2. Select the desired event. An event with a white box indicates that it is selected.
3. Select **Detail.**
4. Adjust the activation of **Heartbeat Annotation:** If activated, white heartbeat labels are displayed on the first ECG waveform, indicating the classification of heartbeats and explaining possible arrhythmias, undetected arrhythmias, or false arrhythmias. Heartbeats are classified as follows:
   - N: Normal
   - V: Ventricular extrasystole
   - S: Supraventricular premature
   - Q: Marc.
   - L: Learning
   - ?: Insufficient information to classify heartbeats
   - I: Inoperative (e.g., branch disconnected)
   - M: Missing heartbeat
5. Select ▪▪▪, Define ECG **Speed** and **Gain.**

If you select **Event List** you can view the event list again.

CAUTION

- **Ensure you have selected the optimal leads with the best wave amplitude and highest signal-to-noise ratio. Selecting the optimal leads is important for heart rate detection, heart rate classification, and detecting ventricular fibrillation.**

NOTE

- **The activation setting for Heartbeat Annotation: on the event review page is relevant to the full disclosure review page.**

18.7.3 Visualization of arrhythmia analysis

The **Arrhythmia Statistics** review page displays all arrhythmia events that occurred in the last 24 hours, the alarm priority, total times, duration, start and end times of each event, compressed waveforms, and details corresponding to the event time. Event duration and alarm priority are indicated by different colors.

To view the arrhythmia analysis, follow this procedure:

1. Select the shortcut key **Main Menu** ÿ in the **Review** column select **Arrhythmia Statistics.**
2. If necessary, select ▪▪▪ and select the desired arrhythmia events.
   - **Show alarms for arrhythmias disabled:** only arrhythmia events with alarms are shown deactivated.
   - **High-quality alarm ECG only:** arrhythmia events with obvious noise and characteristics insignificant.
3. Select the desired arrhythmia event from the list on the left and view the compressed waveforms. time of the event.
4. Select **Back** in the list of arrhythmia events.

If you select a point on the compressed waveforms of an arrhythmia event, you can view the details of the event.

18.8 Full Disclosure Review

The **complete Divulg** review page shows compressed waveforms, full waveforms, and numerical values.

18.8.1 Selection of compressed waves

Before reviewing the compressed waveforms, you must select which waveforms to store and display. To do this, follow this procedure:

1. Select the shortcut key **Main Menu** ÿ in the **Review** column select **Full Disclosure.**
2. Select **Adjust** ÿ select the **storage** tab and define the waves you want to store.
3. Select the **Display tab (Maximum: 3)** and define the waves you want to display.
4. Select ✕ To exit the **Select Wave** menu .
5. Select ▪▪▪ , Define **Scale** and **Duration.**

NOTE

- **The more waves you select for storage, the shorter the wave storage time will be. If you select too many waves, you may not reach the maximum claimed full viewing time due to the storage limit. Use caution when selecting waves.**

18.8.2 Checking the details of compressed waves

To view the details of the compressed waves, follow this procedure:

1. Access the full Divulg review page .
2. Select the desired compressed waves.
3. Select **Detail.**
4. Change the compressed wave settings.
5. Adjust the **Heartbeat Annotation** activation : For more information on the classifications of the heartbeats, see 18.7.2 Viewing Event Details.
6. Select ▪▪▪ , Define ECG **Speed** and **Gain.**
7. Select ÿ select **Save as ev.** to save the desired event.

If you select **General Dec.** you can reselect compressed waves.

18.9 Review of 12-lead ECG analysis

Upon completion of the automatic 12-lead ECG measurement, a 12-lead ECG analysis event is automatically generated. For more information, see 12-Lead ECG Analysis.
at rest.

The **12-lead ECG** review page displays patient information, the 12-lead ECG waveforms, measurement results, and diagnoses. If the date of birth or sex has not been entered, the patient's information will be automatically updated.

patient, you can select patient information or  to complete it.

To review a 12-lead ECG analysis event, follow this procedure:

1. Access the **ECG 12 deriv** review page in any of the following ways:
   - Select the shortcut key **Main Menu** ÿ in the **Review** column select **Tabular Trends.**
   - Select **Review** below the 12-Lead ECG window.
2. Change the display of the 12-lead ECG waves.
   - **Speed:** allows you to set the speed of the wave.
   - **Increm.:** allows you to set the size of the wave.
   - **Arrangement:** allows you to set the wave arrangement.
3. Select **Median complex.** Above each wave is a short vertical bar that marks the position.
   initial and final position of the P wave and the QRS wave, and the final position of the T wave.

If you select **Waveform** you can view the 12-lead ECG waveforms again.

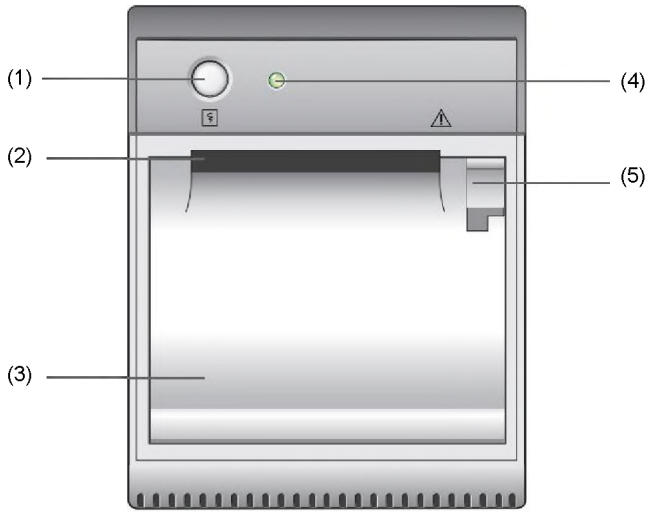
18.10 Trend Data Printing

To print trend data, select the desired review page. For screenshot events, printing event details is not available.

19 Impression

19.1 Recorder

The equipment is equipped with a built-in recorder.



(1) Recorder Button: starts or stops the printing of a real-time report.

(2) Paper output

(3) Register door

(4) Recorder indicator

- Power On: when the recorder is working correctly.
- Off: when the equipment is turned off.
- Flashes: if an error has occurred in the recorder.

(5) Closing: Pull back to open the register door.

19.2 List of reports

The equipment can print the following reports through the logger:

ÿ Real-time report

- Real-time waveform report
- Real-time ST report
- Real-time QT report
- Real-time event reporting, including upload events, download events, and event analysis 12 leads

ÿ Physiological alarm report

ÿ Freezewave Report

ÿ Review reports

- Tabular Trends Review Report
- Graphic Trends Review Report
- Rev. report physiological events

• Comprehensive Disclosure Review Report

• 12-lead analysis review report

y Rescue Log Report

y Summary report

y Self-communicating information

y System configuration report

For more information on printing alarms, see 10 Alarms.

For more information on printing specific functions, refer to the relevant chapters in this manual.

19.3 Paper Loading

To load paper, follow this procedure:

1. Use the lock on the upper right side of the register door to open it.

2. Insert a new roll into the compartment, as shown below. Rotate the paper roll to insert it and pull a portion of it out through the top of the roller.

3. Close the register door.

CAUTION

- **Use only specific thermal paper. Otherwise, the recorder's print head may be damaged, the recorder may not be able to print, or the print quality may be poor.**
- **Never force the recorder paper by pulling on it when a record is in progress. Otherwise, the recorder may be damaged.**
- **Do not leave the register door open unless you are going to reload paper or go to solve problems.**

19.4 Printing the summary report

The summary report provides an overview of the equipment's operations after it is powered on. The summary report will not be saved when the equipment is powered off.

The summary report includes the start time, total number of shocks, stimulation time, operating time from start to print, all events that occurred and the corresponding HR values, and a comments column.

To print the summary report, select the shortcut key **Main Menu** and select **Event Summary** in the **Other column.**

19.5 Start of printing

Printing can be started manually or automatically.

19.5.1 Manual print start

To manually start a record, choose one of the following methods:

ÿ Press the Recorder button at the registrar.

ÿ Select in the current menu or window.

19.5.2 Automatic printing start

Under the following conditions, you can configure the recorder to start printing automatically:

ÿ A parameter alarm is triggered. For more information, see 19.7.2 Activation of the
Automatic printing when an alarm occurs.

ÿ An event is triggered, such as an upload or download event. **Auto-Registration** settings are only
These settings can be changed in configuration mode. For more information, see section 22.7.7 Menu Settings.

ÿ An autocomputation is performed. The activation setting for **Autocomputation Information** can only be changed in configuration
mode. For more information, see 22.7.7 Registration Settings Menu.

19.6 Stopping the printing

Printing can be stopped manually or automatically.

19.6.1 Manually stopping printing

To manually stop printing, press the Recorder button at the registrar.

You can also manually stop printing by deleting all print jobs. For more information, see 19.6.3 Deleting Print Jobs.

19.6.2 Automatic printing stop

Printing stops automatically under the following conditions:

ÿ Printing is complete.

ÿ The registrar runs out of paper.

ÿ The recorder is not working due to technical failures.

ÿ The operating mode is changed.

19.6.3 Elimination of printing tasks

To delete print jobs, follow this procedure:

1. Select the shortcut key **Main Menu** ÿ in the **Common column,** select **Registry Settings.**

2. Select **Clear all print jobs.** This clears all print jobs in the queue and stops the print job.
current printout.

19.6.4 Checking the notices related to printing

You can find the following notices in the print reports:

ÿ In the case of automatically stopped printing, two columns of asterisks "*" are displayed.
end of the report.

ÿ In the case of print jobs that have been stopped manually or abnormally, a column of "*" is displayed at the end of the
report.

19.7 Report Configuration

19.7.1 Configuring real-time reports

You can set up real-time reports; the logger prints the reports according to the settings.

To configure real-time reports, follow this procedure:

1. Select the shortcut key **Main Menu** ÿ in the **Other column,** select **Registry Settings.**
2. Select the desired waveform. Selecting **"Off"** will deactivate a waveform. The recorder It can print a maximum of 3 waves.
3. Set **Length.**

   • **8** s: Prints 8-second intervals before and after the current time. • **16** s: Prints 16-second intervals before and after the current time. • **32** s: Prints 32-second intervals before and after the current time. • **Continuous:** Starts printing from the current time until manually stopped.
4. Set **paper speed.**
5. Adjust Grid activation .

   • When activated, the printed waves are displayed with dividing lines.

   • When deactivated, the printed waves are displayed without dividing lines.

19.7.2 Activation of automatic printing when an alarm occurs

When a parameter alarm is triggered, printing can be started automatically. To do this, follow this procedure:

1. Select the numeric or waveform value area of the desired parameter.
2. Select the **Alarm tab.**
3. Activate **Alarm Results.**

19.8 Clearing paper jams

If the recorder is not working properly or is making unusual noises, first check for a paper jam. If you detect a paper jam, follow these steps to clear it:

1. Open the register door.
2. Remove the paper and tear off the folded part.
3. Reload paper and close the register door.

20 Administration of discharged patients

20.1 Patient data generation

Once powered on and with a patient connected, the device automatically generates a patient ID and begins recording clinical data for that ID. If the device is powered off, it automatically discharges the patient, who is then marked as discharged.

NOTE

- **Old stored data will be overwritten by newer data if capacity is reached.**
  maximum storage capacity of the device.

20.2 Access to discharged patient mode

In discharged patient mode, you can manage discharged patients.

To access discharged patient mode, select the **Menu** key and select **Discharged Patient** in the **System column.**

WARNING

- **Therapy and patient monitoring automatically end when discharged patient mode is accessed. The device automatically restarts and applies the changes after discharged patient mode.**

20.3 Deletion of data of discharged patients

You can delete an archived patient and their corresponding data. To do this, select the desired patient on the **Discharged Patient** screen and select **Delete.**

20.4 Search for information on discharged patients

You can retrieve information about a discharged patient from the computer. To do this, follow this procedure:

1. Access discharged patient mode.
2. Enter the query criteria.
3. Select **Search.**

When selecting  The list of discharged patients is updated .

20.5 Review of discharged patient data

You can review discharged patient trends. To do this, select the desired patient in Discharged Patient mode, and then select **Details.** For more information, see 18 Review.

When selecting  In the **Review** window for a discharged patient, you can see the information of the a patient.

20.6 Export of patient data

You can use a USB drive to export patient data, which you can then view on the BeneVision Central Monitoring System display. For more information, refer to the BeneVision Central Monitoring System Display Operator's Manual.

Patient data that can be saved and exported includes equipment information, settings, patient information (configurable, including patient category definition), trend data (including heart rate value), event data (including pacemaker rate changes, pacemaker output, and pacemaker pulse), full disclosure (including ECG waveforms and pacing impulses), and voice recording.

To protect patient privacy, patient information is not exported by default. The " **Include patient sociodemographic data. Export patient data"** setting can only be changed in configuration mode. For more information, see section 22.7.8, Patient Administration Settings Menu.

To export patient data, follow this procedure:

1. Connect the USB drive to the computer's USB 2.0 connector.
2. Access discharged patient mode.
3. Select the desired patient.
4. Select **Export patient data.**

NOTE

- **Do not remove the USB drive from the computer until the data export is complete.**

21 Data Communication

21.1 Introduction to data communication

The device can communicate with the CMS, eGateway, the rescue summary statistics system, and other devices via wired or wireless networks. It can also transmit data from the device to a third-party system using FTP or HL7 protocols.

21.2 Data Communication Security Information

CAUTION

- **The design, implementation, debugging, and maintenance of the wireless network must be responsibility of Mindray service personnel or authorized technicians.**
- **Always install the wireless network in accordance with local regulations for wireless connections.**
- **It is recommended to use the 5 GHz frequency band whenever possible. In the band of At a frequency of 2.4 GHz there are more sources of interference.**
- **The use of private access points or wireless routers is not permitted. These devices can cause radio interference and lead to data loss on the monitor and in the CMS.**
- **To ensure network security and stability, data communication must take place within a closed network or a virtually isolated hospital network. The hospital is responsible for ensuring the security of the virtually isolated network.**
- **If possible, WPA2-PSK and WPA2-PSK verification and encryption methods should be used. Enterprise. Otherwise, the equipment may stop working or patient information may be leaked. It is recommended to use WPA2-Enterprise and a long password.**
- **Prevent unauthorized users from accessing network authentication information, such as password.**
- **Do not connect non-medical devices to the equipment network.**
- **If the wireless network signal is poor, CMS data could be lost.**
- **The maximum number of monitors connected to a single access point is 3. If too many monitors are connected to the same access point, the network may disconnect.**
- **RF interference can cause the wireless network to disconnect.**
- **Network disconnection can lead to CMS data loss and system failures operation. Check the patient in case of network disconnection and reconnect the network as soon as possible.**
- **Ensure the monitor's IP address is correct. Changing network settings may cause a network disconnection. Contact service if you experience any issues with the IP address configuration.**

21.3 Wired network connection

To connect the wired network, follow this procedure:

1. Connect one end of the network cable to the computer's network port.
2. Connect the other end of the network cable to the network port of the PC installed in the communication system. desired.
3. Change the wired network settings. Wired network settings can only be changed in configuration mode. For more information, see 22.7.9.1 Network Type tab and 22.7.9.2 LAN1 IP tab.

21.4 Wireless network connection

When the network reconnects after a disconnection or when the computer restarts, the computer connects to the last wireless network it was connected to. If it fails to connect to the last wireless network, the computer automatically connects to other wireless networks in the order they were added.

A maximum of 5 wireless networks can be added to the device. Wireless network settings can only be changed in setup mode. For more information, see the Network Type tab in section 22.7.9.1 and the WLAN tab in section 22.7.9.3.

You can manually change the wireless network by selecting  in the system information area and selecting the desired wireless network.

21.5 Connection to the CMS

The device can be connected to the CMS via wired or wireless networks. When connected to the CMS, the system provides the following functions.

y The equipment transmits data to the CMS, including equipment information, settings, patient information, waveforms, parameter values, alarms, trend data, 12-lead ECG analysis data, rescue recording, autocomm information, and user test reports.

y The data mentioned above can be viewed from the CMS.

y Patient information, alarm settings, and alarm status can be synchronized between the team and the CMS.

y In case of recovery after a network disconnection, the equipment transmits the data that has not been synchronized to the CMS.

When the network reconnects after a disconnection or the computer restarts, it automatically connects to the last connected CMS. You can also manually connect the computer to the CMS. To do this, follow this procedure:

1. You can access the **Select CMS** menu in any of the following ways:
   - Select the IP address in the system information area.
   - Select the shortcut key **Main Menu** y in the **Other column,** select **CMS Connection.**
2. Select the desired CMS. If **Pers.** is selected, you must manually enter the IP address of the Select the desired CMS and then select **Connect** to test the connection.

You can also connect the device to the CMS via a 4G router.

For more information about CMS, refer to the BeneVision monitoring system operator's manual.

NOTE

- **You can select the CMS only when Select CMS is enabled. For more information For information, see 22.7.9.5 Central Station Settings tab.**

21.6 eGateway Connection

The device can connect to the eGateway via wired or wireless networks to enable interaction between the device and other devices. When connected to the eGateway, the device provides the following functions:

y The equipment transmits data to the eGateway, including parameter values, waveforms, alarm settings, and events.

y The system time of the computer is automatically synchronized with that of the eGateway.

The eGateway connection settings can be changed in configuration mode. For more information, see 22.7.9.6 Device Detection tab.

21.7 Data transmission via the HL7 protocol

The device can transmit real-time data, waveforms, and alarms to hospital servers using the HL7 protocol. HL7 protocol settings can be changed in configuration mode. For more information, see section 22.7.9.9, HL7 Settings tab.

21.8 Data transmission via the FTP protocol

The device can transmit the 12-lead ECG analysis report to the hospital servers via FTP. FTP settings can be changed in configuration mode. For more information, see the FTP Config tab in section 22.7.9.10.

21.9 NTP Server Connection

The computer can connect to the NTP server via wired or wireless networks. When connected to the NTP server, the computer's system time is automatically synchronized with the NTP server's time. The NTP server connection settings can be changed in configuration mode. For more information, see section 22.7.9.11, Time Synchronization Settings tab.

21.10 Connecting the rescue summary statistical system

The device can connect to the rescue summary statistics system via wired or wireless networks. When connected to the rescue summary statistics system, the device automatically uploads real-time rescue data for further analysis and statistics.

For more information about the rescue summary, see the Rescue Summary Statistical System Operator's Manual.

This page has been intentionally left blank.

22 Configuration Management

22.1 Introduction to configuration management

Configuration management will allow you to customize the equipment to better suit your needs.

After changing the settings, the computer restarts automatically and the new configuration settings are applied immediately.

WARNING

- **Access to the settings menu is password protected. Therapy and monitoring of The patient is automatically interrupted when accessing configuration mode.**
- **The settings should only be modified by authorized personnel.**
- **Never connect the equipment to the patient while accessing the configuration management.**

22.2 Accessing configuration mode

To access configuration mode, follow this procedure:

1. Select the shortcut key **Main Menu** ÿ in the System column select Settings.
2. Select the corresponding settings menu.
   - Enter the password and select **Confirm** to access the Settings Management menu. • Select **Read-only** in the Settings View menu.

In the Settings View menu, you can select **General Settings** to change the system time.
It is not possible to edit other settings, which can only be viewed.

22.3 Changing the configuration management password

The default password to access the Settings Management menu is 315666. You can change this password. To do so, follow these steps:

1. Access the Configuration Management menu.
2. Select **Change Password.**
3. Enter the old password and the new password, respectively.
4. Select **Confirm.**

22.4 Exporting the configurations

The configurations can be exported via a USB drive. To do this, follow this procedure:

1. Connect the USB drive to the computer's USB 2.0 connector.
2. Access the Configuration Management menu.
3. Select **Export settings.**

22.5 Importing the configurations

It is not necessary to configure each computer separately when installing multiple computers with identical configurations. A USB drive can be used to import configurations from one computer to another. To do this, follow this procedure:

1. Prepare a USB drive with the desired settings.
2. Connect the USB drive to the USB 2.0 connector of the target computer.

3. Access the Configuration Management menu.
4. Select **Import settings.**

22.6 Printing configurations

The configurations can be printed via the data logger. To do this, follow this procedure:

1. Access the Configuration Management menu.
2. Select **Register.**

22.7 Changing the settings

Settings changed in clinical mode are affected when the device is restarted. Settings changed in configuration mode are retained even if the device is restarted.

To change the settings, follow this procedure:

1. Access the Configuration Management menu.
2. Select the desired settings menu, and change the settings.
3. If you need to reset the default settings, select **Reset to default** to restore all current values.

NOTE

- **Restoring the default settings does not affect items marked with "*" in the tables next.**
- **Alarm limits apply to all patient categories unless otherwise specified.**

22.7.1 General Settings Menu

Menu item Options/inte val		Predeter- mined	Description
Device location			
Device Name*/ Center*/Department*/ Room No.*/Bed No.*	0 to 15 characters	/	If the equipment is connected to the CMS, **Bed No.** and **Department** can also be changed in the CMS.
Time configuration			
Date	2000-01-01 to 2099-12- 31	/	It allows you to set the system date.
Hour	00:00 to 23:59	/	It allows you to set the system time.
Date format	yyyy-mm-dd, mm-dd-yyyy, dd-mm-yyyy	ayyy-mm-dd Allows	you to set the system date format.
24 hours	Act, Des	Act	Allows you to set whether 24-hour mode is activated.
Time zone	/	/	It allows you to set the system's time zone.
Summer time*	Act, Des	Des	It allows you to set whether summer time is activated.
Summer driving schedule*	Act, Des	Des	Allows you to set whether the function is automatically activated. summer time.
Another configuration			
Language	/	/	Allows you to set the system language for voice and text messages.

Menu item Options/interval		Predetermined	Description
Basic configuration			
Default startup mode	Monitor, Manual, AED Monitor		Allows you to set the default mode after turning on the device
Voice recording	Act, Des	Des	Allows you to set whether the voice recording function is activated.
Screen lock duration	Off, 1 min, 2 min, 5 min, 10 min	5 min	Allows you to set the duration of the automatic screen lock.

22.7.2 Therapy Settings Menu

The settings in this section can only be changed in configuration mode.

22.7.2.1 Manual defib adjustment tab

Menu item Options/interval		Predetermination ado	Description
General settings			
Therapy Access	Live, Confirmed, Cons	Straight	It allows you to set how to access manual Defibrillation mode and Marcap mode. • **Direct:** allows you to directly access the Manual Defibrillation mode and the pacemaker mode. • **Confirmed:** A dialog box will appear to confirm that you have accessed manual defibrillation mode and dialing mode. • **Cons:** A dialog box will appear requesting your password when you access manual Defibrillation mode and Marcap mode.
Set password	4 digits	1234	This option is only available when **Therapy Access** is set to **Cons.**
Time for auto deactivation	30 s, 60 s, 90 s, 120 s	60 s	It allows you to set the time after which the device automatically eliminates stored energy. internally.
Sync after download	Act, Des	Des	It allows you to determine if the device remains in synchronized cardioversion after a shock.
Remote Sync	Act, Des	Des	It allows you to set whether remote synchronized cardioversion is activated.
Tone volume load	High, Medium, Low	Half	It allows you to set the tone volume during charging and when charging is complete. This configuration is also effective in mode DEA.
Impedance indicator of contact	Act, Des	Des	Allows you to set whether the contact impedance indicator is displayed.
Value prevent. contact	Act, Des	Des	Allows you to set whether the contact impedance value is displayed.
Intel analysis.	Act, Des	Des	It allows you to set whether intelligent analysis is activated during external defibrillation.
Managed energy output	Act, Des	Des	Allows you to set whether the energy level of an administered shock is shown on the printout. events.
CPR after shock	Act, Des	Des	Allows you to determine if the device remains in CPR state after a managed shock.

Menu item Options/interval		Predetermination ado	Description
CPR	30s, 60s, 90s, 120s, 150s, 180s	120 s	It allows you to set the duration of CPR administration.
Power settings			
Energy Series	Act, Des	Des	Allows you to set whether the device manages the discharge at the default power level. • **Act:** the default power levels of **Energy 1**, **Energy 2** and **Energy 3** are available. When a shock is delivered to the patient, the device delivers the shock at the predetermined energy level. After three shocks, the device delivers subsequent shocks at the predetermined energy level, **Energy** 3. • **Des:** The default energy levels of **Adult Default Energy** and **Pediatric Default Energy** are available.
Energy 1 (Adult)	100 J, 120 J, 150 J, 170 J, 200 J, 300 J, 360 J	200 J	It allows you to set the defibrillation energy level of the first shock in an adult patient.
Energy 2 (Adult)	Energy 1 (Adult) to 360 J	300 J	Energy 1 ÿ configurable value ÿ Energy 3
Energy 3 (Adult)	Energy 2 (Adult) to 360 J	360 J	Energy 2 ÿ configurable value
Energy 1 (Ped.)	10 J, 15 J, 20 J, 25 J, 30 J, 50 J, 70 J, 100 J, 120 J, 150 J, 170 J and 200 J	100 J	It allows setting the defibrillation energy level of the first shock in the pediatric patient.
Energy 2 (Ped.)	Energy 1 (Ped.) at 200 J 100 J		Energy 1 ÿ configurable value ÿ Energy 3
Energy 3 (Ped.)	Energy 2 (Ped.) at 200 J 200 J		Energy 2 ÿ configurable value
Energy predet. for adult	100 J, 120 J, 150 J, 170 J, 200 J, 300 J, 360 J	200 J	It allows you to set the energy level for manual defibrillation.
Predet. energy for pediatric patients	10 J, 15 J, 20 J, 25 J, 30 J, 50 J, 70 J, 100 J, 120 J, 150 J, 170 J and 200 J	100 J	
Default energy for adult (SINCR)	100 J, 120 J, 150 J, 170 J, 200 J, 300 J, 360 J	120 J	It allows you to set the energy level for synchronous defibrillation.
Predet. energy for pediatric patients (SINCR)	10 J, 15 J, 20 J, 25 J, 30 J, 50 J, 70 J, 100 J, 120 J, 150 J, 170 J and 200 J	25 J	
Aj predet interno	2 J, 5 J, 10 J, 20 J, 25 J, 30 J, 50 J	10 J	It allows you to set the energy level for internal defibrillation.

22.7.2.2 AED Adjustment Tab

Menu item Options/interval		Predetermination ado	Description
General settings			
Auto deactivation time 30 s, 60 s, 90 s, 120 s		30s	It allows you to set the time after which the device automatically eliminates stored energy. internally.
Initial CPR time	Off, 30s, 60s, 90s, 120s, 150s, 180s	Des	Allows setting the initial CPR time after accessing AED mode.

Menu item Options/interval		Predetermination ado	Description
CPR Mode (Adult)	30:2, 15:2, Compression only	30:2	It allows you to set the compression and ventilation frequency.
Pediatric CPR Mode		15:2	
CPR	30s, 60s, 90s, 120s, 150s, 180s	120 s	It allows you to set the duration of CPR administration.
DNR Action	Monitor, CPR	CPR	Allows you to set the state that the device will access after **"Download not recommended"** is indicated. • **CPR:** the team enters CPR mode. • **Monitor:** If a shockable rhythm is detected, the The team continues to monitor the ECG and automatically resumes rhythm analysis.
Voice indicator	Act, Des	Act	Allows you to set whether voice prompts are provided in AED mode.
Voice volume	High, Medium, Low	High	Allows you to set the volume level of the voice prompts in AED mode.
Interv indic voice	Des30 s, 60 s, 90 s, 120 s, 150 s, 180 s	30s	Allows you to set the interval for voice prompts in AED mode.
Power settings			
Download series	1, 2, 3	1	This allows you to set the number of shocks. If set to a value greater than one, the device resumes analyzing the patient's heart rhythm after the shock to check if it had the desired effect. Voice prompts are provided along with the shock counter to guide you through additional shocks.
Energy 1 (Adult)	100 J, 120 J, 150 J, 170 J, 200 J, 300 J, 360 J	200 J	It allows you to set the defibrillation energy level of the first shock in an adult patient.
Energy 2 (Adult)	Energy 1 (Adult) to 360 J	300 J	Energy 1 ÿ configurable value ÿ Energy 3
Energy 3 (Adult)	Energy 2 (Adult) to 360 J	360 J	Energy 2 ÿ configurable value
Energy 1 (Ped.)	10 J, 15 J, 20 J, 25 J, 30 J, 50 J, 70 J, 100 J, 120 J, 150 J, 170 J and 200 J	100 J	It allows setting the defibrillation energy level of the first shock in the pediatric patient.
Energy 2 (Ped.)	Energy 1 (Ped.) at 200 J 100 J		Energy 1 ÿ configurable value ÿ Energy 3
Energy 3 (Ped.)	Energy 2 (Ped.) at 200 J 200 J		Energy 2 ÿ configurable value

22.7.2.3 Markup Adjustment Tab

Menu item Options/interval		Predetermined	Description
Frequency marker (ppm)	From 30 to 210 ppm	70 ppm	It allows you to set the delivery speed of pacemaker pulses.
Marcap output (mA)	From 0 to 200 mA	30 mA	It allows you to set the duration of the pacemaker pulses.
Exit step marker.	1 mA, 2 mA, 5 mA	5 mA	It allows you to set the pacemaker pulse duration.
Default Dial Mode Setting Mode	Mode fixed	Configuration mode	Allows you to set the pacemaker mode when accessing pacemaker mode.

Menu item Options/interval		Predetermined	Description
Pulse cuff.	20 ms, 40 ms	20 ms	It allows you to set the pacemaker output configuration to which the pulses are supplied. pacemaker.

22.7.2.4 CPR Adjustment Tab

Menu item Options/interval		Predetermined	Description
CPR Metronome (DEA)	Act, Des	Act	Allows you to set whether compression is performed in the **CPR Mode** setting in AED mode.
CPR Metronome (Manual)	Act, Des	Des	Allows you to set whether compression is performed in the **CPR Mode** setting in manual defibrillation mode.
Instructions for the CPR (AED)	Act, Des	Act	Allows you to set whether voice prompts are provided when using CPR assistance in AED mode.
Instructions for the CPR (Manual)	Act, Des	Des	Allows you to set whether voice prompts are provided when using CPR assistance in Manual Defibrillation mode.
CPR filter	Act, Des	Act	Allows you to set whether the CPR filter should be activated when performing CPR.

22.7.2.5 Hotkey Settings Tab

Menu item Options/interval		Predetermined	Description
Location1	Adrenaline, Amiodarone, Lidocaine, Atropine, Adenosine, Dopamine, Aminophylline, Naloxone, Oxygen inhalation, Ventilation, Tracheal intubation, Neck support Stop the bleeding, bandage, Immobilized	Adrenalin	Select the desired location, and then select the event name for the hotkey. An event cannot be displayed in more than one location.
Location2		Amiodarone	
Location3		Lidocaine	
Location4		Oxygen inhalation	
Location5		Ventilation	

22.7.3 Alarm settings menu

Menu item Options/interval		Predetermined	Description
Audio settings			
Minimum alarm volume	From 0 to 10	2	Allows you to set the lowest level for the alarm volume
Alarm sound	ISO, ISO2	ISO	It allows you to set the alarm tone pattern to distinguish the tone of the heartbeat, the pulse tone, and the tone of keystrokes by their frequency.
High alarm interval	3 to 15 s	3 s	Allows you to set the interval between alarm tones:
Average alarm interval	3 to 30 s	8 s	
Low alarm interval	16 to 30 s	20 s	

Menu item Options/interval		Predetermined	Description
Increase volume automatic	Des, 1 step, 2 steps	2 steps	• **2 steps:** If the alarm is not reset within the designated delay time after being triggered, the alarm volume is automatically increased by two levels. • **Step 1:** If the alarm is not reset within the designated delay time after being triggered, the alarm volume is automatically increased by one level. • **Deactivation:** Even if the alarm is not reset within the designated delay time after being triggered, the alarm tone volume does not change.
Delayed increase in volume.	10 s, 20 s, 30 s	20 s	Allows you to set the alarm volume increase delay time
Lock settings			
Visible	Deactivated, Lethal, Lethal/High, Lethal/High/ Medium, Lethal/High/ Medium/Low	Des	It allows you to set rules for blocking alarms: **Dis:** You can set separate blocking rules for alarms of different priorities.
Lethal sound block	Act, Des	Des	By blocking the audible alarm signal, the visual signal is simultaneously blocked. Selecting lower priority alarms simultaneously blocks higher priority alarms.
High sound blocking	Act, Des	Des	
Medium sound blocking	Act, Des	Des	
Low sound blocking	Act, Des	Des	
Pause/Reset Settings			
Pause	Pause alarm, Pause audio	Alarm pause	Allows you to set the pause function. • **Alarm pause:** pauses alarms. • **Audio pause:** pauses the alarm tone.
Time pause	1 min, 2 min, 3 min, Permanent	2 min	Allows you to set the pause interval for alarms.
Priority pauses	Everything, Medium and Low, Deactivate	All	It allows you to set alarms to be paused based on their priority. • **All:** Selecting **Pause Alarm** in the alarm list pauses all alarms. • **Medium and low:** Selecting **Pause Alarm** in the alarm list pauses medium and low priority alarms. High priority alarms will not be paused. • **Deactivate: Pause alarm** in the alarm list is deactivated.
Alarm light	Turned on upon restart, Turns off upon restart	Powered on upon restart	• **On on reset:** When the alarm system is reset, the alarm tones of active alarms are turned off, but the alarm light continues to flash. • **Power off on restart:** when the alarm system, both the alarm tone and the alarm light of active alarms are deactivated.

Menu item Options/interval		Predetermined	Description
Alarm notification	Act, Re-alarm, Des	Act	Select the reminder tone rule when the alarm volume is set to zero or the alarm is reset or turned off. • **Act:** the equipment emits warning tones at the designated interval. • **Re-alarm:** If the alarm condition persists, alarms marked with "y" will be generated again once the interval defined for the warning tone has elapsed. • **Dis:** The device does not emit warning tones in the designated interval. Alarms marked with "y" are silenced.
Alarm deactivated warning	Act, Des	Act	It allows you to set whether the device notifies you when the alarm is deactivated.
Warning interval	1 min, 2 min, 3 min, 5 min, 10 min	5 min	Allows you to set the interval between warning tones.
Setup (Configuration)			
ECG leads disconnected. High, Medium, Low		Low	Allows you to set the priority of the **"ECG disconnected" alarm.**
SpO2 sensor off	High, Medium, Low	Low	Allows you to set the alarm priority for **"SpO2 Sensor Disconnect".**
Without SMC	High, Medium, Low	Low	Allows setting the alarm priority to **"No SMC".**
Alarm delay	1 to 15 s, Des	12 s	• 1 to 15 s: In the case of continuously measured parameters, the equipment does not present the alarm if the alarm condition is resolved within the delay time. • **Dis:** an alarm always appears. The **Alarm Delay** setting does not apply to apnea alarms or ST alarms.
ST alarm delay	30s, 45s, 1min, 1.5min, 2min, 3min	30 s	The equipment does not present the ST alarm if the alarm condition is resolved within the delay time.
Alarm Desat. SPO2 desac	Activate, Deactivate	Deactivate	Allows you to set if the SpO2 Desat alarm can be triggered . turn off. • **Deactivate:** the SpO2 Desat alarm cannot be deactivated turn off. • **Activate:** The Desat. SpO2 alarm can be turned off.
Apnea alarm deactivated	Activate, Deactivate	Deactivate	It allows you to set whether the apnea alarm can be activated. turn off. • **Deactivate:** The apnea alarm cannot be deactivated turn off. • **Activate:** The apnea alarm can be turned off.
Arrhythmia recovery time: 0 to 5 min		2 min	The alarm light and tone will be turned off during the designated time period when some arrhythmia alarms are detected. 0: disables this function.
Without battery	Active status indicator, Inactive status indicator	Active status indicator	Allows you to set how the status indicator behaves if the battery has not been installed.
CMS/eGW alarm disconnected	Act, Des	Des	Allows you to set whether an alarm is issued when the equipment disconnects from the CMS or gateway. **Deactivated:** The **"Network disconnected"** alarm is not issued if the equipment is disconnected from the CMS or eGateway.

NOTE

• **The alarm volume increase function does not apply to locked alarms.**

22.7.4 Parameter Configuration Menu

22.7.4.1 General Settings Tab

Menu item	Options/interval	Predetermination ado	Description
Parameter color settings			
ECG	Green, Yellow, Cyan, White, Red, Blue, Purple, Orange	Green	It allows you to set the colors of the waves and the numerical values of the parameters.
Resp		Yellow	
SpO2		Cyan	
PANI		White	
CO2		Yellow	
Adjust units			
ST Unit	mV, mm	mV	It allows you to set the unit of measurement for each parameter.
CO2 unit	mmHg, kPa,%	mmHg	
Pressure unit	mmHg, kPa	mmHg	
Parameter activation/deactivation			
SpO2/Resp/PANI/CO2	Act, Des	Act	Allows you to set whether to activate the monitoring of a parameter.

22.7.4.2 ECG Configuration Menu

Menu item		Options/interval		Predeter-mined	Description
Alarm settings					
FC/FP Alarm Switch		Act, Des		Act	It allows you to set whether the heart rate and pulse rate alarms.
	Priority of alarm	High, Medium		Half	Allows you to set the priority of FC and FP alarms.
	Results of alarm	Act, Des		Des	Allows you to set whether the parameter is automatically printed when the FC and FP alarms are triggered.
High HR/FP (ppm)		Adult FC/FP y40 ppm: (lower limit + 2 bpm) at 40 bpm FC/FP >40 ppm: (lower limit + 5 bpm) at 295 bpm		120	It allows you to set the limits of alarm for HR and FP. FC/FP y40 ppm: the variation is 1 ppm. FC/FP >40 ppm: the variation is 5 ppm.
		Ped.		160	
		Neon.		200	
Low FC/FP (ppm)		Adult FC/FP y40 ppm: from 16 bpm to (upper limit – 2 bpm) HR/PF >40 bpm: 40 bpm to (upper limit – 5 bpm)		50	
		Ped.		75	
		Neon.		100	

Menu item	Options/interval	Predetermined	Description
ECG Gain and Lead Settings			
ECG1	3rd: I, II, III	II	The available options are defined by the current setting of **Conjunt deriv.**
	5th right: I, II, III, aVL, aVR, aVF, V		
	12 right: I, II, III, aVL, aVR, aVF, V1		
ECG1 Gain	x0.125, x0.25, x0.5, x1, x2, x4, Auto x1		It allows you to set the size of the ECG waveform.
Setup (Configuration)			
Alarm origin	Both, FP, FC, Autom	Autom	It allows you to determine the origin of the QRS tone.
Speed	6.25mm/s, 12.5mm/s, 25mm/s, 50mm/s	25 mm/s	It allows you to set the ECG wave speed
Filter	ST, Diagnosis, Monitor, Therapy	Monitor	Sets the ECG waveform filter mode.
Derivative set	Automatic, 3 right, 5 right, 12 right	Autom	It allows you to set the type of ECG leads This setting affects the default waveform sequence of the ECG leads.
Wave design	Standard, Cabrera	Standard	It allows you to set the ECG waveform design.
Intellectual derivation	Act, Des	Act	It allows you to set whether the device automatically switches to the available lead when the first ECG waveform lead is disconnected.
QRS Volume	From 0 to 10	2	**This setting is the same as the QRS Volume setting in the SpO2 Adjustment menu.**
QTc formula	Hodges, Bazett, Fridericia, Framingham	Hodges	It allows you to set the QTc formula to correct the QT interval of the heart rate. • **Hodges:** $QTc = QT + 1.75 \times (HeartRate - 60)$ • **Bazett:** $QTc = \frac{QT}{\sqrt{\frac{HeartRate}{60}}}$ • **Fridericia:** $QTc = \frac{QT}{\sqrt[3]{\frac{HeartRate}{60}}}$ • **Framingham:** $QTc = QT \times 154 \left(1 - \frac{60}{HeartRate}\right)$
ECG Standard	AHA, IEC	AHA	It allows you to set the ECG standard according to the leads you are using.
Cutoff frequency	50 Hz, 60 Hz	50 Hz	The notch filter eliminates line frequency interference. It allows you to set the notch filter frequency according to your country's power grid frequency.

22.7.4.3 Arrhythmia Adjustment Tab

Alarm settings			
Menu item	**Alarm switch**	**Alarm priority**	**Alarm results**
Asystole	Act	High, not configurable	Des
Fibr.ventr /Taq.ventr	Act	High, not configurable	Des
Tachyventr.	Act	High, not configurable	Des
Ventricular bradycardia	Act	High, not configurable	Des
Extreme Taq	Act	High, not configurable	Des
Extreme Brady	Act	High, not configurable	Des
R in T	Des	Half	Des
Run CVP	Des	Low	Des
Doublet	Des	Indication	Des
CVP multif.	Des	Half	Des
CVP	Des	Indication	Des
Bigeminy	Des	Half	Des
Trigeminism	Des	Half	Des
Taq.	Des	Half	Des
Bradic.	Des	Half	Des
Marcap does not capture	Des	Indication	Des
Marcap. does not stimulate	Des	Indication	Des
Lost heartbeats	Des	Indication	Des
Non-sustained ventricular tachycardia	Des	Half	Des
Ventilation rhythm	Des	Half	Des
Pause	Des	Low	Des
Irregular rhythm	Des	Indication	Des
Fibr. A.	Des	Indication	Des
CVP/min	Des	Half	Des
Pauses/min	Des	Half	Des
SVT	Des	Half	Des
CVP/min	Des	Half	Des

Threshold configuration		
Menu item	**Options/interval**	**Predetermined**
Delayed asystole	Adult 3 to 10 seconds	5 s
	Ped.	5 s
	Neon.	3 s
Extreme Taq	Adult: 65 lpm to 300 lpm	160 lpm
	Ped.	180 lpm
	Neon.	220 lpm

Taq.	Adult: 60 lpm to 295 lpm		120 lpm
	Ped.		160 lpm
	Neon.		200 lpm
Bradic.	Adult: 16 lpm to 120 lpm		50 lpm
	Ped.		75 lpm
	Neon.		100 lpm
Extreme Brady	Adult 15 to 115 bpm		35 lpm
	Ped.		50 lpm
	Neon.		80 lpm
Multi-function CVP window	From 3 to 31 beats		15 beats
CVP/min	Adult 1 to 00		10
	Ped.		10
	Neon.		5
Pauses/min	From 1 to 15		8
Threshold of pauses	Adult 1.5s, 2.0s, 2.5s, 3.0s		2.0 s
	Ped.		2.0 s
	Neon.		1.5 s
Irregular end of auricular fibrotic rhythm	0, 1 min, 2 min, 3 min, 4 min, 5 min, 10 min, 15 min, 30 min		2 min
FC SVT	Adult: 100 lpm to 300 lpm		180 lpm
	Ped.		200 lpm
	Neon.		210 lpm
SVC SVT	From 3 to 99 beats		5 heartbeats
CVP/min	From 1 lpm to 100 lpm		10 lpm
Velocity, tachymetry, and wind speed	Adult: 100 lpm to 200 lpm		130 lpm
	Ped.		130 lpm
	Neon.		150 lpm
Vel. bradic. vent.	Adult: 15 lpm to 60 lpm		40 lpm
	Ped.		40 lpm
	Neon.		60 lpm
CVP tachyventricular	Adult: 3 to 99 beats		6 heartbeats
	Ped.		6 heartbeats
	Neon.		5 heartbeats
CVP bradic. ventric.	Adult: 3 to 99 beats		5 heartbeats
	Ped.		5 heartbeats
	Neon.		3 heartbeats

22.7.4.4 ST Adjustment Tab

Menu item		Options/interval	Predetermined	Description
Alarm settings				
ST-XX* Alarm Switch		Act, Des	Des	Allows you to set whether the ST alarm is activated.
	Alarm priority	High, Medium	Half	Allows you to set the priority of the ST alarm.
	Alarm results	Act, Des	Des	Allows you to set whether the parameter is automatically printed when the ST alarm is triggered.
ST high (mV)		ST alarm mode: Absolute (lower limit + 0.2 mV) to 2.0 mV ST alarm mode: Relative From 0 mV to 2.0 mV:	0.2	Allows setting ST alarm limits. The variation is 0.05 mV.
ST low (mV)		ST alarm mode: Absolute -2.0 mV to (upper limit - 0.2 mV) ST alarm mode: Relative From -2.0 mV to 0 mV:	-0.2	
*: ST-XX represents 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.				
Setup (Configuration)				
ST Analysis		Act, Des	Des	Allows you to set whether ST measurement is activated.
ST Alarm Mode		Absolute, Relative	Absolute	Allows setting the ST alarm mode.
Automatic adjustment		Act, Des	Act	Allows you to set whether the ST point location will be automatically adjusted.
ST Point		J+40 ms, J+60 ms, J+80 ms, J+60/80 ms	J+60 ms	It allows you to set the fixed distance from point ST to point J.

22.7.4.5 QT Adjustment Tab

Menu item		Options/interval	Predetermines do	Description
Alarm settings				
QTc	Alarm switch	Act, Des	Des	Allows you to set whether the QTc alarm is activated.
	Alarm priority	High, Medium	Half	Allows setting the QTc alarm priority.
	Alarm results	Act, Des	Des	Allows you to set whether the parameter is automatically printed when the QTc alarm is triggered.
ýQTc	Alarm switch	Act, Des	Des	Allows you to set whether the ýQTc alarm is activated.
	Alarm priority	High, Medium	Half	Allows setting the priority of the ýQTc alarm.
	Alarm results	Act, Des	Des	Allows you to set whether the parameter is automatically printed when the ýQTc alarm is triggered.

Menu item	Options/interval		Predetermines do	Description
long QTc (ms)	Adult 200 t	800	500	Allows setting the initial value of QTc.
	Ped.		480	
	Neon.		460	
high ÿQTc (ms)	from 30 to 200		60	It allows you to set the initial value of ÿQTc.
Setup (Configuration)				
QT Analysis	Act, Des		Des	Allows you to set whether QT measurement is activated.

22.7.4.6 Response Adjustment Tab

Menu item		Options/interval		Predetermined	Description
Alarm settings					
FR	Alarm switch	Act, Des		Act	Allows you to set whether the RR alarm is activated.
	Alarm priority	High, Medium, Low		Half	Allows you to set the priority of the RR alarm.
	Alarm results	Act, Des		Des	Allows you to set whether the parameter is automatically printed when the RR alarm is triggered.
Apnea Alarm Switch		Act, Des		Act	Allows you to set whether the apnea alarm is activated.
	Alarm priority	Not configurable		High	Allows you to set the priority of the apnea alarm.
	Alarm results	Act, Des		Des	Allows you to set whether the parameter is automatically printed when the apnea alarm is activated.
High FR (rpm)		Adult FR ÿ20:	From (lower limit + 2) to 20 FR >20: From (lower limit + 5) to 100	30	It allows you to set RR alarm limits. FR ÿ20: the variation is 1. FR >20: the variation is 5.
		Ped.		30	
		Neon. FR ÿ20:	From (lower limit + 2) to 20 FR >20: From (lower limit + 5) to 150	100	
Low FR (rpm)		Adult FR ÿ20:	From 0 to (upper limit - 2) FR >20: From 20 to (upper limit - 5)	8	
		Ped.		8	
		Neon.		30	
Setup (Configuration)					
Delayed apnea		10s, 15s, 20s, 25s, 30s, 35s, 40s.		20 s	It allows you to determine if the equipment does not present the alarm if the alarm condition is resolved within the delay time.

Menu item	Options/interval	Predetermined	Description
Deriv. Resp	Adult I, II, Automatic	Autom	It allows you to set whether one lead is used or whether all leads are used for Resp monitoring.
	Ped.	Autom	
	Neon.	II	
Increase	x0.25, x0.5, x1, x2, x4, x5, Auto	x2	It allows you to set the size of the Resp waveform.
Speed	3mm/s, 6.25mm/s, 12.5mm/s, 25mm/s, 50mm/s	6.25 mm/s	It allows you to set the wave speed of Resp

22.7.4.7 SpO2 Adjustment Tab

Menu item		Options/interval	Predetermined	Description
Alarm settings				
SpO2 Alarm	Switch	Act, Des	Act	Allows you to set whether the SpO2 alarm is activated.
	Alarm priority	High, Medium	Half	Allows you to set the priority of the SpO2 alarm.
	Alarm results	Act, Des	Des	Allows you to set whether the parameter is automatically printed when the SpO2 alarm is triggered.
Desat. SpO2		Not configurable	High	Allows you to set the priority of the Desat SpO2 alarm.
SpO2 High (%)		Adult From (lower limit + 2) to 100	100	It allows you to set the SpO2 alarm limits. The variation is 1%.
		Ped.	100	
		Neon.	95	
SpO2 Low (%)		Mindray/Masimo Adult SpO2 : (Desat+1) to (upper limit – 2)	90	
		Ped.	90	
		Neon. Nellcor SpO2 : (Desat+1) or 20 (the higher value) to (upper limit – 2)	85	
Desat. SpO2 (%)		From 0 to (lower limit - 1)	80	It allows you to set the limits of the Desat SpO2 alarm. The variation is 1%.
Setup (Configuration)				
Speed		6.25mm/s, 12.5mm/s, 25mm/s, 50mm/s	25 mm/s	It allows you to set the sweep speed of the SpO2 waveform.
View FP		Act, Des	Act	Allows you to set whether or not the FP value is displayed in the SpO2 numeric values area.
Sensitivity (for SpO2 of Mindray and SpO2 of (Maximo)		Mindray SpO2 : High, Medium, Low, Average		It allows you to set the response speed to changes in SpO2 values .
		Masimo's SpO2 : High, Normal, APOD Normal		

Menu item	Options/interval	Predetermined	Description
PANI simult.	Act, Des	Des	When SpO2 and NIBP are monitored simultaneously in the same limb, it allows you to set whether the SpO2 alarm state is locked until the NIBP measurement is finished.
Seconds of sat (for SpO2 of Nellcor)	0s, 10s, 25s, 50s and 100s.	0s	It allows you to set the SpO2 saturation seconds.
Average (for SpO2 of (Maximo)	2-4s, 4-6s, 8s, 10s, 12s, 14s, 16s	8s	It allows you to set the average time for SpO2 measurement .
SAT fast (for SpO2 of (Maximo)	Act, Des	Des	Allows you to set whether the FastSAT function is activated.
Show SIQ (for SpO2 of (Maximo)	Act, Des	Des	Allows you to set whether the SIQ screen is activated.
Show PI	Act, Des	Act	Allows you to set whether the PI screen is activated.
SpO2 tone	Mode 1, Mode 2	Mode 1	Allows you to set the SpO2 tone mode.

22.7.4.8 PANI Adjustment Tab

Menu item		Options/interval	Predetermined	Description
Alarm settings				
PANI-S Alarm Switch		Act, Des	Act	Allows you to set whether the PANI-S alarm is activated.
	Alarm priority	High, Medium	Half	Allows setting the priority of the PANI-S alarm.
	Alarm results	Act, Des	Des	Allows you to set whether the parameter is automatically printed when the PANI-S alarm is activated.
PANI-M Alarm Switch		Act, Des	Act	Allows you to set whether the PANI-M alarm is activated.
	Alarm priority	High, Medium	Half	Allows you to set the priority of the PANI-M alarm.
	Alarm results	Act, Des	Des	Allows you to set whether the parameter is automatically printed when the PANI-M alarm is triggered.
PANI-D Alarm Switch		Act, Des	Act	Allows you to set whether the PANI-D alarm is activated.
	Alarm priority	High, Medium	Half	Allows setting the priority of the PANI-D alarm.
	Alarm results	Act, Des	Des	Allows you to set whether the parameter is automatically printed when the PANI-D alarm is triggered.

Menu item		Options/interval		Predetermined	Description
PANI-S extreme	Alarm switch	Act, Des		Act	Allows you to set whether the extreme PANI-S alarm is activated.
	Alarm priority	High, Medium		High	Allows setting the priority of the extreme PANI-S alarm.
	Alarm results	Act, Des		Des	Allows you to set whether the parameter is automatically printed when the extreme PANI-S alarm is triggered.
PANI-M extreme	Alarm switch	Act, Des		Act	Allows you to set whether the extreme PANI-M alarm is activated.
	Alarm priority	High, Medium		High	Allows setting the priority of the extreme PANI-M alarm.
	Alarm results	Act, Des		Des	Allows you to set whether the parameter is automatically printed when the extreme PANI-M alarm is triggered.
PANI-D extreme	Alarm switch	Act, Des		Act	Allows you to set whether the extreme PANI-D alarm is activated.
	Alarm priority	High, Medium		High	Allows setting the priority of the extreme PANI-D alarm.
	Alarm results	Act, Des		Des	Allows you to set whether the parameter is automatically printed when the extreme PANI-D alarm is triggered.
High NIBP (mmHg)		Adult (Low+5) to 290		160	Allows setting PANI-S alarm limits. NIBP ÿ50: the variation is 1 mmHg. NIBP >50: the variation is 5 mmHg.
		Ped.	From (Low+5) to 240	120	
		Neon.	From (Low+5) to 140	90	
Low NIBP (mmHg)		Adult 25 years (High-5)		90	
		Ped.		70	
		Neon.		40	
High NIBP (mmHg)		Adult (Low+5) to 260		110	Allows you to set the PANI-M alarm limits. NIBP ÿ50: the variation is 1 mmHg. NIBP >50: the variation is 5 mmHg.
		Ped.	From (Low+5) to 215	90	
		Neon.	From (Low+5) to 125	70	
Low NIBP (mmHg)		Adult 15 years (High-5)		60	
		Ped.		50	
		Neon.		25	
High NIBP (mmHg)		Adult (Low+5) to 250		90	Allows setting PANI-D alarm limits. NIBP ÿ50: the variation is 1 mmHg. NIBP >50: the variation is 5 mmHg.
		Ped.	From (Low+5) to 200	70	
		Neon.	From (Low+5) to 115	60	
Low NIBP (mmHg)		Adult 10 to High-5)		50	
		Ped.		40	
		Neon.		20	

Menu item	Options/interval		Predetermined	Description
PANI-S extremely high (mmHg)	Adult upper limit 290		175	It allows setting the alarm limits for extreme PANI-S. NIBP y50: the variation is 1 mmHg. NIBP >50: the variation is 5 mmHg.
	Ped.	upper limit 240	130	
	Neon. Upper limit 140		95	
PANI-S extremely low (mmHg)	Adult 25 to low limit		75	
	Ped.		60	
	Neon.		35	
PANI-M extremely high (mmHg)	Adult upper limit 260		125	It allows setting the extreme PANI-M alarm limits. NIBP y50: the variation is 1 mmHg. NIBP >50: the variation is 5 mmHg.
	Ped.	upper limit 215	100	
	Neon. Upper limit 125		75	
PANI-M extremely low (mmHg)	Adult 15 to low limit		45	
	Ped.		40	
	Neon.		20	
Extremely high NIBP (mmHg)	Adult upper limit 250		105	It allows setting the alarm limits for extreme PANI-D. NIBP y50: the variation is 1 mmHg. NIBP >50: the variation is 5 mmHg.
	Ped.	upper limit of 200	80	
	Neon. Upper limit 115		65	
Extremely low NIBP (mmHg)	Adult 10 to low limit		35	
	Ped.		30	
	Neon.		15	
Setup (Configuration)				
Initial pressure (mmHg)	Adult 80 to 280		160	Allows you to set the initial inflation pressure of the cuff
	Ped.	From 80 to 210	140	
	Neon. From	60 to 140	90	
Venipuncture pressure (mmHg)	Automatic, 20 to 120		Autom	It allows setting the venipuncture pressure.
Interval.	Manual, Sequence, 1 min, 2 min, 2.5 min, 3 min, 5 min, 10 min, 15 min, 20 min, 30 min, 1 hr, 1.5 hr, 2 hr, 3 hr, 4 hr, 8 hr		15 min	It allows you to set the interval between NIBP measurements.
Startup mode	Interval, Clock		Clock	It allows you to set the start mode by defining the automatic PANI mode.
Final tone PANI	Act, Des		Des	Allows you to set whether the device emits a warning tone when the NIBP measurement is complete.
Visual format	Sys/day (average), (Average) Sys/day, Med. Sys/day (average)		Allows you to set the NIBP display format	
View alarm limits Act, Des			Des	Define whether or not the diastolic NIBP and mean NIBP alarm limits will be displayed.
View FP	Act, Des		Des	Allows you to set whether or not the FP value is displayed in the PANI parameters area.
Time expired PANI	5 min, 10 min, 15 min, 30 min, 45 min, 1 hour		15 min	It allows you to set the waiting time for PANI measurements.

22.7.4.9 CO2 Adjustment Tab

Menu item		Options/interval	Predetermined	Description
Alarm settings				
EtCO2 Alarm Switch		Act, Des	Act	Allows you to set whether the EtCO2 alarm is activated.
	Alarm priority	High, Medium	Half	Allows you to set the priority of the CO2 alarm.
	Alarm results	Act, Des	Des	Allows you to set whether the parameter is automatically printed when the EtCO2 alarm is triggered.
FiCO2 Alarm Switch		Act, Des	Act	Allows you to set whether the FiCO2 alarm is activated.
	Alarm priority	High, Medium	High	Allows setting the FiCO2 alarm priority.
	Alarm results	Act, Des	Des	Allows you to set whether the parameter is automatically printed when the FiCO2 alarm is triggered.
High EtCO2 (mmHg)		Adult (Low-2) to 99	50	It allows you to set CO2 alarm limits . Step: 1 mmHg
		Ped.	50	
		Neon.	45	
Low EtCO2 (mmHg)		Adult 1 to (High-2)	25	
		Ped.	25	
		Neon.	25	
High FiCO2 (mmHg)		Adult 1 to 99	4	
		Ped.	4	
		Neon.	4	
Setup (Configuration)				
Speed		3mm/s, 6.25mm/s, 12.5mm/s, 25mm/s, 50mm/s	6.25 mm/s	It allows you to set the speed of the CO2 wave
Wave type		Plot, Fill	Layout	It allows you to set the wave type of CO2
CO2 scale (mmHg)		15, 20, 25, 40, 50, 60, 80	50	It allows you to set the CO2 wave scale .
Sideflow CO2 configuration (only available when **sideflow CO2 accessories are connected)**				
Waiting for car		Des, 15 min, 30 min, 60 min	60 min	It establishes that the CO2 module will automatically enter standby mode once a designated period of time has elapsed if no breathing has been detected since the last detected breath.
TCPS Compensation		Act, Des	Des	It allows you to set whether humidity compensation is activated.

Menu item	Options/interval	Predetermined	Description
O2 Compensation	From 0% to 100%:	21%	It allows you to set the concentration of each gas.
N2O compensation	From 0% to 100%:	0%	
GA Compensation	From 0% to 24%:	0%	

22.7.5 Menu Adjustment 12 leads

Menu item Options/interval		Predetermined	Description
Setup (Configuration)			
Tachycardia (bpm)	From 80 to 130	100	It allows you to set the tachycardia threshold. This adjustment is only effective for patients in cases of more than 180 days.
Bradycardia (bpm)	From 40 to 60	50	It allows you to set the bradycardia threshold. This adjustment is only effective for patients in the case of more than 2191 days.
QTc formula	Hodges, Bazett, Fridericia, Framingham	Hodges	It allows you to set the QTc formula to correct the QT interval of the heart rate. • **Hodges:** $QTc = QT + 1.75 \times (HeartRate - 60)$ • **Bazett:** $QTc = QT \times \sqrt{\frac{HeartRate}{60}}$ • **Fridericia:** $QTc = QT \times \sqrt[3]{\frac{HeartRate}{60}}$ • **Framingham:** $QTc = QT + 154 \times \left(1 - \frac{60}{HeartRate}\right)$
Prior acquisition	Act, Des	Des	It allows you to set whether the device acquires 10 seconds of ECG data before starting the automatic measurement. • **Act:** If more than 10 seconds of ECG data have been acquired, the device will start printing immediately after selecting **Analyze.** • **Des:** The device starts printing after **Analyze** is selected and 10 seconds of ECG data are acquired.
Muscle movement artifact filter	Des, 35 Hz, 20 Hz	35 Hz	The muscle motion artifact filter attenuates noise in the wave by restricting the included frequencies. The muscle motion artifact filter is a low-pass filter. Signals exceeding the set frequency are filtered out.
Diagnostic quality	150 Hz, 350 Hz	350 Hz	This option is only available when **Muscle Motion Artifact Filter** is set to **Off.** It allows you to set the upper frequency response limit for the ECG waveforms. Signals above the limit are filtered out.
Extended registration	Act, Des	Des	It allows you to set whether a rhythm measurement is automatically initiated when critical values of "extreme tachycardia", "extreme bradycardia" or "significant arrhythmias" are detected at the end of the automatic measurement.

Menu item Options/interval		Predetermined	Description
Patient information. Admission indication message.	Act, Des	Act	Allows you to set if the **Demog Data menu.** **Patient** appears automatically after starting the automatic measurement.
Screenshot	Screenshot, Waveform capture	Screenshot	Allows you to set the capture content after selecting **Screenshot.** • **Screenshot:** Captures the current screen. • **Waveform Capture:** Captures 5 seconds of 12-lead ECG waveforms acquired before and after selecting **Screenshot.**
Registry settings			
self-registration	Act, Des	Act	Determines whether the device starts printing immediately after selecting **Analyze** in the automatic measurement.
Medium complexity	Act, Des	Des	It allows you to determine whether the median complex information will be included in the 12-lead ECG analysis report.
Measurement matrix	Act, Des	Des	It allows you to determine whether the information from the measurement matrix will be included in the 12-lead ECG analysis report.
Measurements	Act, Des	Act	It allows you to determine whether the measurement results will be included in the 12-lead ECG analysis report.
Interpretation	Act, Des	Act	It allows you to determine whether the diagnosis will be included in the 12-lead ECG analysis report.
Interpretive summary	Act, Des	Act	Allows you to set whether the summary of interpretations will be included in the 12-lead ECG analysis report. **The interpretation summary is included in the report only if Interpretation and Interpretation Summary are activated.**
RV5/SV1	Act, Des	Act	Allows you to set whether RV5/SV1 information will be included in the 12-lead ECG analysis report. RV5/SV1 information is included in the report only if **Measurements** and **RV5/SV1 are enabled.**
Amplitude	5 mm/mV, 10 mm/ mV, 20 mm/mV	10 mm/mV	Allows setting the wave amplitude of the printed ECG.
Speed	25 mm/s, 50 mm/s,	25 mm/s	It allows you to set the ECG waveform printing speed.
Format 12 derivac.	3×4, 3×4+2	3x4	Allows you to set the waveform format of the 12-lead ECG analysis report.
Rhythm derivation 1	I, II, III, aVR, aVL, aVF, V1, V2, V3, V4, V5, V6	II	• Allows establishing the rhythm derivation if **Format 12 derivac.** is set to **3x4+1.** • Allows setting the rhythm derivation for a rhythm measurement.
Rhythm derivation 2		V2	
Rhythm derivation 3		V5	
Simultaneous format sequence	Sequential	Sequential	It allows you to set the printing speed of the ECG waves.

22.7.6 TBI Warning Settings Menu

Menu item	Options/interval	Predetermined	Description
Lower limit of SpO2(%)	From 0 to 100	90	Allows you to set the TBI warning limits for each parameter.
NIBP-S lower limit (mmHg) 25 to290		90	
Lower limit of EtCO2 (mmHg) From 1 to 44		35	
Upper limit of EtCO2 (mmHg) From 36 to 9		45	

22.7.7 Menu Settings registration

Menu item Options/interval		Predetermined	Description
General settings			
Waveform format	Standard, Compact, Simplified	Standard	It allows you to set the display format of the printed waves.
Length	8 s, 16 s, 32 s, Continuous 8 s		It allows you to set the printing duration in real time.
Print duration	10 s, 20 s, 30 s	20 s	It allows you to set the length of the printed waves when an alarm is triggered.
Paper speed	6.25mm/s, 12.5mm/s, 25mm/s, 50mm/s	25 mm/s	It allows you to set the printing speed.
Grid	Act, Des	Act	It allows you to set whether the wave pattern includes grid lines.
self-registration			
Loading event	Act, Des	Des	Allows you to set whether the event is automatically printed when a load event is triggered.
Download event	Act, Des	Act	Allows you to set whether the event is automatically printed when a download event is triggered.
Autocomputing information	Act, Des, Only if error Des		Allows you to set whether the self-check report is printed automatically when the self-check is finished. • **Act:** the self-check report is printed automatically when the self-check is finished. • **Des:** the self-check report is not printed when the self-check is finished. • **Only if there is an error:** the autocomputing report is printed automatically when it finishes and when the self-check fails.

22.7.8 Patient Administration Menu

Menu item	Options/interval	Predetermined	Description
General settings			
Predet patient category	Adult, Pediatric, Neonatal.	Adult	Allows you to set the default patient category.
Load the latest patient type	But	No	It allows you to determine if the patient category of the last patient applies to the current patient.

Menu item	Options/interval	Predetermined	Description
Visual information for the patient	Bed number, Name pac.	Bed number	It allows you to set the type of patient information that is displayed in the patient information area.
Field settings			
Patient ID/Age (EG: Newborn)	Selected, not selected	Selected Allows you	to set the element that is displayed in the **Patient Management window.**
Room No./Visit Number/ Middle name/Race	Selected, not selected	Not selected	
Adjust units			
Unit height	cm, in.	cm	It allows you to set the default height unit for the patient.
Unit weight	kg, lb	kg	Allows you to set the default unit of weight for the patient.
Export			
Include patient sociodemographic data. Export patient data	But	No	It allows you to specify whether patient information is included when exporting patient data.

22.7.9 Network Configuration

The settings in this section can only be changed in configuration mode.

22.7.9.1 Network Type Tab

Menu item	Options/interval	Predetermined	Description
Network type	Auto, LAN1, WLAN, Mobile Network	Autom	It allows you to set the network type. **Autom:** the device automatically identifies the network type.

22.7.9.2 IP LAN1 Tab

Menu item		Options/interval	Predetermined	Description
Obtain IP address automatically.*		Selected, not selected	Selected Allows you	to set whether the device automatically obtains an IP address.
Use the following address*	IP Address	From 0 to 255	0. 0. 0. 0	**IP address, subnet mask** and **gateway** are required.
	Subnet mask			
	Gangway			
Obtain DNS address automatically*		Selected, not selected	Selected Allows you	to set whether the device automatically obtains the DNS address.
With this DNS address*	Preferred DNS server	From 0 to 255	0. 0. 0. 0	The IP addresses for **Preferred DNS Server** and **Alternate DNS Server** are required.
	Alternative DNS server			

22.7.9.3 WLAN Tab

Menu item		Options/interval	Predetermined	Description
Add WLAN		/	/	Add the wireless network and set up the network in the pop-up dialog box.
Network test		/	/	Check if the wireless network is properly connected.
WLAN				
Name		0 to 12 characters	/	It allows you to enter the name of the wireless network.
SSID		0 to 32 characters	/	/
Security		/	WEP DESAC. Allows you to set the information of security.	
Cons		0 to 63 characters	/	It allows you to enter the password to access the wireless network.
WLAN IP				
Obtain IP address automatically.*		Selected, not selected	Selected Allows you to set whether the device automatically obtains an IP address.	
Use the next address*	IP Address	From 0 to 255	0. 0. 0. 0	**IP address, subnet mask** and **gateway** are required.
	Subnet mask			
	Gangway			
Obtain DNS address automatically*		Selected, not selected	Selected Allows you to set whether the device automatically obtains the DNS address.	
With this DNS address*	Preferred DNS server	From 0 to 255	0. 0. 0. 0	The IP addresses for **Preferred DNS Server** and **Alternate DNS Server** are required.
	Alternative DNS server			
WLAN settings				
WLAN Band		Auto, 5 GHz, 2.4 GHz	Autom	**Autom:** the device automatically identifies the WLAN band.
2.4G Channel		1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, all	All	It allows you to establish 2.4G channels.
5G Channel		36, 40, 44, 48, 149, 153, 157, 161, 165, all	All	It allows you to set up 5G channels.
Certificate management				
Local		/	/	**Delete:** Deletes the selected certificates.
USB drive		/	/	Select the certificates you want to import from the USB drive, and then you can select **Import** to import the desired certificates.

22.7.9.4 Mobile Network Settings Tab

Menu item	Options/interval	Predetermined	Description
SIM card	Card 1, Card 2	Card 1	Select the SIM card you want.
APN Name (SIM card 1)/ APN Name (SIM card 2)	0 to 30 characters	/	Set the name, username, or password of the desired SIM card.
APN Username (SIM card 1)/APN Username (SIM card 2)			
APN password (SIM card) 1)/APN password (card SIM 2)			

22.7.9.5 Central Station Settings Tab

Menu item	Options/interval	Predetermined	Description
Select CMS*	Act, Des	Act	Allows you to set whether the available CMSs are displayed.
Automatically connect bedside monitor to CMS*	Act, Des	Act	Allows you to set whether the CMS connects automatically after being turned on.
Add central station	/	/	It allows you to set the name, department, and address of the desired CMS server.
Network test	/	/	Check if the desired CMS is connected correctly.

22.7.9.6 Device Detection Tab

The multicast function allows devices to detect each other, or for the device and the CMS to detect each other. Devices in the same multicast group can detect each other.

Menu item	Default setting	Description
TTL Multicast	1	It allows you to set the real time and IP address of the multicast group.
Multicast address	225.0.0.8	
Main server address	/	Allows you to set the IP address of the main server.
Connection status	/	Displays the connection status of the main server.

22.7.9.7 QOS Tab

Menu item	Default setting	Description
QoS level for real-time monitoring	0	It allows setting the quality of the network connection service for real-time monitoring, for example, of measurements and parameter waveforms, alarms, etc.
QoS level for others	0	It allows you to set the quality of service of the network connection for monitoring that is not in real time, for example, history data, printing, etc.

22.7.9.8 Information Security Tab

Menu item Options/interval		Predetermine	Description
Issue demographic data.	Act, Des	Act	• **Act:** When viewing other patients, the device location and patient information of remote devices are displayed in the remote devices list. • **Dis:** Patient information is not shown in the remote device list.

22.7.9.9 HL7 Settings Tab

Menu item Options/interval		Predetermine	Description
Data and wave configuration			
Server address	0 to 63 characters	/	Allows you to set the desired HL7 server.
Destination IP	From 0 to 255	0.0.0.0	
Port	From 0 to 65535	0	
Shipping information	Act, Des	Des	Allows you to set whether monitoring parameters are automatically sent to the HL7 server.
Data interval	1 sec., 30 sec., 5 min., 30 min., 1 h.	1 s	Allows you to set the interval for sending data to the HL7 server.
Shipping waveforms	Act, Des	Des	It allows you to set whether the waves are automatically sent to the HL7 server.
Alarm settings			
Server address	0 to 63 characters	/	Allows you to set the desired HL7 server.
Destination IP	From 0 to 255	0.0.0.0	
Port	From 0 to 65535	0	
Send alerts	Act, Des	Des	Allows you to set whether alarms are automatically sent to the HL7 server.
Compatibility			
Protocol version HL7	/	HL7 Protocol Version 1.0	It allows you to set the HL7 protocol version.

22.7.9.10 FTP Configuration Tab

Menu item Options/interval		Predetermine	Description
Name	0 to 12 characters	/	Allows you to set the desired FTP server.
Server address	0 to 64 characters	/	
Port	From 0 to 65535	0	
Username	0 to 30 characters	/	
Cons	0 to 30 characters	/	
ECG Report	XML, PDF	XML	It allows you to set the default report format that is transferred to the FTP server.

22.7.9.11 Time synchronization settings tab

Menu item Options/interval		Predetermined	Description
Start NTP time synchronization	Act, Des	Des	Allows you to set whether the computer's system time is synchronized with the NTP server's time.
Interval	10s, 30s, 1min, 5min, 30min, 1h, 2h, 6h, 12h, 24h	1 h	Allows you to set the time synchronization interval.
Direct service temp	0 to 64 characters	/	Allows you to set the desired NTP server name.
Main service	From 0 to 255	0.0.0.0	Allows you to set the IP address of the desired NTP server.
Connection status	With connection, Without connection	/	Displays the connection status of the desired NTP server.
Network test	/	/	Check if the NTP server is connected correctly.

22.7.10 Menu Settings test

Menu item	Options/interval	Predetermined	Description
General settings			
Ind. test usu	Act, Des	Des	It allows you to set whether the device remembers to perform the user test if the recommended test time is reached.
Autocom time	24 h: From 00 to 23 12 h: 12 am to 11 pm	3:00 am	It allows you to set the start time for the self-check performed each day.
Energy autocom.	10 J, 20 J, 30 J, 50 J, 70 J, 100 J	10 J	Sets the energy level supplied by the self-test.
Customized report			
Function dial/Power management/Monitor module/ Main board/Recorder/ Controls/Audio/Screen/ Status indicator/Indicator contact	Act, Des	Des	Allows you to set the element that is displayed in the test summaries.
Battery/Defibrillation function/Paddles External (for equipment configured with a paddle tray)/ Energy precision	Act, Des	Act	

This page has been intentionally left blank.

23 Battery

23.1 Introduction to the battery

When an external power source is unavailable, the device is designed to operate on battery power. In the event of a sudden power failure, the device will automatically switch to battery power without interrupting therapy or monitoring. Therefore, it is recommended that the device always be connected with a fully charged battery.

23.2 Battery safety information

WARNING

- **Keep batteries out of reach of children.**
- **Use only the specified battery. Using a different type of battery may pose a risk of fire or explosion.**
- **Keep the batteries in their original packaging until you are ready to use them.**
- **Do not expose batteries to liquids.**
- **Do not crush, drop, or puncture the battery. Mechanical damage could cause problems. internal short circuits and malfunctions. If the battery is dropped or struck against a hard surface, whether the damage is externally visible or not, do not use the battery and dispose of it properly.**
- **If the battery is damaged or leaking, replace it immediately.**
- **The battery must be charged in this equipment or with the specified charger.**
- **An extremely high ambient temperature may activate the battery overheat protection, causing the device to shut down.**
- **Do not open the batteries, do not subject them to a heat source above 60°C, do not burn them or Short-circuit their terminals. They may catch fire, explode, leak, or overheat, which could cause injury.**

NOTE

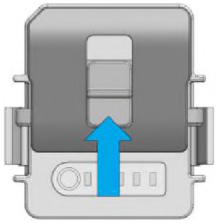
- **Connect the equipment to an external power source whenever possible.**
- **It is advisable to always install a fully charged battery in the equipment.**

23.3 Battery replacement

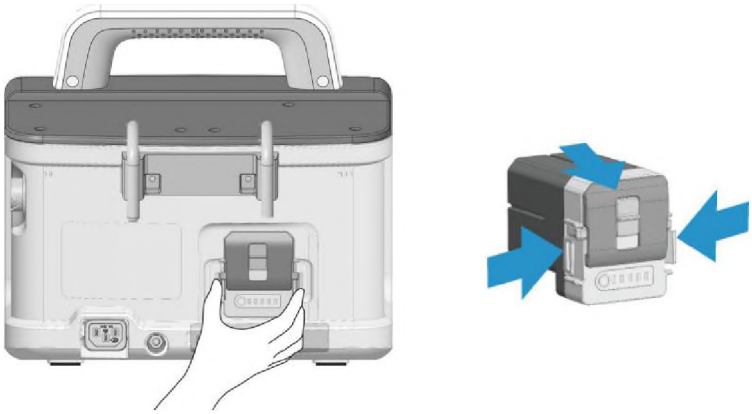
Replacing a battery with a battery compartment, as an example below. If the battery does not have a battery compartment, the compartment-related operations can be ignored in the following steps.

To change the battery, do the following:

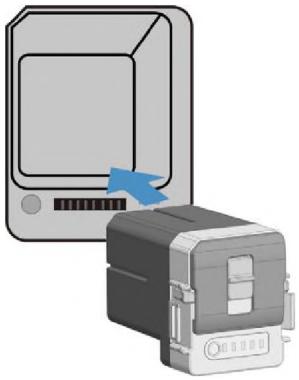
1. Move the latch upwards to unlock the battery compartment.



2. Press the tabs located on both sides of the battery and remove it.



3. Place a new battery in the battery compartment and tighten until you hear a click.



4. Move the latch down to lock the battery compartment.

23.4 Battery indications

The battery indicator, battery charge indicator, on-screen battery symbol, and related alarm messages indicate the battery status.

NOTE

- **After prolonged use, the battery level symbol may differ from the actual level. Always observe the alarm information displayed on the screen.**

23.4.1 Battery Indicator

The battery indicator on the front panel shows the following status:

ÿ Yellow: The battery is charging.

ÿ Green: The battery is fully charged, the device is running on battery power.

ÿ Off: No battery is installed or it is faulty.

23.4.2 Battery symbols

The battery symbols on the screen indicate the following status:

ÿ  This indicates that the battery is functioning correctly. The green portion represents the remaining charge. Each The bar represents 20% of the battery capacity.

ÿ  This indicates that the battery charge level is low and needs to be recharged.

ÿ  This indicates that the battery is almost depleted and must be charged immediately. Otherwise, the device will automatically shut down shortly.

ÿ  indicates that the battery is charging.

ÿ  This indicates that there is no battery installed or that there has been a battery failure.

23.4.3 Battery power indicator

The battery charge indicator is located on the outside of the battery. It consists of five LEDs, each representing 20% of the battery's capacity. Pressing the button next to each LED will display the remaining battery charge.

23.4.4 Alarm Without battery

When the device is powered solely from the external power supply, the status indicator flashes red and the **"No battery" alarm is displayed.**

You can turn off the display of this indicator. The " **No Battery"** setting can only be changed in setup mode. For more information, see section 22.7.3 Alarm Settings Menu.

23.4.5 Low Battery Alarm

When the device is powered solely by the battery and the capacity is less than 60%, the indication **"Battery capacity less than 60%" is displayed.**

When the device is powered solely by battery power and the battery is low, the status indicator flashes red and the message **"Battery capacity less than 60%" is displayed.** If the device is in clinical mode with alarms paused or disabled, alarm lights and tones will be used. If the device shuts down, a beep will sound periodically. In this case, you must immediately connect the device to a power source.

external.

When the device is powered solely by battery power and the battery is nearly depleted, the following message is displayed : **"Critically Low Battery! The system will shut down immediately. Connect to an external power source."** If the device is in Monitor, Manual Defibrillator, or Marcap mode, alarm lights and tones are used. In this case, you must immediately connect the device to an external power source. The message will continue to be displayed until the device is connected to an external power source. If no action is taken, the device will automatically shut down in 3 minutes.

NOTE

- **The "Low Battery" alarm indicates that the battery is starting to run low; you should connect the device to an external power source immediately. After this alarm is activated, at least 20 minutes of monitoring and 6 shocks at 360 J can be performed.**

23.4.6 Alarm: Worn Battery

If the installed battery life is significantly less than specified, the **"Battery Maintenance Required" alarm will be displayed.** In this case, replace the battery with a new one or contact service personnel.

23.4.7 Battery Error Alarm

If the installed battery fails, the **"Battery Error" alarm will be displayed.** In this case, replace the battery with a new one or contact service personnel.

23.5 Battery charging

The battery charges automatically when connected to an external power source, regardless of whether the device is on or off. Charging speed is slower when the device is on.

23.6 Battery Conditioning

Battery performance deteriorates over time. To extend battery life, you should condition the batteries at least every 6 months (every 3 months is recommended).

If the battery has not been conditioned for a long time, the charge indication may not be accurate and could incorrectly assess the remaining battery life.

To condition a battery:

1. Disconnect the equipment from the patient and stop all operations
2. Let the battery charge uninterrupted until it is fully charged.
3. Let the device run on battery power until it is completely depleted and the device shuts down.
   automatically.
4. Fully recharge the battery for use or charge it to 40% - 60% for storage.

NOTE

• Do not use the equipment during battery conditioning. • Do not interrupt the battery conditioning process.

23.7 Battery performance check

The performance of rechargeable batteries deteriorates over time. To prolong battery life, it is recommended to check its performance every three months or if you suspect the battery may be failing.

Refer to steps 1–3 of section 23.5 Battery Charging to check battery performance. Battery runtime is a direct indicator of its performance. If the battery runtime is significantly shorter than specified, the battery may have reached the end of its service life or may be faulty. If the battery performance meets requirements, fully recharge the battery for use, or charge it to 40–60% for storage.

NOTE

- **The expected battery life depends on the frequency and duration of use. If used Properly, the lifespan of a lithium-ion battery can reach approximately two years. If used incorrectly, its lifespan may be shortened. It is recommended to replace the battery every two years.**
- **To optimize battery performance, a fully (or almost fully) discharged battery should be charged as soon as possible.**
- **Battery operating time depends on the configuration and operation of the equipment. For example, if NIBP is measured more frequently, operating time is shortened.**

23.8 Battery Storage

When storing batteries, ensure that the battery terminals do not come into contact with metal objects. If the batteries have not been installed in the equipment and are to be stored for an extended period, they should be kept in a cool place with a partial charge of between 40% and 60% (3 LEDs illuminated on the charge indicator).

Condition stored batteries every three months. For more information, see section 23.5 Battery Charging.

NOTE

- **Remove the battery from the device if you will not be using it for an extended period of time (for example, several weeks). Otherwise, the battery may become over-discharged.**
- **If batteries are stored at a high temperature for an extended period of time, their lifespan will be significantly reduced.**
- **The battery storage temperature is between -20°C (-4°F) and 60°C (140°F). Storing batteries in a cool place can slow the deterioration process. The ideal storage temperature for batteries is 15°C.**

23.9 Battery Recycling

Dispose of the battery in the following situations:

y The battery shows signs of damage.

y The battery fails.

- The battery has deteriorated and its lifespan is significantly shorter than specified.
- The battery has reached the end of its useful life.

Dispose of batteries properly in accordance with local regulations.

This page has been intentionally left blank.

24 Care and cleaning

24.1 Introduction to care and cleaning

This chapter only describes the cleaning and disinfection of the equipment and some accessories. For cleaning and disinfection of other reusable accessories, please refer to the corresponding instructions for use.

24.2 Safety information on care and cleaning

WARNING

- **Use only the cleaning products, disinfectants, and methods specified in this Chapter. The use of unapproved substances or methods may damage the equipment and void the warranty.**
- **Do not mix disinfectant solutions as this can generate dangerous gases.**
- **Mindray is not responsible for the effectiveness of the cleaning products, disinfectants, or methods specified as a resource for infection control. Consult your hospital for infection control advice.**
- **Make sure to turn off the equipment and disconnect all power cords from the outlets before cleaning the equipment.**
- **The responsible hospital or institution must carry out all cleaning and disinfection procedures specified in this chapter.**

CAUTION

- **Never immerse any part of the equipment or its accessories in any liquid or allow between liquid inside.**
- **Contact of cleaning solutions or disinfectants with connectors or metal parts It could cause corrosion.**
- **Do not pour or spray any liquid directly onto the equipment or accessories, or allow liquid to penetrate connections or openings.**
- **If liquid is spilled on the equipment or accessories, unplug the power cord and dry the equipment and contact the service staff.**
- **Never use abrasive materials (such as metal scouring pads or silver polish) or corrosive cleaners (such as acetone or cleaners containing acetone).**
- **Dilute and use cleaning solutions or disinfectants according to the manufacturer's instructions.**
- **Inspect the equipment after cleaning and disinfection. If you notice any signs of damage, stop using it. use it.**

24.3 Cleaning and disinfection of equipment

24.3.1 Cleaning the main unit

Clean your equipment regularly. Before cleaning the equipment, consult the hospital's equipment cleaning guidelines.

To clean the equipment, follow this procedure:

1. Dampen a soft, lint-free cloth with water or ethanol (70%).
2. Squeeze out excess liquid from the cloth.
3. Clean the device's display screen

4. Clean the external surface of the equipment with the damp cloth, avoiding connectors and metal parts.

5. Dry the surface with a clean cloth. Allow the equipment to air dry in a cool, well-ventilated place.

CAUTION

- **During cleaning, turn off the device or lock the touchscreen to disable operation tactile.**

24.3.2 Cleaning the thermal print head

When the printhead is dirty, print quality deteriorates. Check the printed copies to ensure the print is legible and dark. If the copies print in light colors, it may indicate a dirty printhead.

To clean the thermal printhead, follow this procedure:

1. Take precautions against static electricity, such as wearing an anti-static wrist strap.

2. Open the register door and remove the paper from the register.

3. Gently rub the print head with cotton swabs moistened with ethanol to remove dust and foreign particles.

4. Clean off excess moisture with dry cotton swabs.

5. Let the print head air dry.

6. Reload the recorder paper and close the recorder door.

CAUTION

- **Do not use anything that could damage the heating element.**
- **Do not unnecessarily force the thermal printhead.**
- **The thermal printhead heats up during printing. Do not clean the printhead. immediately after printing.**

24.3.3 Equipment Disinfection

Disinfect equipment according to your hospital's maintenance schedule. Cleaning equipment before disinfection is recommended. Always follow the manufacturer's instructions for diluting and using disinfectants. The following table lists approved disinfectants:

Product Name	Product type	Manufacturer
Alpet® D2 Disinfectant wipes for surfaces	Wipes	BEST SANITIZERS INC™.
CIDEX® OPA	Liquid	Gilag GmbH International Advanced Sterilization products
Clorox Dispatch® Disinfectant wipes with bleach for hospitals	Wipes	Clorox professional products company
Clorox Healthcare® Bleach Bactericidal wipes	Wipes	Clorox professional products company
Clorox Healthcare® Hydrogen Peroxide Disinfectant cleaning wipes	Wipes	Clorox professional products company
Diversey Oxivir® TB Wipes	Wipes	Diversey Inc
Metrex CaviCide1™	METERX® RESEARCH Liquid Spray	
Metrex CaviWipes™	Wipes	METERX® RESEARCH

Product Name	Product type	Manufacturer
PDI Sani-Cloth® AF3 Disposable bactericidal wipes	Wipes	PDI Inc.
Sani-Cloth® PDI Bleach Disposable bactericidal wipes	Wipes	PDI Inc.
PDI Sani-Cloth® HB Disposable bactericidal wipes	Wipes	PDI Inc.
PDI Sani-Cloth® Plus Disposable bactericidal wipe	Wipes	PDI Inc.
PDI Super Sani-Cloth® Disposable bactericidal wipes	Wipes	PDI Inc.
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
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, 196 lpm	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® Wipes	Wipes	BODE Chemie GmbH
Cleanisept® Wipes	Wipes	Dr. Schumacher GmbH
mikrozid® PAA Wipes	Wipes	Schülke & Mayr GmbH
mikrozid® Sensitive Wipes	Wipes	Schülke & Mayr GmbH

Product Name	Product type	Manufacturer
Ecolab Incidin® OxyWipe S	Wipes	Ecolab Deutschland GmbH
Glutaraldehyde, 2%	Liquid	/
70% Ethanol	Liquid	/
70% Isopropanol	Liquid	/
Sodium hypochlorite, 0.5%	Liquid	/
Hydrogen peroxide, 3%	Liquid	/
Rely+On™ Virkon® Broad-spectrum disinfectant for surfaces, 1%	Dust	Antec International Ltd
1-propanol, 50%	Liquid	/
Descosept® forte	Liquid	Dr. Schumacher GmbH
Descosept® AF	Liquid	Dr. Schumacher GmbH
Dismozon® plus, 0.4%	Dust	BODE Chemie GmbH
mikrozid® AF Wipes	Wipes	Schülke & Mayr GmbH
Terralin® Liquid	Liquid	Schülke & Mayr GmbH
Perform® Classic OXY concentrate, 0.5%	Dust	Schülke & Mayr GmbH

NOTE

- **It is recommended to immediately clean any disinfectant residue from the equipment after disinfection. Otherwise, cracks could appear in the casing.**

24.4 Cleaning and disinfection of other accessories

The NIBP air tubing and SpO2 cable should be cleaned and disinfected using the cleaning and disinfecting products and methods described in this section. For other accessories, refer to the instructions included with them.

CAUTION

- **Liquids introduced into the NIBP air tube can damage the equipment. When cleaning or Disinfect the PANI air tube, prevent liquid from entering it.**
- **Periodically check the NIBP air tube and connector for signs of wear.**
  Wear and tear or deterioration may occur due to cleaning and disinfection of the NIBP air tubing. If you detect any leaks, replace the NIBP air tubing. Dispose of the damaged NIBP air tubing according to local hospital waste disposal regulations.
- **Never immerse or soak the accessories in liquid.**
- **Never clean or disinfect the connectors or metal parts.**
- **Use only Mindray-approved cleaning and disinfecting products and methods, as described in this section, to clean or disinfect the accessories. The warranty does not cover any damage caused by unapproved substances or methods.**
- **To avoid long-term damage, accessories may be disinfected only when necessary according to hospital policy.**

24.4.1 Cleaning the accessories

You should clean the NIBP air tubing and SpO2 cable regularly. Before cleaning the accessories, consult the hospital's cleaning guidelines.

To clean the accessories, follow this procedure:

1. Clean the accessories with a soft cloth dampened with water or ethanol (70%).
2. Remove any remaining cleaning solution with a dry cloth.
3. Let the accessories air dry.

24.4.2 Disinfection of accessories

It is recommended to disinfect the NIBP air tubing and SpO2 cable only when required according to hospital policy. It is recommended to clean the accessories before disinfecting them.

24.4.2.1 Disinfectants for the PANI air tube

These are the disinfectants approved for use with PANI air tubes:

Product Name	Product type	Manufacturer
Alpet® D2 Disinfectant wipes for surfaces	Wipes	BEST SANITIZERS INC™.
CIDEX® OPA	Liquid	Gilag GmbH International Advanced Sterilization products
Clorox Dispatch® Disinfectant wipes with bleach for hospitals	Wipes	Clorox professional products company
Metrex CaviCide1™	METERX® RESEARCH Liquid Spray	
Metrex CaviWipes™	Wipes	METERX® RESEARCH
PDI Sani-Cloth® AF3 Disposable bactericidal wipes	Wipes	PDI Inc.
PDI Sani-Cloth® Plus Disposable bactericidal wipes	Wipes	PDI Inc.
PDI Super Sani-Cloth® Disposable bactericidal wipes	Wipes	PDI Inc.
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® Wipes	Wipes	Schülke & Mayr GmbH
Glutaraldehyde, 2%	Liquid	/
70% Ethanol	Liquid	/
70% Isopropanol	Liquid	/
Rely+On™ Virkon® Broad-spectrum disinfectant for surfaces, 1%	Dust	Antec International Ltd
1-propanol, 50%	Liquid	/

24.4.2.2 Disinfectants for the SpO2 cable

The following table lists the disinfectants approved for SpO2 cables:

Product Name	Product type	Manufacturer
CIDEX® OPA	Liquid	Gilag GmbH International Advanced Sterilization products
Clorox Dispatch® Disinfectant wipes with bleach for hospitals	Wipes	Clorox professional products company
Clorox Healthcare® Bleach Bactericidal wipes	Wipes	Clorox professional products company
Clorox Healthcare® Hydrogen Peroxide Disinfectant cleaning wipes	Wipes	Clorox professional products company
Diversey Oxivir® TB Wipes	Wipes	Diversey Inc
PDI Super Sani-Cloth® Disposable bactericidal wipes	Wipes	PDI Inc.
Virex® TB	Liquid, spray	Diversey Inc
Glutaraldehyde, 2%	Liquid	/
70% Ethanol	Liquid	/
70% Isopropanol	Liquid	/
Sodium hypochlorite, 0.5%	Liquid	/
Hydrogen peroxide, 3%	Liquid	/
Rely+On™ Virkon® Broad-spectrum disinfectant for surfaces, 1%	Dust	Antec International Ltd
1-propanol, 50%	Liquid	/

24.5 Sterilization

Do not sterilize equipment, accessories, or supplies unless otherwise specified in the instructions for use provided with the accessories and supplies.

24.6 Effects of inadequate cleaning

Using cleaners other than those recommended can have the following effects:

- ÿ Product discoloration
- ÿ Corrosion of metal parts
- ÿ Weakening and breakage of cables, connectors and equipment casing
- ÿ Reduction in the lifespan of cables and branch wires
- ÿ Degradation of overall system performance
- ÿ Equipment breakdowns or failures

25 Maintenance

25.1 Introduction to Maintenance

The equipment must be kept ready for immediate use. To ensure its proper functioning, you must strictly follow the maintenance procedures described in this chapter. After 12 months of use, or whenever the equipment is repaired or upgraded, a thorough inspection must be carried out to ensure reliability.

Make sure to clean and disinfect the equipment before performing tests or maintenance tasks.

If you find any damage or malfunctions, stop using the equipment. Contact the hospital's biomedical engineers or service personnel immediately.

25.2 Safety information on maintenance

WARNING

- **Stop using the equipment if you notice any visible damage. If you observe any damage, contact service personnel.**
- **Follow the maintenance and testing schedule or local regulations for testing and maintenance. Failure to follow the maintenance schedule may result in equipment failure and potential health hazards.**

- **Modifying this equipment is not permitted.**
- **This equipment does not contain user-serviceable parts.**
- **Do not open the equipment casings. Safety checks or maintenance that involve disassembly of the equipment must be carried out by professional service personnel. Otherwise, improper equipment failures and potential health risks may occur.**
- **Do not touch the connected electrodes or external paddles while performing the Autocomp. or user test. Doing so could result in an electric shock.**
- **Technical service personnel must be properly qualified and very familiar with the operation of the equipment.**

CAUTION

- **The equipment and accessories will not be subjected to repair or maintenance while being are being used on a patient.**
- **If a problem occurs with the equipment, contact the service personnel.**
- **When the useful life of the equipment and its accessories ends, they must be disposed of according to the Instructions governing the disposal of such products. If you have any questions regarding the disposal of the equipment, please contact Mindray.**

NOTE

- **If necessary, contact the manufacturer for circuit diagrams, parts lists, descriptions, calibration instructions, or any other information related to repairing the equipment.**

25.3 Verification of software information

You may be asked for information about the computer's software.

To view system software information, select the shortcut key **Main Menu** , and select **Version** in the **System column.**

You can view more information about the equipment in user maintenance mode. For more information, see 25.6.1 User Maintenance Settings.

25.4 Routine Maintenance

Routine maintenance should be performed periodically in conjunction with the warranty program of the hospital where the equipment is used.

The following table lists the recommended maintenance items and maintenance frequency:

Maintenance element	Recommended frequency	Evidence item
Shift change check	Each shift (at least every day), after use.	For more information, consult your institution or refer to the E Defibrillator Checklist.
Self-check Automatically, whenever the equipment is switched on		Perform tests on the main control board, therapy module, monitor module, and batteries.
	Every day, by default, at 3:00 am	Performs tests of the main control board, therapy module, monitor module, batteries, 1 J internal discharge, 10 J1 internal/external discharge (can be set in configuration mode, see 22.7.10 Test Settings Menu).
	Every week	Performs tests of the main control board, therapy module, monitor module, batteries, 1 J internal discharge, 10 J1 internal charge/external discharge (can be set in configuration mode, see 22.7.10 Test Settings Menu), 200 J and 360 J internal discharges.
User test	Every week	Performs tests of the main control board, therapy module, monitor module, batteries, 1 J internal discharge, 200 J internal/external discharge , 360 J internal/external discharge , connection of external paddles (for equipment configured with the paddle tray), all front panel buttons, audio, display, patient contact indicator , and status indicator.

[1] If the electrode cable is connected to a 50 y test load or the external paddles are placed in the paddle tray, an external discharge will occur. Otherwise, an internal discharge will occur.

[2] Test items can be ignored during user testing, but it is recommended to perform these tests when at least once a year.

External paddles and electrodes are essential components for defibrillation but can deteriorate easily. It is recommended to check the condition and performance of these components daily and replace them every three years.

ECG leads are essential components for data acquisition and analysis, but they can deteriorate easily. It is recommended that the appearance and performance of the lead be inspected daily, as described in the Defibrillator Checklist.

25.4.1 Self-check

The self-test (Autocomp.) checks the equipment's performance and alerts you if there are any problems. The equipment, whether connected to an external power source or running on battery power, can perform the Autocomp. at the configured time, even if it is turned off.

By default, the self-check starts every day at 3:00 AM. The **Auto-check time** setting can be changed in configuration mode. For more information, see 22.7.10 Menu
Adjustment test.

The device does not display any information on the screen during the self-test. You can check the self-test result according to the following table:

Of	Suitable	Unfit
Status indicator and alarms	• The status indicator lights up in green. • No alarms are displayed on the screen.	• The status indicator flashes red. • A beep is emitted periodically until the equipment is restarted. • The alarm **"Last autocom error"** is displayed .
Test summary	The test results are provided in the Test Summary. For detailed information on how to review the results, see 25.4.3 Checking the Test Results.	
CMS	If the device is connected to the CMS, the self-test report will be automatically transmitted to the CMS when the self-test is complete. For information on connecting to the CMS, see section 21.5 Connecting to the CMS.	

It is recommended to perform the user test if an error occurs during the self-test. For more information, see 25.4.2 User Test.

When the self-test is complete, a self-test report is automatically saved. The **Self-Test Report** setting can be changed in configuration mode. For more information, see 22.7.10 Test Settings Menu.

NOTE

- **If the equipment is turned off, you can only perform the Autocomp. when it is connected to the external power supply or has a battery.**
- **The self-test simulates the discharge test using impedances on the blade tray. The self-test is passed only if the outer blades make proper contact with the metal parts of the blade tray.**
- **Thoroughly clean the outer blades and place them correctly in the blade tray after each use. Failure to do so may result in a self-check error or damage to the outer blades.**
- **Self-testing reduces battery power. If the device is not connected to an external power source immediately, the battery may be depleted.**
- **Before performing the Autocomp., verify that the equipment is connected to the external power supply or has a battery installed, and that the external paddles are correctly positioned in the tray or that the equipment is connected with the paddle cable and a 50 ÿ test load.**
  If the Self-Test passed but the blade cable is not connected to the 50 ÿ test load, the Self-Test report will display "Test load not connected with cable". This means that the equipment only passed the internal discharge test but not the external discharge test connected to the test load.

25.4.2 User testing

If an error occurs in Autocomp., the equipment connection should be checked and the user test performed to eliminate errors.

Each time the equipment is turned on, the time for the user test is checked automatically.
The device can be configured to display the message **"User test due"** to remind you to perform the user test. The User Test **indicator** activation setting can only be changed in configuration mode. For more information, see section 22.7.10, Test Settings Menu.

WARNING

- **If the equipment has been dropped or suffered a hard impact, you must immediately perform a test user to check the performance of the equipment.**
- **Do not perform the user test when the patient is connected to the equipment.**

NOTE

- **Before the user test or after each use, thoroughly clean the external blades and place them properly in the tray. The user test is only passed if the external blades make proper contact with the metal parts of the tray.**

- **During the user test, the charging and discharging elements can automatically detect the type of therapy cable connected and perform the corresponding test. If different therapy cables are required (electrode or paddle cables), you must connect the desired cables separately and perform a separate user test for each one.**

- **If the impedance value shown by the patient contact indicator changes significantly, check that the external blades and metal parts of the blade tray are clean.**

- **Install at least one battery and properly position the external paddles in the paddle tray or connect the electrode cable and the 50 ÿ test load. Otherwise, the user test will not be performed correctly.**

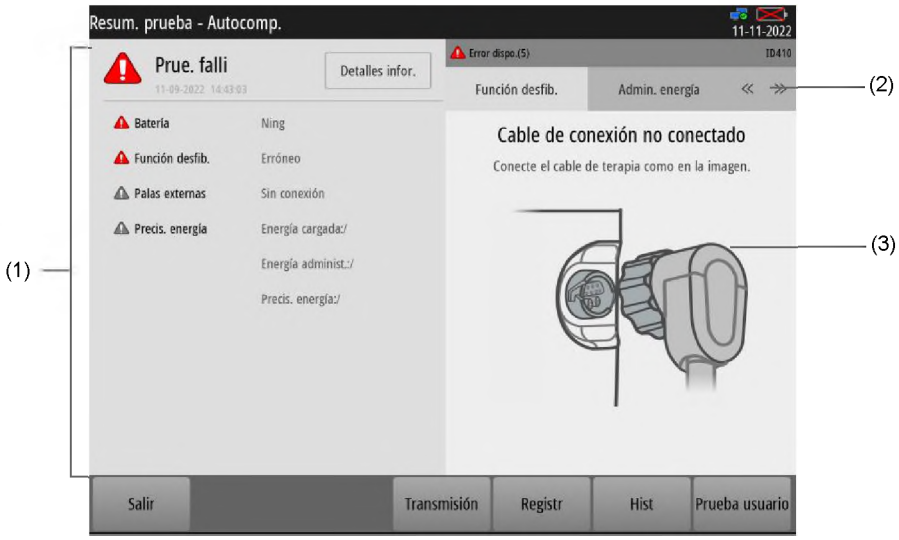
- **The power switch is not checked during the button test. If you hold it down**
  If you hold the power switch for more than 3 seconds, the device will turn off.
- **The tested buttons light up in green during the button test.**

25.4.2.1 Access to test mode

In test mode, therapy and patient monitoring automatically end.

To access test mode, follow this procedure:

1. Select the shortcut key **Main Menu** ÿ in the **Common** column , Select **User Test.**
2. Select **Confirm**



(1) Last Summary Test: Displays the results of the battery, external blades (for equipment configured with a blade tray), and power accuracy tests by default. The display of test items can only be changed in configuration mode. For more information, see 22.7.10 Test Settings Menu.

(2) Test Errors tab: Displays the detailed error item and provides text and image instructions for correcting it. When selecting « - » More tabs can be displayed.

(3) Instructions for eliminating errors

25.4.2.2 Start of user testing

In test mode, select **User Test** to start a user test.

The test summary is displayed when the test is complete. You can then select **Record.** to print the test result.

If any of **the Battery, Defibrillator Function, Dial-up Function** , or **Power Management** test items fail, the status indicator flashes red and the **"Last User Test Failed"** alarm is displayed when the device is restarted. If any of the **Battery1, Battery2, Defibrillator Function, Dial-up Function, or Power** Management test items fail, the status indicator flashes red and the **"Last User Test Failed"** alarm is displayed when the device is restarted.

25.4.3 Verification of the Test Results

When the status indicator flashes red and the alarms **"Last Autocom Error" or "Last User Test Failed" are displayed,** it means the test has not passed. In this case, you must access test mode to check the test result and clear the errors. For more information, see 25.4.2.1 Accessing Test Mode.

25.4.3.1 Displaying the latest test result

When you enter test mode, the latest test summary is displayed. If necessary, you can select **Details info.** to view more details.

NOTE

- **If the Autocomp. periodic test item (external discharge) or the user test energy test item (external discharge) is passed, the admin. energy and accuracy are displayed, although these results are used for reference only.**

25.4.3.2 Elimination of errors from the last test

If the last test fails, you must eliminate the error items and perform a successful user test. To do this, follow this procedure:

1. Access test mode. For more information, see 25.4.2.1 Accessing test mode.
2. Select the desired error tab in **Error dispo..**
3. If necessary, select  to show more tabs.
4. Eliminate the errors by following the instructions shown.
5. Select **User Test** and perform the user test.

25.4.3.3 Displaying the test results history

In test mode, select **Hist** to view the test results history. If necessary, select a test for more details.

To print more than one test report simultaneously on the logger, you can select **Locate** and then select the desired tests from the report list.

25.4.4 Transmission of test reports

If connected to the CMS, the device automatically transmits the Autocomp and user reports to the CMS upon completion of the test. For information on connecting to the CMS, see section 21.5 Connecting to the CMS.

25.5 Function Checks

Function checks improve self-testing, which helps the team ensure availability.
It is recommended to perform a functional check once a year. Functional checks, except for the recorder check, should only be performed by qualified Mindray service personnel.

25.5.1 Registrar Check

To perform the register check, follow this procedure:

1. Access Monitor mode. For more information, see 9.1 Starting monitoring of the patient.
2. Print the ECG waveforms. Check that the recorder is working properly and that the printout is clear. legible and correct.
3. Simulate errors by removing the paper from the recorder or releasing the recorder's lock. Verify that the messages are displayed correctly. The recorder functions correctly once the faults have been resolved.

25.5.2 ECG cable test

Testing tool: ECG simulator

To perform the ECG lead test, follow this procedure:

1. Open the 12-lead ECG window. For more information, see 12.3 Accessing the 12-lead ECG window.

2. Connect the ECG cable to the equipment and the electrodes to the simulator.

3. Turn on the simulator and select a normal ECG rhythm.

4. Wait a few seconds. Check if the waveform is displayed correctly and no disconnected shunt alarm is shown in the alarm information area.

5. Print the 12-lead ECG waveforms in real time. Check that the waveform of each lead is displayed correctly on the printed copy.

25.5.3 Manual defibrillation test

Testing tools: defibrillator/pacemaker analyzer

Loading/unloading

To perform the load/unload test, follow this procedure:

1. Remove the batteries from the device and connect it to the external power source.

2. Access configuration mode. For more information, see 22.2 Accessing configuration mode configuration.

3. Select **Log Settings** and turn on **Event Download.**

4. After restarting the device, access manual Defib mode. For more information, see 6.3 Accessing in the Defib mode. Manual.

5. Connect the therapy cable to the therapy port on the device, and place the electrodes or external paddles on the defibrillator/pacemaker analyzer.

6. Set the analyzer to energy measurement mode and verify that the energy value is 0 or is blank.

7. Set the power level to 1 J on the device.

8. Load or unload the equipment and check if the energies measured by the analyzer comply with the following levels of precision:

Selected energy (J)	Measured value (J)
1	From 0 to 3
100	From 90 to 110
360	From 324 to 396

9. Set the energy to 100 J and 360 J respectively, and repeat step 8.

10. Disconnect the equipment from the external power source and connect it to a fully charged battery. loaded.

11. Re-enter Manual Defib mode.

12. Repeat steps 3 through 9 and verify that the device automatically logs download events. correct way.

Power Deactivation

To perform the power-off test, follow this procedure:

1. Disconnect the equipment from the external power source and connect it to a fully charged battery. loaded.

2. Access the manual defibrillator mode. For more information, see 6.3 Accessing the manual defibrillator mode. Manual.

3. Connect the therapy cable to the therapy port on the device, and place the electrodes or external paddles on the defibrillator/pacemaker analyzer.
4. Set the analyzer to energy measurement mode and verify that the energy value is 0 or is blank.
5. Set the power level to 360 J on the device.
6. Charge the device and check that the charging tone is emitted during charging.
7. Once charging is complete, select **Off** to discharge the energy internally.
8. Check that the **"Charging disconnected"** indicator is displayed and that the charging completion tone stops. In this case, the value measured by the analyzer is 0 J or blank.
9. Access configuration mode. For more information, see 22.2 Accessing configuration mode configuration.
10. Select **Manual desfib adjustment** and set **Tpo for auto desact** to **[60** s].
11. After restarting the equipment, set the analyzer to energy measurement mode and check that the value energy is 0 or blank.
12. Set the power level to 360 J on the device.
13. Charge the equipment. Once charging is complete, wait 60 seconds to check that the **"Charge disconnected" indicator appears,** and the energy measured by the analyzer is 0 J or blank.

Synchronized cardioversion

To perform the synchronized cardioversion test, follow this procedure:

1. Connect the therapy cable to the therapy port on the device, and place the electrodes or external paddles on the defibrillator/pacemaker analyzer.
2. Connect the ECG cable to the ECG connector on the equipment and place the ECG electrodes over the defibrillator/pacemaker analyzer.
3. Set the analyzer to time measurement mode and establish normal sinusoidal output rhythms. For example, set the amplitude to 1 mV and the heart rate to 60 bpm.
4. Access configuration mode. For more information, see 6.3 Accessing Desfib mode. Manual.
5. Select **Manual desfib adjustment** and set **Syncr after discharge** to **On.**
6. After restarting the equipment, adjust the power level to 10 J.
7. Activate the synchronized cardioversion function on the device. For more information, see 6.7.1 Activating Synchronized Cardioversion.
8. Set the ECG lead to **Electr** or **Palasy** and load the equipment.
9. Once charging is complete, press and hold the Discharge button to administer a shock. Check that the following requirements are met:
   - The equipment administers a synchronized discharge and the energy delivered according to the analyzer measurement is 10 J ± 2 J.
   - The analyzer measures a synchronous defibrillation delay time of less than 60 ms.
   - The synchronized discharge marker appears above the R wave.
   - The instructions are displayed correctly during the test.
10. Set the ECG lead to II and load the equipment. Repeat step 9.

25.5.4 Stimulation test

Testing tools: defibrillator/pacemaker analyzer

To perform the stimulation test, follow this procedure:

1. Disconnect the equipment from the external power source and connect it to a fully charged battery. loaded.
2. Access dial mode. For more information, see 8.3 Accessing dial mode.
3. Select **Fixed Mode**

4. Connect the therapy cable to the therapy port on the device, and place the electrodes on the defibrillator/ pacemaker analyzer.
5. Set the analyzer to stimulation measurement mode. Use a 50 y test load.
6. Set **Frec marcap** to **70 ppm** and **Salida marcap** to **30 mA** on the equipment.
7. Select **Start Estimate.** Verify that the pacemaker frequency measured by the analyzer is 70 ppm ±1 ppm and the measured pacemaker output is 30 mA ± 5 mA.
8. Select **Stop Estimate**
9. Set **Frec marcap** to **170 ppm** and **Salida marcap** to **200 mA** on the equipment.
10. Select **Estimate Start.** Verify that the pacemaker frequency measured by the analyzer is 170 ppm ±2 ppm and the measured pacemaker output is 200 mA ± 10 mA.

25.6 Preventive Maintenance

Preventive maintenance should be performed annually only by qualified Mindray service technicians.

25.6.1 User maintenance settings

Configuration management will allow you to customize the equipment to better suit your needs.

To access user maintenance mode, select the shortcut key **Main Menu** y from the **System** column select **Maintenance** y enter the maintenance password y ↵.

WARNING

- **User access to maintenance mode is password protected. Therapy and patient monitoring automatically terminate when user access to maintenance mode.**
- **User maintenance settings should only be modified by authorized personnel. If necessary, contact your department head or the biomedical engineering department to obtain the passwords used at your facility.**

Eyelash	Menu item	Description
CO2 Module	Zero recovery for 30 s.	Set the display of CO2 readings once the zero point calibration is complete. • **Act:** During the reacquisition period, no values are displayed, only **"Zero Recovery"** is shown in the CO2 numeric area • **Des:** values are shown during the repurchase period.
	P zero	Manually reset the CO2 module.
Authentication	Automatic Logout Timeout: If no operation is performed within the configured period, the device automatically exits user maintenance mode.	
	Alarm setting	Set up the password-protected method to change alarm settings, modify arrhythmia settings, and view patient review data. • **No cons:** No password required. • **Cons:** A password is required. "alarm" is the default password.
	Arrhythmia	
	Visualization of patient review data	
	Change password	Change the password to change alarm settings, modify arrhythmia settings, and view patient review data.
Version	/	It displays the system software version, the module hardware and software versions, and the firmware version.
Battery info.	/	Displays information about the battery installed in the device.

Eyelash	Menu item	Description
Bluetooth	Activate	Determines whether other Bluetooth devices can find the device.
	Pairs when disconnected	Set the unpairing interval between the computer and the Bluetooth device once connected.
Others	Delete all patient data	Remove all patient information and data from the device.
	Change password	Change the password to access maintenance mode by the user.

25.6.2 Module performance tests

Module performance testing includes Resp, SpO2, NIBP, and CO2 tests . Module performance testing should only be performed by qualified Mindray service personnel. For more information, refer to the relevant service manual.

25.6.3 Electrical safety tests

Electrical safety testing should only be performed by qualified Mindray service personnel. For more information, see section G, Electrical Safety Inspection.

This page has been intentionally left blank.

Specifications

A.1 Safety specifications

A.1.1 Safety ratings

The equipment is classified according to IEC 60601-1:

Type of protection against electrical shocks	Class I
Degree of protection against electric shocks	Type BF defibrillation test for CO2 monitoring and defibrillation external. CF type defibrillation resistant for ECG, SpO2, NIBP and internal defibrillation.
Degree of protection against harmful entry of solids into the monitor Degree of protection against harmful water ingress into the monitor	IP55
Safety rating for application in the presence of a mixture of flammable anesthetic gases with air, oxygen or nitrous oxide	Equipment unsuitable for use in the presence of a mixture of flammable anesthetic gases with air, oxygen, or nitrous oxide.
Operating mode	Continuous
Degree of mobility	Portable

A.1.2 Environmental specifications

WARNING

- **When the temperature changes from the lowest storage temperature to the temperature ambient (without condensation), it is recommended to use the equipment at least one hour after this change for it to function correctly.**
- **The equipment may not meet performance specifications if stored or used outside the specified temperature and humidity ranges. If equipment performance degrades due to aging or environmental conditions, contact service personnel.**
- **When the equipment and associated products have different environmental specifications, the effective range for the combined products will be that which is common in the specifications of all products.**

NOTE

- **The environmental specifications of the modules without specifications will be the same as those of the main unit.**

Main unit				
Element		**Temperature**	**Relative Humidity Baron etric**	
Operating condition	When configured with ECG and manual defibrillation, without batteries	From -20ºC to 55ºC	From 5% to 95%, without condensation	From -382m to 4575m (57.0 kPa to 106.2 kPa)
	When configured with all features	From 0ºC to 50ºC		
Storage conditions		From -40ºC to 75ºC		

Discharge
Complies with the requirements applicable to medical devices of 6.3.4.2, EN1789 (10.1.3, IEC60601-1-12): Peak acceleration: 1000 m/s2 (102 g) Duration: 6ms Pulse shape: mid-sinus Number of downloads: 3 downloads per direction per axle (18 downloads in total)
Bomb
It meets the requirements applicable to ambulances in 6.3.4.2, EN1789. Peak acceleration: ÿ15 g Pulse duration: 6ms Number of pumps: 1000 Direction: vertical, with the equipment in normal operating position.
Vibration
It meets the requirements applicable to medical devices of 6.3.4.2, EN1789 (10.1.3, IEC60601-1-12). 10Hz to 60Hz: 5.0 (m/s2) 2/Hz 100 Hz to 200 Hz: -7 dB/octave 200Hz to 2000Hz: 1.0 (m/s2) 2/Hz Duration: 30 minutes per direction per vertical axis (3 axes in total)
Free fall
One fall on each surface (6 surfaces in total), at a height of 0.75 m.

A.2 Power supply specifications

A.2.1 External power supply specifications

AC power input	
Input voltage	From 100 to 240 VAC (-15%, +10%)
Input current	From 1.8 to 0.8A
Frequency	50/60Hz (±3Hz)
DC power input (with DC/AC converter)	
Input voltage	12 VDC (-15%, +25%)
Output voltage	230 VAC, 50 Hz
Output power	150 W

A.2.2 Battery specifications

Battery Type	Rechargeable lithium-ion battery
Battery voltage	14.4V

Battery capacity	4500 mAh		
Maximum number of batteries configured	Only one battery can be connected.		
Battery charging time	Charged by the equipment connected to the external power supply		• Less than 3 hours to 90% and less than 4 hours to 100% with the device turned off. • Less than 5 hours to 90% and less than 6 hours to 100% with the device switched on.
	Charged using the charger		Less than 3 hours at 90% and less than 4 hours at 100%
Battery operating time	Operating mode nt	A battery	Test condition
	Monitor	ÿ6.5 h	• New battery fully charged. • Ambient temperature of 20 °C±5 °C. • The device is configured with a 3 or 5 lead ECG and manual defibrillation, and the screen brightness is set to the lowest level, with no printing.
		ÿ5.5 h	• New battery fully charged. • Ambient temperature of 20 °C±5 °C. • The device is configured with a 3 or 5 lead ECG, Resp, SpO2 and NIBP measurements set at a 15 minute interval and manual defibrillation, and the screen brightness is set to factory default values, without printing.
	Defibrillation n	ÿ220 downloads of 360 J	• New battery fully charged. • Ambient temperature of 20 °C±5 °C. • The device is configured with a 3 or 5 lead ECG and manual defibrillation, and the screen brightness is set to the default level, without printing. • 3 downloads per minute.
		ÿ300 downloads of 200 J	
	Stimulation n	ÿ4.5 h	• New battery fully charged. • Ambient temperature of 20 °C±5 °C. • The device is configured with a 3 or 5 lead ECG, manual defibrillation and external pacing, and the screen brightness is set to the default level, without printing. • Load impedance of 50 ÿ, pacing frequency 80 ppm, pacing output at 60 mA, pacing pulse at 40 ms.
	Low alarm presented	At least 20 minutes of monitoring and 6 downloads of 360 J	• Ambient temperature of 20 °C±5 °C. • The device is configured with a 3 or 5 lead ECG and manual defibrillation, and the screen brightness is set to the default level, without printing.
Battery charge indicator	5 LEDs indicate the battery charge level		

A.2.3 Charger specifications

Maximum number of charged batteries	Two batteries can be charged at the same time.
AC power input	
Input voltage	100 to 240 VAC (±10%)
Input current	From 1.8 to 0.8A
Frequency	50/60Hz (±3Hz)

DC power input	
Input voltage	12.4 to 30.3 VDC
Input current	15.5 to 6.5 A

A.3 Physical specifications

DIMENSIONS (W x D x H)	285 mm x 170 mm x 265 mm (including handle, excluding outer blades)
Maximum weight	4.2±0.3 kg (the equipment is configured with 3 or 5 lead ECG, manual defibrillation and a battery)

A.4 Hardware specifications

A.4.1 Display screen

Screen type	Multi-point capacitive color touchscreen
Screen size	8 inch
Resolution	1024×768 pixels
Visualized waves	5 maximum
Wave display time	36 s maximum (ECG)

A.4.2 Recorder

Method	High-resolution heat transfer dot matrix
Paper width	50 mm
Paper speed	6.25mm/s, 12.5mm/s, 25mm/s, 50mm/s. Error no more than ± 5%
Number of waves	3 maximum
Grid lines	The printout can be configured with or without grid lines.

A.4.3 LED

Alarm light	1 (coded with two colors: red and yellow)
Power LED	1 (green)
Battery LED	1 (coded with two colors: yellow and green)
Status indicator	1 (coded with two colors: red and green)

A.4.4 Sound indicators

Speaker	It allows you to hear alarm tones (between 45 and 85 dB), key tones, and QRS tones. It supports vibration tones and tone modulation at various levels. The alarm tones comply with the IEC60601-1-8 standard.
Whistle	It emits warning tones.
Audio signal	Alarm tone: ISO mode with a frequency of 600 Hz QRS tone: brief beep with a frequency of 495 Hz Charging tone: prolonged beep with a frequency of 400 Hz to 533 Hz Charging complete tone: double beep with a frequency of 440 Hz Key tone: short beep with a frequency of 1000 Hz

A.4.5 External connectors

Power input	1, AC power input with equipotential ground terminal, connect the external power supply.
Multifunction connector	1. Connect a CPR sensor or cable for analog output or synchronized cardioversion.
USB connector	1 USB 2.0, connect the USB drive.
Network connector	1 RJ45 connector, 100 Base-TX, IEEE 802.3, connects a standard network cable.

A.4.6 Signal outputs

Multifunction connector	
Regulations	It meets the requirements of IEC60601-1 for protection against short circuits and leakage currents
Analog ECG output (only from ECG accessories)	
Bandwidth (-3 dB; reference frequency: 10 Hz)	Diagnostic Mode: From 0.05 to 150 Hz Monitor mode: 0.5 to 40 Hz Therapy mode: 1 to 20 Hz ST Mode: From 0.05 to 40 Hz
Maximum QRS delay	25 ms (in diagnostic mode and with the filter disconnected)
Sensitivity	1 V/mV ±5%
Pacemaker increase	Signal amplitude: Vohÿ2.5 V Pulse width: 10 ms±5% Signal rise and fall times: ÿ100 ÿs
Synchronous input	
Entry limit	HIV ÿ 2.4 V; VIL ÿ 0.4 V
Input signal range	From 0 to 5 V (TTL level)
Input impedance	ÿ10 kÿ
Pulse width	>5 ms
Alarm results	
Alarm delay time from the device to another remote device	• For the prehospital network: the alarm delay time measured in the equipment signal output connector: ÿ10 s • For the hospital network: the alarm delay time measured in the monitor signal output connector: ÿ2 s
Sound pressure level range with alarm signal	From 45 dB(A) to 85 dB(A) within a range of one meter

A.5 Data storage

Internal storage	4GB
Events	At least 1000 events for each patient.
Waves	At least 120 hours for one ECG waveform and stimulation pulses with a resolution of not less than 1 second, or 60 hours for two ECG waveforms and stimulation pulses
Voice recording	At least 8 hours for each patient
Tabular trends	A minimum of 200 hours of trend data with a resolution of no less than 1 minute.
Autocomputing information	At least 1000 records

Data Export	The data can be exported to a PC using a USB drive

A.6 Communication specifications

A.6.1 Wi-Fi Specifications (Wlink as a station)

Protocol	IEEE 802.11a/b/g/n
Modulation mode	BPSK, QPSK, 16QAM, 64QAM
Operating frequency	From 2412 MHz to 2472 MHz: From 5180 MHz to 5320 MHz; from 5500 MHz to 5700 MHz; 5745 MHz to 5825 MHz
Wireless baud rate	IEEE 802.11a: 6Mbps to 54Mbps IEEE 802.11b: 1 Mbps to 11 Mbps IEEE 802.11g: 6Mbps to 54Mbps IEEE 802.11n: MCS0 to MCS7
Output power	<20 dBm (EC requirement: RMS detection mode)
Operating mode	As a station, access AP for data transmission
Data security	Regulatory: WPA-PSK, WPA2-PSK, WPA-Enterprise, WPA2-Enterprise EAP method: EAP-TLS, EAP-TTLS, PEAP-MSCHAPv2 Encryption: TKIP, AES
Clear viewing distance	Clear viewing distance between the equipment and the PA: ÿ 50 m.
Network disconnection alarm delay time	Network disconnection alarm message and delay between the equipment and the CMS: <14 s.
Performance of the prehospital network	
System capacity, immunity to interference, and network stability	It meets the following requirements: • The total delay of data transmission from the equipment to the CMS: <10 s. • Delay in applying equipment-related settings configured in the CMS: <10 s. • The percentage of data loss from Wi-Fi communication over a 4-hour period: ÿ0.5%
Test conditions	It meets the following conditions simultaneously: • One device admitted to the same PA • Each team can communicate with the CMS. • The signal strength of the weakest AP where the equipment is located is not less than -65 dBm. • The distance between the devices causing interference and the The device is larger than 20 cm. Wi-Fi interference (not greater than -85 dBm) on the same channel and Wi-Fi interference (not exceeding - Interference (50 dBm) on an adjacent channel occurs synchronously. Devices that cause interference include 2.4G wireless devices, mobile networks, intercoms, cordless phones, and electrosurgical equipment. Wi-Fi devices are not included among the devices that cause interference.
Hospital network performance	
System capacity, immunity to interference, and network stability	It meets the following requirements: • Total delay of data transmission from the equipment to the CMS ÿ2 s. • Delay in applying equipment-related settings configured in the CMS: <2 s. • The network-connected device exhibits a roaming rate of 30 times; the percentage of data loss from Wi-Fi communication over a 24-hour period is ÿ0.1%.

Test conditions	It meets the following conditions simultaneously: • Number of devices allowed on the same access point: y3 • Each team can communicate with the CMS. • The signal strength of the weakest AP where the equipment is located is not less than -65 dBm. • The distance between the devices causing interference and the The device is larger than 20 cm. Wi-Fi interference (not greater than -85 dBm) on the same channel and Wi-Fi interference (not exceeding - Interference levels of 50 dBm in an adjacent channel occur synchronously. Devices that produce interference include 2.4G wireless devices, mobile networks, microwave ovens, intercoms, cordless phones, and electrosurgical equipment. Wi-Fi devices are not included among the devices that cause interference.

WARNING

• Perform all data communication network functions within a closed network.

A.6.2 Mobile specifications

Network type	4G, 5G
Operating frequency	y 4G Module (EU): • LTE FDD: B1/B3/B7/B8/B20/B28A • LTE TDD: B38/B40/B41 • WCDMA: B1/B8 • GSM: B3/B8 y 5G Module: • NR: n1/n2/n3/n5/n7/n8/n12/n20/n28/n38/n40/n41/n48/n66/ n71/n77/n78/n79 • LTE-FDD: B1/B2/B3/B4/B5/B7/B8/B9/B12/B13/B14/B17/B18/ B19/B20/B25/B26/B28/B29/B30/B32/B66/B71 • LTE-TDD: B34/B38/39/B40/B41/B42/B48
Modulation mode/standard	LTE, 5G Sub-6 GHz
Network disconnection alarm delay time	Network disconnection alarm message and delay between the equipment and the CMS: <14 s.
Performance of the prehospital network	
System capacity, immunity to interference, and network stability	It meets the following requirements: • The total delay of data transmission from the equipment to the CMS: <10 s. • The percentage of data loss from mobile communication over a 4-hour period: y0.5%
Test conditions	It meets the following conditions simultaneously: • With a distance greater than 2 m between them, three devices can function correctly at the same time. • Each team can communicate with the CMS. • The strength of the weakest signal where the equipment is located is greater than -95 dBm. • The distance between the devices causing interference and the equipment is greater than 20 cm. Devices causing interference include, but are not limited to, 2.4G wireless devices, mobile networks, telephones, and cordless phones.

A.6.3 Bluetooth Specifications

Protocol	Bluetooth Low Energy 5.0
Modulation mode	GFSK
Operating frequency	From 2402 MHz to 2480 MHz:
Channel separation	2 MHz
Wireless baud rate	2 Mbps, 1 Mbps, 125 kbps
Output power	<20 dBm
Data security	AES128

A.6.4 NFC Specifications

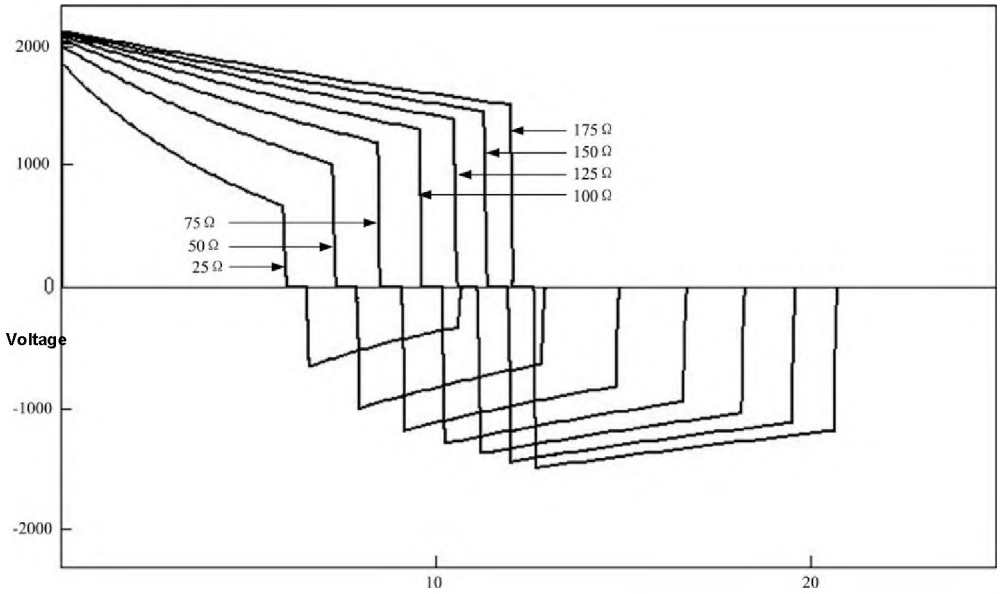
Protocol	ISO/IEC 14443 A, ISO/IEC 14443 B
Operating frequency	13.56 MHz

A.7 Therapy specifications

A.7.1 Defibrillator specifications

Regulations	Complies with IEC 60601-2-4 standard
Defibrillation mode	Manual defibrillation, synchronized cardioversion, AED
Defibrillation wave	Biphasic truncated exponential (BTE) waveform, automatic compensation according to patient impedance
Defibrillation electrodes	External paddle set supplied with pediatric paddles included, multifunction electrodes and internal paddles
Blade controls and indicators external	Charging button, discharge buttons, power selection buttons, charging complete indicator, and patient contact indicator
Internal blade controls and indicators	Download button
Time of analysis of the rhythm susceptible to discharge	< 5 s
Selected energy range	
External defibrillation	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 15, 20, 25, 30, 50, 70, 100, 120, 150, 170, 200, 300, 360 J
Internal defibrillation	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 15, 20, 30, 50 J
Patient impedance range	
External defibrillation	25 to 300 ÿ
Internal defibrillation	15 to 300 ÿ
Synchronized download delay	
Local synchronized download delay	< 60 ms (from the peak of the R wave)
Remote synchronized download delay	< 25 ms (from synchronous signal rising edge)
DEA	
Download series	Energy level from 100 to 360 J, configurable for adult use. 10 to 200 J, configurable for pediatric use Downloads: 1, 2, 3, configurable; It complies with the 2020 AHA/2021 ERC guidelines by default.
ECG analysis performance AED	Refer to Mindray C Defibrillable Rhythm Analysis Algorithm.

360 J defibrillation waveform up to 25 ÿ, 50 ÿ, 75 ÿ, 100 ÿ, 125 ÿ, 150 ÿ, 175 ÿ impedance



Selected energy	Impedance							Precision
	25ÿ	50ÿ	75ÿ	100ÿ	125ÿ	150ÿ	175ÿ	
1 J	1	1	1	0.9	0.9	0.9	0.8	±10% or ±2 J, whichever is higher
2 J	2	2	2	1.9	1.8	1.7	1.6	
3 J	2.9	3	2.9	2.8	2.7	2.6	2.4	
4 J	3.9	4	3.9	3.7	3.6	3.4	3.2	
5 J	4.9	5	4.9	4.7	4.5	4.3	4.1	
6 J	5.8	6	5.8	5.6	5.3	5.1	4.9	
7 J	6.8	7	6.8	6.6	6.3	6	5.7	
8 J	7.8	8	7.8	7.4	7.1	6.8	6.5	
9 J	8.8	9	8.8	8.4	8	7.7	7.3	
10 J	9.7	10	9.7	9.3	8.9	8.5	8.1	
15 J	15	15	15	14	13	13	12	
20 J	20	20	20	19	18	17	16	
25 J	24	25	24	23	22	21	20	
30 J	29	30	29	28	27	25	24	
50 J	49	50	49	47	45	43	41	
70 J	68	70	68	65	62	60	57	
100 J	97	100	97	93	89	85	81	
120 J	116	120	116	111	106	101	97	
150 J	146	150	146	140	134	128	122	
170 J	166	170	166	159	151	145	138	
200 J	195	200	195	187	178	170	163	
300 J	292	300	292	280	267	255	244	
360 J	351	360	350	336	321	306	293	

Power supply	Manual defibrillation						DEA					
	Charging time* From initial power-up (from cold start) to full charge				From initial power-on (from quick start mode) to full charge		From the start of rhythm analysis Loading complete		From initial start-up (from cold start) to full load		From initial power-on (from quick start mode) to full charge	
	200 J	360 J	200 J	360 J	200 J	360 J						360 J
With a new, freshly charged battery	<3 s	<7 s	<11 s	<6 s		<10 s	<10 s	<21 s	<13 s			<15 s
With a new, freshly charged battery, depleted by 15 discharges of 360 J	<4 s	<8 s	<12 s	<7 s		<11 s	<11 s	<23 s	<14 s			<16 s
With an external power supply	<4 s	<7 s	<11 s	<7 s		<10 s	<11 s	<22 s	<14 s			<15 s

* The battery is charged at an ambient temperature of 20 ±5 °C.

NOTE

- **The device starts up in fast start mode in less than 2 seconds.**

A.7.2 CPR Compression Specifications

Compressions from the CPR sensor

Frequency of compressions	Measurement range: 40 to 160 cpm Accuracy: ±2 cpm

Compressions from the defibrillation electrodes

Frequency of compressions	Measurement range: 60 to 200 cpm Accuracy: ±3 cpm

A.7.3 Pacemaker specifications

Regulations	Complies with IEC 60601-2-4 standard
Pacemaker mode (Pacemaker)	On demand, Fixed
Output waveform	Monophasic square wave pulse Pulse width of 20 or 40 ms Accuracy: ±5%
Stimulation frequency	From 30 ppm to 210 ppm Accuracy: ±1.5% Resolution: 5 ppm
Stimulation output	From 0 mA to 200 mA, Accuracy: ±5% or ±5mA (whichever is higher) Resolution: 1 mA, 2 mA or 5 mA
Refractory period	From 200 to 300 ms (depending on the stimulation frequency)
Stimulate 4:1	Stimulation pulse frequency reduced by 4 points when this function is activated.

NOTE

- **When the stimulation frequency changes from 30 bpm to 210 bpm, the response time to stimulation (HR increasing from 30 bpm to 210 bpm) is less than 20 s.**

A.8 Monitor specifications

A.8.1 ECG Specifications (from ECG accessories)

Regulations	Complies with IEC 60601-2-27 and IEC 60601-2-25 standards
Patient connection	3-lead ECG cable, 5-lead ECG cable, or cable 12-lead ECG
ECG entries	3-lead ECG: I, II, III 5-lead ECG: I, II, III, aVR, aVL, aVF, V 12-lead ECG: **I, II, III, aVR, aVL, aVF, V1 to V6**
ECG Standard	AHA, IEC
Screen 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, error less than ± 5%
Sweep speed	6.25mm/s, 12.5mm/s, 25mm/s, 50mm/s, error less than ± 5%
Bandwidth (-3 dB)	Diagnostic Mode: From 0.05 to 150 Hz Monitor mode: From 0.5 to 40 Hz Therapy mode: From 1 to 20 Hz ST Mode: From 0.05 to 40 Hz High frequency decongestion (for ECG analysis of 12 leads): 350 Hz, 150 Hz, 35 Hz, 20 Hz, can be selected
Common mode rejection	Monitor, Therapy and ST modes: >105 dB (with notch filter activated) >90 dB (with notch filter deactivated) Diagnostic Mode: >90 dB (with notch filter disabled) High frequency decompression (for 12-lead ECG analysis): >90 dB (with notch filter disabled)
Notch filter	50/60 Hz, In Monitor, Therapy, and ST modes: the notch filter is automatically activated Diagnostic Mode and High Frequency Disconnect: the notch filter is activated manually. Power frequency interference rejection: ÿ20 dB
Differential input impedance	ÿ5 Mÿ
ECG signal range	±8mV (peak-to-peak value)
Calibration signal	1mV (peak-to-peak value) ±5%
Electrode equilibrium potential tolerance	±500mV
Shunt detection current disconnected	Measuring electrode: ÿ0.1 ÿA Unit electrode: ÿ1 ÿA
Baseline recovery time	<2.5 s (after defibrillation)
Protection against defibrillation	It withstands a load of 5000 V (360 J) without data loss or damage. Time to return to baseline: <2.5 s (after defibrillation) Polarization recovery time: <10 s Defibrillation energy absorption: ÿ10% (100 ÿ load)

ESU Protection	Cutting mode: 300 W Coagulation mode: 100 W Recovery time: y10 s Noise rejection: 2mV It meets the requirements of clause 202.6.2.101 of IEC 60601-2-27
Pacemaker pulse	
Pacemaker pulse markers	Pacemaker pulses that meet these conditions are labeled with the marker PACEMAKER: Amplitude: From ±2 to ±700 mV Width: 0.1 to 2 ms Upload time: From 10 to 100 ys (not exceeding 10% of the pulse width) There is no over-modulation
Pacemaker pulse rejection	When performing the test according to IEC 60601-2-27: 201.12.1.101.13, the heart rate meter rejects all pulses that meet the following conditions. Amplitude: From ±2 to ±700 mV Width: 0.1 to 2 ms Upload time: From 10 to 100 ys Input rotation speed: 2.2 V/s ±15 % RTI There is no over-modulation
FC	
Measurement range	Adults: From 15 to 300 ppm Child, newborn: From 15 to 350 lpm
Precision	±1% or ±1 lpm, whichever is higher
Resolution	1 lpm
Average heart rate	In compliance with the requirements of clause 201.7.9.2.9.101 b) 3) of IEC 60601-2-27, the following method is used: If the last three consecutive RR intervals exceed 1200 ms, the average of the last four RR intervals is used to calculate the HR. Otherwise, the heart rate is calculated by subtracting the minimum and maximum intervals from the last 12 RR intervals and then averaging them. The heart rate value displayed on the screen is updated every second.
Response time to change in heart rate	It meets the requirements of IEC 60601-2-27: Clause 201.7.9.2.9.101 b) 5). From 80 to 120 lpm: less than 11 s From 80 to 40 lpm: less than 11 s
Alarm time for tachycardia	It meets the requirements set out in clause 201.7.9.2.9.101 b) 6) of IEC 60601-2-27. Vibe B1h, range: <11 s B1, range: <11 s B1d, range: <11 s B2h, range: <11 s B2, range: <11 s B2d, range: <11 s
Arrhythmia analysis classifications	Asystole, Ventricular Fibr./Ventr. Tachy., Ventricular Tachy., Ventricular Bradycardia, Extreme Tachy., Extreme Brady., Ventricular Rhythm, CVP/min, Pauses/min, Doublet, Bigeminy, Trigeminy, R on T, Run CVP, CVP, Bradycardia, Tachycardia, Missed Beats, Pacemaker does not pace, Pacemaker does not receive, Multiflocculant CVP, Non-sustained Ventricular Tachycardia, Pause, Irregular Rhythm, Atrial Fibr. (adults only), SVT, CVP/min

High T-wave rejection capability	When the test is performed according to clause 201.12.1.101.17 of IEC 60601-2-27, the heart rate meter rejects all QRS complexes of 100 ms with less than 1.2 mV amplitude and T waves with a T wave interval of 180 ms, as well as those with a QT interval of 350 ms.
Response to irregular rhythm	In compliance with the requirements of clause 201.7.9.2.9.101 b) 4) of IEC 60601-2-27, the heart rate, after 20 seconds of stabilization, is shown as follows: Ventricular bigeminy (3a): 80±1 bpm Ventricular bigeminy with slow alternation (3b): 60±1 bpm Ventricular bigeminy with rapid alternation (3c): 120±1 bpm Bidirectional systole (3d): 90±2 bpm
ST Segment Analysis	
Measurement range	From -2.0 to 2.0 mV (RTI)
Precision	From -0.8 to 0.8 mV: ±0.02 mV or ±10%, whichever is greater. Above this range: Unspecified
Resolution	0.01 mV
QT/QTc Analysis	
Measurement range	QT: 200 to 800 ms QTc: 200 to 800 ms QT-HR: 15 to 150 bpm in adults, 15 to 180 bpm in pediatric patients and newborns
Precision	QT: ±30 ms
Resolution	QT: 4 ms QTc: 1 ms
Interpretation of a 12-lead ECG	
Sampling rate	1000 samples/s (A/D) 500 samples/s (ECG algorithm)
Amplitude quantization	24 bits
Measurements	Heart rate, FP interval, QRS duration, QT/QTc interval, P/QRS axis/ The diagnostic report

A.8.2 ECG specifications (of therapy accessories)

Patient connection	Multifunctional paddles or electrodes
ECG entries	Paddles or electrodes
Screen 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, error less than ± 5%
Sweep speed	6.25mm/s, 12.5mm/s, 25mm/s, 50mm/s, error less than ± 5%
Bandwidth (-3 dB)	Therapy mode: From 1 to 20 Hz ÿÿ0.4dB ÿÿ -3.0dB
Common mode rejection	Therapy mode: >105 dB (with notch filter activated)
Notch filter	Therapy mode: 50/60 Hz, the muesc filter is automatically activated.
Differential input impedance	y5 My
ECG signal range	±8mV (peak-to-peak value)
Calibration signal	1mV (peak-to-peak value) ±5%
Electrode equilibrium potential tolerance	±1V

Detection current for disconnected leads	y0.1 yA
Baseline recovery time	<2.5 s (after defibrillation)
Protection against defibrillation	It withstands a load of 5000 V (360 J) without data loss or damage. Recovery time to baseline: <2.5 s (after defibrillation) Polarization recovery time: <10 s Defibrillation energy absorption: y10% (100 y load)
ESU Protection	Cutting mode: 300 W Coagulation mode: 100 W Recovery time: y10 s It meets the requirements of clause 202.6.2.101 of IEC 60601-2-27
Pacemaker pulse	
Pacemaker pulse markers	Pacemaker pulses that meet these conditions are labeled with the marker PACEMAKER: Amplitude: From ±2 to ±700 mV Width: 0.1 to 2 ms Upload time: From 10 to 100 ys (not exceeding 10% of the pulse width) There is no over-modulation
Pacemaker pulse rejection	When performing the test according to IEC 60601-2-27: 201.12.1.101.13, the heart , he rate meter rejects all pulses that meet the following conditions. Amplitude: From ±2 to ±700 mV Width: 0.1 to 2 ms Upload time: From 10 to 100 ys There is no over-modulation
FC	
Measurement range	Adults: From 15 to 300 ppm Children From 15 to 350 lpm
Precision	±1% or ±1 lpm, whichever is higher
Resolution	1 lpm
Sensitivity	200 yV
Average heart rate	In compliance with the requirements of clause 201.7.9.2.9.101 b) 3) of IEC 60601-2-27, the following method is used: If the last three consecutive RR intervals exceed 1200 ms, the average of the last four RR intervals is used to calculate the HR. Otherwise, the heart rate is calculated by subtracting the minimum and maximum intervals from the last 12 RR intervals and then averaging them. The heart rate value displayed on the screen is updated every second.
Response time to change in heart rate	It meets the requirements of IEC 60601-2-27: Clause 201.7.9.2.9.101 b) 5). From 80 to 120 lpm: less than 11 s From 80 to 40 lpm: less than 11 s
Arrhythmia analysis classifications	Asystole, Ventricular Fibr./Ventr. Tachy., Pacing device not stimulating, Pacing device not receiving
High T-wave rejection capability	When the test is performed according to clause 201.12.1.101.17 of IEC 60601-2-27, the heart rate meter rejects all QRS complexes of 100 ms with less than 1.2 mV amplitude and T waves with a T wave interval of 180 ms, as well as those with a QT interval of 350 ms.

A.8.3 Responsible Specifications

Derivation	The options are derivation I, II and Autom.
Respiratory excitation wave	<300 yA, RMS, 62.8 kHz (±10%)
Minimum respiratory impedance threshold	0.3 ÿ with x5 gain
Baseline impedance range	From 200 to 2500 ÿ, using an ECG cable with a resistance of 1 kÿ
Bandwidth	From 0.2 to 2.5 Hz (-3 dB)
Sweep speed	3mm/s, 6.25mm/s, 12.5mm/s, 25mm/s or 50mm/s, error less than ± 5%
Respiratory rate	
Measurement range	From 0 to 200 rpm
Resolution	1 rpm
Precision	From 121 to 200 rpm: ±2 rpm From 0 to 120 rpm: ±1 rpm
Apnea alarm time	10s, 15s, 20s, 25s, 30s, 35s, 40s

A.8.4 SpO2 Specifications

Mindray SpO2 Module

Regulations	Complies with ISO 80601-2-61
Measurement range	From 0 to 100%
Resolution	1%
Response time	<30 s (normal perfusion, no disturbances, sudden changes in SpO2 value from 70% to 100%)
Precision*	From 70% to 100%: ±2% ABS (adult, pediatric) From 70% to 100%: ±3% ABS (neonate) From 0 to 69%: unspecified
Renewal frequency	y1 s

*One percent was added to the accuracy of the neonatal sensors to compensate for the variation in accuracy due to the properties of fetal hemoglobin. Studies were conducted to validate the accuracy of the pulse oximeter with SpO2 sensors for neonates compared to a co-oximeter. The study included newborns between 1 and 30 days of age, with a gestational age ranging from 22 weeks to term. Statistical analysis of the study data demonstrates that the accuracy (arms) meets the stated accuracy specification.

See the following table.

Sensor type	Total number of newborns	Data	Arms
518B	97 (51 male and 46 female)	200 pairs	2.38%
520N	122 (65 male and 57 female)	200 pairs	2.88%

The pulse oximeter with SpO2 sensors for newborns was also validated in adults.

PI	
Measurement range	From 0.05 to 20%
Resolution	From 0.05% to 9.99%: 0.01% From 10.0% to 20.0%: 0.1%
CPR Quality Index	
Display interval	From 0 to 100

Resolution	1
Frequency of compressions	
Display interval	20 to 300 cpm
Accuracy range	40 to 160 cpm
Precision	±3 cpm
Resolution	1 cpm

Masimo SpO2 Module

Regulations	Complies with ISO 80601-2-61
Measurement range	From 1% to 100%:
Resolution	1%
Response time	y20 s (normal perfusion, without disturbances, sudden changes in the value of SpO2 from 70% to 100%)
Accuracy1	From 70% to 100%: ±2% ABS (measured without movement in adult/child mode) From 70% to 100%: ±3% ABS (measured without movement in newborn mode) From 70% to 100%: ±3% ABS (measured with movement) From 1% to 69%: unspecified
Renewal frequency	y1 s
Mean time for SpO2	2-4s, 4-6s, 8s, 10s, 12s, 14s, 16s
Low perfusion conditions	Pulse amplitude: >0.02% Light penetration: >5%
SpO2 accuracy2 with low perfusion	±2%
PI measurement interval	From 0.02 to 20%

1The motion-free accuracy of the Masimo pulse oximeter with sensors has been validated in blood studies conducted with healthy adult volunteers under hypoxic-induced conditions ranging from 70% to 100% SpO2 compared to a laboratory co-oximeter and an ECG monitor. This variation is equal to approximately one standard deviation, corresponding to 68% of the population. One percent was added to the accuracy of the neonatal sensors to compensate for the variation in accuracy due to the properties of fetal hemoglobin.

The accuracy of the Masimo pulse oximeter with sensors has been validated in blood studies conducted with healthy adult volunteers under induced hypoxia. These studies involved induced movements such as rubbing and tapping in the 2-4 Hz range at an amplitude of 1-2 cm and non-repetitive movements between 1-5 Hz at an amplitude of 2-3 cm. The results were compared to a laboratory co-oximeter and an ECG monitor, with the induced hypoxia occurring at 70% to 100% SpO2. This variation is approximately equal to one standard deviation, corresponding to 68% of the population.

2The low perfusion accuracy of the Masimo pulse oximeter has been validated in laboratory tests compared to a Biotek Index 2 simulator and a Masimo simulator with signal strengths greater than 0.02% and a transmission percentage greater than 5% for a saturation range of 70 to 100%. This variation is equal to approximately one standard deviation, which corresponds to 68% of the population.

Nellcor SpO2 Module

Regulations	Complies with ISO 80601-2-61
Measurement range	From 0 to 100%
Resolution	1%
Response time	y30 s (normal perfusion, without disturbances, sudden change in the value of SpO2 from 70% to 100%)
Precision	From 70% to 100%: ±2% ABS (adult, pediatric) From 70% to 100%: ±3% ABS (neonate) From 0 to 69%: unspecified
Renewal frequency	y1 s

When the SpO2 sensor is applied to neonatal patients as directed, the specified accuracy range increases by ±1% to compensate for the theoretical effect on oximeter measurements of fetal hemoglobin in the blood of newborns.

A.8.5 FP Specifications

FP of the **Mindray SpO2 module**

Measurement range	From 20 to 300 lpm
Resolution	1 lpm
Response time	<30 s (normal perfusion, without disturbances, sudden changes in FP value from 25 to 220 bpm)
Precision	±3 lpm
Renewal frequency	y1 s

FP of the **Masimo SpO2 module**

Measurement range	From 25 to 240 lpm
Resolution	1 lpm
Response time	y20 s (normal perfusion, without disturbances and a transition of the FP value from 25 to 220 lpm)
Precision	±3 lpm (measured without movement) ±5 lpm (measured with movement)
Renewal frequency	y1 s

FP of the **Nellcor SpO2 module**

Measurement range	From 20 to 300 lpm
Resolution	1 lpm
Response time	y30 s (normal perfusion, without disturbances, sudden change in the value of FP of 25 to 250 lpm)
Precision	From 20 to 250 lpm: ±3 lpm From 251 to 300 ppm: unspecified
Renewal frequency	y1 s

A.8.6 PANI Specifications

Regulations	Complies with IEC 80601-2-30 standard			
Operating mode	Manual, Auto, STAT, Sequence			
Auto mode repeat intervals: 1 min, 2 min, 2.5 min, 3 min, 5 min, 10 min, 15 min, 20 min, 30 min, 1 h, 1.5 h, 2 h, 3 h, 4 h, 8 h				
STAT mode cycle time	5 min			
Maximum measurement time	Adult, child: 180s Newborns: 90s			
Measurement range	Measuring elements	Adults	Children	Newborn
	Systolic (mmHg)	From 25 to 290	From 25 to 240	From 25 to 140
	Diastolic (mmHg)	From 10 to 250	From 10 to 200	From 10 to 115
	Average (mmHg)	From 15 to 260	From 15 to 215	From 15 to 125

Measurement accuracy*	Maximum mean error: ±5 mmHg Maximum standard deviation: 8 mmHg
Static pressure measurement range	From 0 mmHg to 300 mmHg
Static pressure measurement accuracy ±3 mmHg	
Resolution	1 mmHg
Software protection against excessive pressure	Adults: 297 ±3 mmHg Children: 297 ±3 mmHg Newborns: 147 ±3 mmHg
Initial cuff inflation pressure range	Adults: From 80 to 280 mmHg Children: From 80 to 210 mmHg Newborns: From 60 to 140 mmHg
*Verification of measurement accuracy: In adult and pediatric modes, blood pressure measurements made with this device meet the standard for non-invasive sphygmomanometers (ISO 81060-2) in terms of mean error and standard deviation when compared to intra-arterial or auscultatory measurements (depending on the setting) in a typical patient population. The fifth Korotkoff sound was used as the auscultatory reference for diastolic pressure. In newborn mode, blood pressure measurements made with this device meet the US national standard for non-invasive sphygmomanometers (ISO 81060-2) in terms of mean error and standard deviation when compared to intra-arterial measurements (as set) in a typical patient population.	
FP	
Measurement range	30 to 300 lpm
Resolution	1 lpm
Precision	±3 lpm or ±3%, whichever is higher

A.8.7 CO2 specifications

Regulations	Complies with ISO 80601-2-55
Measurement range	From 0 to 150 mmHg
Accuracy1	Total accuracy mode: From 0 to 40 mmHg: ±2 mmHg From 41 to 76 mmHg: ±5% of reading From 77 to 99 mmHg: ±10% of reading From 100 to 150 mmHg: ±(3 mmHg+8% of reading)
Precision deviation	It meets the requirements for measurement accuracy within 6 hours.
Resolution	1 mmHg
Flow frequency tolerance of sample	±15% or ±15 ml/min, whichever is higher.
Start time	20s (typical), 90s (maximum)
Sample flow frequency	50 ml/min
Up time	ÿ200 ms at 50 ml/min (measured with a CO2 adapter and sampling tube) ÿ250 ms at 50 ml/min (measured with a standard sampling tube) ÿ280 ms at 50 ml/min (measured with a long sampling tube)
Response time	ÿ5.0 sa 50 ml/min (measured with a CO2 adapter and sampling tube) ÿ5.0 sa 50 ml/min (measured with a standard sampling tube) ÿ6.5 sa 50 ml/min (measured with a long sampling tube)

Apnea time	10s, 15s, 20s, 25s, 30s, 35s, 40s	
FRVa		
FRVa measurement range	From 0 to 150 rpm	
FRVA Accuracy	y60 rpm: ±1 rpm From 61 to 150 rpm: ±2 rpm	
FRVA Resolution	1 rpm	
Effect of interfering gases on CO2 measurements		
Gas	**Concentration**	**quantitative effect2**
O2	y100%	±1 mmHg
N2O	y60%	
Hal	y4%	
Sev	y5%	
ISO	y5%	
Nurse	y5%	
Des	y15%	±2 mmHg

[1] Inaccuracy specifications are affected by respiratory rate and I:E change. EtCO2 accuracy is within specifications for respiratory rate y60 rpm and I/E ratio y1:1, or respiratory rate y30 rpm and I/E ratio y2:1.

[2] It indicates that an additional error must be added in case of gas interference when CO2 measurements are taken from 0 to 40 mmHg.

This page has been intentionally left blank.

B Compliance with compatibility regulations

electromagnetic and radiofrequency emissions

B.1 EMC

The equipment meets the requirements set out in IEC 60601-1-2: 2014.

WARNING

- **The use of accessories, transducers, and cables other than those specified or supplied by the manufacturer of this device could result in an increase in electromagnetic emissions or a reduction in the electromagnetic immunity of this device and cause malfunction.**

- **The operation of non-ME EQUIPMENT (e.g., ITE) that is part of an ME SYSTEM could be seen Interrupted due to electromagnetic interference from nearby equipment. Measures may need to be taken to reduce this effect, such as changing the orientation or location of the non-ME equipment or shielding the location.**
- **This device should not be used alongside other equipment or stacked with another device, as this may cause malfunction. If such use is necessary, both devices should be inspected to ensure they are functioning correctly.**
- **Portable radio frequency (RF) communication equipment (including peripherals such as antenna cables and external antennas) must be used at a minimum distance of 30 cm (12 inches) from any component of this device, including cables specified by the manufacturer. Failure to do so may affect the performance of this device.**
- **Other devices may affect this equipment even if they meet the requirements of CISPR.**
- **When the input signal is below the minimum amplitude indicated in the specifications techniques, erroneous measurements may occur.**

NOTE

- **Take special precautions regarding EMC; install and operate the equipment according to the information from the CEM that is set out below.**
- **Mobile and portable RF communication devices may affect this equipment.**

This **equipment is designed for use in professional healthcare settings or in home healthcare environments such as restaurants, cafes, shops, markets, schools, churches, libraries, outdoor spaces (streets, roads, parks), private residences (nurseries, homes, clinics), train stations, bus stations, airports, hotels, hostels, guesthouses, museums, or theaters. If used in a special environment, such as an MRI suite, the equipment's performance may be affected by the operation of other equipment.**

nearby.

Guide and declaration: Electromagnetic emissions		
This equipment is designed for use in the electromagnetic environment specified below. The customer or user of the equipment must ensure that it is used in that environment.		
Emissions test	**Accordance**	**Electromagnetic environment: guide**
CISPR 11 RF Emissions	Group 1	The equipment uses RF power only for internal operation. Therefore, RF emissions are minimal and there is no possibility of them causing interference with nearby electronic devices.

Guide and declaration: Electromagnetic emissions		
CISPR 11 RF Emissions	Class B	The equipment can be used in any type of establishment, including domestic ones and those directly connected to the low-voltage public electricity network provided by buildings used for domestic purposes.
Harmonic emissions IEC 60601-1-2 EN 61000-3-2	Class A	
Voltage fluctuations/ intermittent emissions IEC 60601-1-2 EN 61000-3-3	It fulfills	

If the device operates in the electromagnetic environment specified in the table **Guide and Declaration: Electromagnetic Immunity,** it will remain safe and provide the following basic performance: HR accuracy, Resp accuracy, SpO2 accuracy, FP accuracy, NIBP accuracy, CO2 accuracy, stimulation rate accuracy, stimulation output accuracy, energy accuracy, CPR function, alarm, stored data, user interface function.

Guide and declaration: electromagnetic immunity			
This equipment is designed for use in the electromagnetic environment specified below. The customer or user of the equipment must ensure that it is used in that environment.			
Immunity test	**Test level IEC 60601**	**Level of compliance**	**Electromagnetic environment: guide**
Electrostatic discharge (ESD) IEC 61000-4-2	±8 kV per contact ±15kV in air	±8 kV per contact ±15kV in air	The floors must be made of wood, concrete, or ceramic. If they are covered with synthetic material, the relative humidity must be at least 30%.
Fast transient electric currents and bursts IEC 61000-4-4	±2 kV in electrical networks ±1 kV on input and output lines (length greater than 3 m)	±2 kV in electrical networks ±1 kV on input and output lines (length greater than 3 m)	The quality of the electrical network must be equivalent to that of a typical hospital or commercial premises.
Sudden overload IEC 61000-4-5	±1 kV line-to-line ±2 kV line to ground	±1 kV line-to-line ±2 kV line to ground	
Voltage drops and voltage interruptions IEC 61000-4-11	0% UT) in 0.5 cycles 0% UT in 1 cycle and 70% U T in 25/30 cycles 0% UT for 250/300 cycles	0% UT) in 0.5 cycles 0% UT in 1 cycle and 70% U T in 25/30 cycles 0% UT for 250/300 cycles	The electrical grid quality should be equivalent to that of a typical hospital or commercial premises. If the user needs to use the product continuously during power outages, it is recommended to operate the product with an uninterruptible power supply (UPS) or battery.
Magnetic fields at nominal power frequency IEC 61000-4-8	30 A/m	30 A/m	Mains frequency magnetic field levels should be those typical of any hospital or typical commercial premises.
UT represents the AC mains voltage prior to the application of the test level.			

Guide and declaration: electromagnetic immunity

This equipment is designed for use in the electromagnetic environment specified below. The customer or user of the equipment must ensure that it is used in that environment.

Immunity test	IEC 60601 test level	Level of compliance	Electromagnetic environment: guide
RF conducted IEC 61000-4-6	3 Vrms From 150 kHz to 80 MHz	3 Vrms (V1)	Mobile or portable RF communication equipment must be used at a separation distance equal to or greater than the recommended distance (calculated using the equation applicable to the transmitter frequency) from the device components, including cables. Recommended separation distance: $d = \frac{3.5}{V1}\sqrt{P}$ From 150 kHz to 80 MHz $d = \frac{3.5}{AMD1}\sqrt{P}$ From 80 MHz to 800 MHz $d = \frac{7}{AMD1}\sqrt{P}$ From 800 MHz to 2.7 GHz Where P equals the output power of the transmitter in watts (W), according to the transmitter manufacturer, and yd equals the recommended separation distance in meters (m)b. The field strengths derived from fixed RF transmitters, according to the results of an electromagnetic location inspection , must be lower than the compliance level for each frequency interval. Interference may occur near equipment marked with the symbol: 
	6 Vrms in ISM bands and amateur radio stations between 0.15 MHz and 80 MHz	6 Vrms (V2)	
Radiated RF electromagnetic fields IEC 61000-4-3	3V/m From 80 MHz to 2.7 GHz: (IEC60601-2-27, IEC60601-2-25, IEC60601-2-49, IEC60601-2-34)	3 V/m (E1)	
	10V/m From 80 MHz to 2.7 GHz: (IEC60601-2-4)	10 V/m	
	20V/m From 80 MHz to 2.7 GHz: (IEC60601-2-4, IEC80601-2-30, ISO 80601-2-55, ISO 80601-2-56, ISO 80601-2-61)	20 V/m	
Proximity fields with respect to RF wireless communication equipment IEC61000-4-3	27 V/m From 380 to 390 MHz	27 V/m	
	28 V/m From 430 to 470 MHz, From 800 to 960 MHz, From 1700 to 1990 MHz, From 2400 to 2570 MHz	28 V/m	
	9 V/m From 704 to 787 MHz, From 5100 to 5800 MHz	9 V/m	

Note 1: The higher frequency range applies to 80 MHz and 800 MHz.

Note 2: These guidelines do not apply in all cases. Absorption and reflection from structures, objects, and individuals can affect electromagnetic propagation.

[to] The ISM (Industrial, Scientific, and Medical) bands between 150 kHz and 80 MHz are 6.765 MHz to 6.795 MHz, 13.553 MHz to 13.567 MHz, 26.957 MHz to 27.283 MHz, and 40.66 MHz to 40.70 MHz. Amateur radio stations between 0.15 MHz and 80 MHz are 1.8 MHz to 2.0 MHz; 3.5 MHz to 4.0 MHz; 5.3 MHz to 5.4 MHz; 7 MHz to 7.3 MHz; 10.1 MHz to 10.15 MHz; 14 MHz to 14.2 MHz; and 18.07 MHz to 18.17 MHz. from 21.0 MHz to 21.4 MHz; from 24.89 MHz to 24.99 MHz; from 28.0 MHz to 29.7 MHz and from 50.0 MHz to 54.0 MHz.

[b] The level of conformity in the ISM frequency bands between 150 kHz and 80 MHz and in the frequency range from 80 MHz to The 2.7 GHz band is intended to reduce the likelihood of portable and mobile communication equipment causing interference if accidentally moved into patient areas. For this reason, an additional factor of 10/3 is used in calculating the recommended separation distance for transmitters in these frequency ranges.

[c] The field intensities derived from fixed transmitters, such as radiotelephony base stations (mobile/ Wireless and terrestrial mobile radio, amateur radio, and AM/FM and television broadcasting cannot be accurately predicted theoretically. To assess the electromagnetic environment resulting from fixed RF transmitters, an electromagnetic site inspection must be performed. If the field strength measured at the location where the device is used exceeds the applicable RF conformity level above, the following must be observed:

The device is checked to ensure it is functioning correctly. If abnormal performance is detected, additional measures, such as reorienting or repositioning the device, may be required.

[d] In the frequency range between 150 kHz and 80 MHz, field strengths must be less than 3V/m.

Recommended separation distances between this equipment and mobile and portable RF communication devices			
The equipment must be used in an electromagnetic environment where interference from radiated radio frequencies is controlled. The customer or user of the equipment can help avoid electromagnetic interference by maintaining a minimum distance between mobile and portable RF communication devices (transmitters) and the equipment, as recommended below according to the maximum output power of the communication devices.			
Maximum indicated output power of the transmitter in watts (W)	**Separation distance according to the transmitter frequency (m)**		
	From 150 kHz to 80 MHz: $d = \frac{3.5}{V1}\sqrt{P}$	From 80 MHz to 800 MHz: $d = \frac{3.5}{1}\sqrt{P}$	From 800 MHz to 2.7 GHz: $d = \frac{7}{1}\sqrt{P}$
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 those transmitters whose maximum output power is not listed above, you can determine the recommended separation distance in meters (m) from the equation applicable to the transmitter frequency, where P represents the maximum output power of the transmitter in watts (W) specified by the manufacturer. Note 1: The higher frequency range applies to 80 MHz and 800 MHz. Note 2: These guidelines do not apply in all cases. Absorption and reflection from structures, objects, and individuals can affect electromagnetic propagation.			

B.2 Compliance with radio frequency regulations

CE

The device complies with the basic requirements and other relevant provisions of Directive 2014/53/EU.

WARNING

- **Maintain a distance of at least 20 cm from the device if the wireless function is enabled.**
  in use.

C Algorithm for analyzing shockable rhythms

Mindray

The device is configured with Mindray's shockable rhythm analysis algorithm and acquires and analyzes the patient's ECG signals to determine if a defibrillation shock is necessary. If a shockable rhythm is detected, the algorithm recommends a defibrillation shock. If a non-shockable rhythm is detected, the algorithm does not recommend a shock, thus avoiding delivering an unnecessary defibrillation shock to the patient.

Mindray's shockable rhythm analysis algorithm also applies to patients with pacemakers. The algorithm identifies and filters pacing interference, which does not affect the ECG rhythm analysis.

Mindray's shockable rhythm analysis algorithm has been validated using the Mindray algorithm performance evaluation database.

C.1 Methodology for rhythm notation and recognition

This section describes the recording method, the source of the rhythms and their selection criteria, the methods and criteria for annotating the database to evaluate the Mindray shockable rhythm analysis algorithm.

C.1.1 Database for evaluating the performance of the Mindray algorithm

The database for evaluating the performance of the Mindray algorithm includes the international standard database and the Mindray clinical database for ECG data evaluation. ECG data
For the evaluation, they are selected according to the AHA recommendations for 10 seconds. to with a wavelength of

The database for evaluating Mindray's shockable rhythm analysis algorithm includes:

ÿ MIT-BIH: Massachusetts Institute of Technology - Beth Israel Hospital Arrhythmia Database (of Holter devices)

ÿ AHA: American Heart Association database for the evaluation of arrhythmia detectors ventricular (from Holter devices)

ÿ VFDB: MIT-BIH Malignant Ventricular Arrhythmia Database (from Holter devices)

ÿ CU: Creighton University Prolonged Ventricular Arrhythmia Database (third edition) (from hospital monitoring devices)

ÿ NST: Stress test and noise database (12 ECG recordings of 30 minutes each and 3 noise-only recordings, provided with the MIT-BIH database)

ÿ Mindray clinical data (from monitors, monitor/defibrillators and automated external defibrillators) (from Mindray)

C.1.2 Categories of rhythms

All rhythm categories for evaluating ECG data have been confirmed by clinical specialists.

ÿ Shockable rhythms

- Coarse-grained ventricular fibrillation (VF): amplitude ÿ0.2 mV
- Rapid ventricular tachycardia (VT): HR ÿ150 bpm, QRS duration ÿ120 ms

ÿ Non-shockable rhythms

- Normal sinus rhythm
- Asystole: amplitude <0.1 mV
- Atrial fibrillation/flutter, supraventricular tachycardias, sinus bradycardia, rhythms idioventricular, atrioventricular block, premature ventricular contractions, etc.

ÿ Intermediate rhythms

- Fine-grained ventricular fibrillation: 0.1 mV < amplitude <0.2 mV
- Other VT: ventricular tachycardias that do not meet the criteria for VT in the rhythm category defibrillatable

C.2 Performance of the defibrillable rhythm analysis algorithm Mindray

The performance test results of the equipment configured with Mindray's defibrillatable rhythm analysis algorithm meet the requirements of IEC 60601-2-4b and AHA recommendations.

The test results according to the requirements of IEC 60601-2-4 are shown below:

Rhythm category	Requirement	Test result
Defibrillable (sensitivity): coarse grain FV Fast TV	 >90% >75%	 According According
Non-shockable (specificity)	>95%	According
Positive predictive value	Report only	>98%
False positive rate	Report only	<2%

The test results, according to AHA recommendations, are shown below:

Rhythm category	minimum size of the sample (cases)	Performance target	Size of the sample analyzed (cases)	Result of the proof
Defibrillable (sensitivity): coarse grain FV Fast TV	 200 50	 >90% >75%	 205 80	 According According
Non-shockable (specificity): Normal sinus rhythm Asystole Other non-shockable rhythms	300 100 100 30	 >99% >95% >95%	 171 180 385	 According According According
Intermediate: fine grain FV Other TV	 25 25	 Report only Report only	 27 42	 66.67% defibrillable 76.19% non-shockable

[b]. Kerber RE, et al, "Automatic External Defibrillators for Public Access Defibrillation: Recommendations for Specifying and Reporting Arrhythmia Analysis Algorithm Performance, Incorporating New Waveforms, and Enhancing Safety: A Statement for Health Professionals from the American Heart Association Task Force on Automatic External Defibrillation," Subcommittee on AED Safety and Efficacy. Circulation, 1997: Vol. 95: 1677-1682.

b. Clause 201.7.9.3.103 "Essential Performance data of the Rhythm Recognition Detector" and clause 201.107 "Requirements for Rhythm Recognition Detector," International Electrotechnical Association, IEC 60601-2-4, Medical Electrical Equipment – Part 2-4: Particular Requirements for the Basic Safety and Essential Performance of Cardiac Defibrillators: 2010.

D Alarm messages

D.1 Messages from physiological alarms

D.1.1 General physiological alarm messages

Alarm messages	Default priority	Cause and solution
XX* High	Half	The measured value has risen above the high alarm limit or fallen below the low alarm limit. Check the patient's status and whether the patient category and alarm limit settings are correct.
XX* Low	Half	

*XX represents the label of a parameter, such as FC, NIBP, FR, SpO2, FP, etc.

D.1.2 Arrhythmia alarm messages

If any of the arrhythmia alarms in the following table occur, check the patient's condition and the connections of the electrodes, lead wires, and patient cable.

Alarm message	Default priority	Alarm message	Default priority
Asystole	High	Bradic.	Half
Fibr.ventr /Taq.ventr	High	Marcap. does not stimulate	Indication
Tachyventr.	High	Marcap does not capture	Indication
Ventricular bradycardia	High	Lost heartbeats	Indication
Extreme Taq	High	Non-sustained ventricular tachycardia	Half
Extreme Brady	High	Ventilation rhythm	Half
R in T	Half	Pause	Low
Run CVP	Low	Irregular rhythm	Indication
Doublet	Indication	Fibr. A.	Indication
CVP multif.	Half	CVP/min	Half
CVP	Indication	Pauses/min	Half
Bigeminy	Half	SVT	Half
Trigeminism	Half	High SVC/min	Indication
Taq.	Half		

D.1.3 ST physiological alarm messages

ST Alarm Mode	Alarm messages	Default priority	Cause and solution
Absolute	ST-XX* High	Half	The ST value has risen above the upper alarm limit or fallen below the lower alarm limit. Check the patient's status and whether the patient category and alarm limit settings are correct.
	ST-XX* Low	Half	

ST Alarm Mode	Alarm messages	Default priority	Cause and solution
Relative	ST single	Half	The ST value has risen above the upper alarm limit or fallen below the lower alarm limit. Check the patient's status and whether the patient category and alarm limit settings are correct.
	ST double	Half	The ST values of two or more ECG leads have risen above the upper alarm limit or fallen below the lower alarm limit. Check the patient's status and whether the patient category and alarm limit settings are correct.
*XX represents the ECG lead label.			

D.1.4 Physiological alarm messages from the Resp module

Alarm message	Default priority	Cause and solution
Apnea	Adult/child: Half Neonate: High	The patient's breathing signal was so weak that the equipment could not analyze it. Check the patient's condition and connections.
Responsive artifact	High	The patient's heartbeat is interfering with their breathing. Check the patient's condition and respiratory connections.

D.1.5 Physiological alarm messages from the SpO2 module

Alarm message	Priority default	Cause and solution
Low SpO2 (XX h XX min XX s)*	High	The SpO2 value falls below the alarm limit. Check the patient's condition and whether the alarm limit settings are correct.
Desat. SpO2 (XX h XX min XX s)*	High	The SpO2 value falls below the desaturation alarm limit. The SpO2 value falls below the desaturation alarm limit. Check the patient's condition and whether the alarm limit settings are correct.
*XX h XX min XXs represents the time period that the SpO2 alarm lasts.		

D.1.6 FP physiological alarm messages

Alarm message	Priority default	Cause and solution
No pulse	High	The pulse signal was so weak that the team was unable to analyze it. Check the patient's status, the SpO2 sensor, and the measurement location.

D.1.7 PANI physiological alarm messages

Alarm message	Priority default	Cause and solution
PANI-S extremely high/PANI-D extremely high/ PANI-M extra high	High	The NIBP value is higher than the upper extreme NIBP alarm limit. Check the patient's condition and whether the alarm limit settings are correct.

Alarm message	Default priority	Cause and solution
PANI-S extremely low/PANI-D extremely low/ PANI-M extra low	High	The NIBP value is lower than the lower extreme NIBP alarm limit. Check the patient's condition and whether the alarm limit settings are correct.

D.2 Technical alarm messages

This section details the technical alarms, their predetermined priorities, alarm reset instructions, and the actions that can be taken when an alarm occurs.

Technical alarms use different alarm indicators when the alarm system is reset.

In the following tables, the technical alarms are classified into three categories to facilitate their interpretation:

ÿ A: Some technical alarms have disappeared. The equipment is not displaying any alarm indications.

ÿ B: Some technical alarms have been changed to warning messages.

ÿ C: Except for some special technical alarms, other alarms are silenced and a ÿ appears before the message. alarm.

D.2.1 General technical alarm messages

Alarm message	Default priority	Alarm reset indication	Cause and solution
XX* out of range	Low	C	The measured value is not within the measurement range. Please contact service personnel.
* XX represents the label of a parameter, such as FC, NIBP, FR, SpO2, FP, etc.			

D.2.2 ECG technical alarm messages

Alarm message	Default priority	Alarm reset indication	Cause and solution
ECG noise	Under/Indication	TO	The ECG signal is noisy. Look for any possible sources of signal noise around the cable and electrode, and prevent the patient from moving too much.
Amp. ECG too reduced.	Low	C	The ECG amplitude does not reach the detected threshold. Check for any sources of interference around the cable and electrode.
ECG disconnected. (XX h XX min XX s)1	Low	B	The electrode has come loose from the patient or the lead wire has become disconnected from the patient cable. Check the electrode connections, lead wires, and patient cable.
ECG XX2 descent	Low	B	The electrode has come loose from the patient or the lead wire has become disconnected from the patient cable. Check the electrode connections, lead wires, and patient cable.
Electric/blades desc	Low	B	The electrodes or paddles have been removed from the patient, or the therapy cable is loose. Check the connections of the electrodes and therapy cable, or the paddles and therapy cable.

Alarm message	Default priority	Alarm reset indication	Cause and solution
Incorrect ECG signal	Low	TO	The patient's skin impedance is too high. Check the placement of the ECG electrodes.
Recognizing ECG	Indication	/	ECG recognition has been activated manually or automatically.
QT cannot be analyzed	Indication	/	QT measurements are not calculated.

[1] XX h XX min XX s represents the time period that the **"ECG disconnected" alarm lasts.**
[2] XX represents the ECG lead label, e.g., RL, LL, V, etc.

D.2.3 Technical alarm messages from the Response module

Alarm message	Default priority	Alarm reset indication	Cause and solution
Interference resp.	Indication	/	The breathing circuit has been disrupted. Check for noise sources in the signal.
Electrical contacts deficit	Indication	/	Check the electrode application. Reposition or change the electrodes if necessary.

D.2.4 Technical alarm messages from the SpO2 module

Alarm message	Priority default	Indication of restoration alarm	Cause and solution
SpO2 sensor off	Low	B	The SpO2 sensor has become detached from the patient or the equipment. Check the sensor connection. If the alarm persists, replace the sensor.
There is no SpO2 sensor	Low	TO	The SpO2 extension cable has been disconnected from the equipment, or the SpO2 sensor has been disconnected from the SpO2 extension cable. Check the cable connection and the SpO2 sensor. If the alarm persists, replace the sensor.
Excessive light for SpO2	Low	C	The ambient light is too strong. Move the move the sensor to another location with less ambient light or Cover it to minimize it.
No pulse SpO2	Low	C	The SpO2 sensor has not received a pulse signal. Check the patient's condition and change the sensor's application site. If the alarm persists, replace the sensor.
SpO2 incompatible sensor	Low	C	An incompatible or unspecified SpO2 sensor is being used . Use the specified sensors.
Low SpO2 signal quality	Low	C	1. Check the sensor and its position. 2. Check that the patient is still and does not have tremors. 3. The patient's pulse may be too low to be measured.
SpO2 Interference	Low	C	The SpO2 signal is interfering. Look for possible sources of noise in the signal and prevent the patient from moving too much.
SpO2 sensor error	Low	C	Replace the sensor and repeat the measurement.

Alarm message	Default priority	Alarm reset indication	Cause and solution
SpO2 pulse search	Indication	/	SpO2 is looking for the pulse.
Low SpO2 perfusion	Indication	/	The SpO2 sensor is not properly positioned or the patient's perfusion index is too low. 1. Check the sensor and its position. 2. Replace the sensor if necessary.

D.2.5 PANI technical alarm messages

Alarm message	Default priority	Alarm reset indication	Cause and solution
Loose PANI sleeve	Low	TO	There is a leak in the hose or air tube. Use the correct type of cuff based on the patient's size. Apply the cuff and connect the air tubes as instructed in the manual.
Airway leak or cuff PNI	Low	TO	Check for leaks in the air tubes and the PANI sleeve.
PANI Airline Error	Low	TO	The air tube may be obstructed. Check the air tube for blockages or kinks. If the alarm continues, contact service personnel.
Weak PANI signal	Low	TO	The patient's pulse is weak or the cuff is loose. Check the patient's condition and change the cuff application site.
PANI out of range	Low	TO	The measured NIBP value exceeds the measurement range. Check the patient's condition.
Excessive movement PANI	Low	TO	Check the patient's condition and reduce patient movement.
Excessive cuff pressure PNI	Low	TO	The PANI airway may be obstructed. Check the airway and take the measurement again. If the alarm continues, contact service personnel.
Time expired PANI	Low	TO	The measurement time exceeds 120 seconds in adult or pediatric mode, or 90 seconds in neonatal mode, and a blood pressure (BP) value cannot be obtained. Check the patient's condition and NIBP connections, or replace the cuff and repeat the measurement.
Missing PNI sleeve and pac.	Low	TO	The cuff type is not suitable for the patient category. Check the patient category and change the cuff if necessary. If the patient category is correct, check that the tube is not kinked and that the airway is not obstructed.
Air escape PANI	Low	TO	Leaks were detected in the airways during the NIBP leak test. Check for leaks in the air tubing and NIBP cuff.

D.2.6 CO2 technical alarm messages

Alarm message	Priority default	Indication of restoration alarm	Cause and solution
high temp CO2 module	Low	C	The ambient temperature is too high or a module has failed. 1. Increase the ambient temperature. 2. Restart the computer. 3. If the alarm persists, the CO2 module may be faulty; contact service personnel.
Low temp CO2 module	Low	C	The ambient temperature is too low or a module has failed. 1. Increase the operating temperature. 2. Restart the computer. 3. If the alarm persists, the CO2 module may be faulty; contact service personnel.
Error p zero CO2	Low	C	Restart the equipment. If the alarm continues, contact service personnel.
High airway CO2 pressure	Low	C	1. Check the airway pressure settings of the ventilator or anesthesia machine. 2. Disconnect the equipment from the respirator or the anesthesia machine. 3. Restart the computer. 4. If the alarm continues, contact service personnel.
Low airway CO2 pressure		C	1. Check the airway pressure settings of the ventilator or anesthesia machine. 2. Disconnect the equipment from the respirator or the anesthesia machine. 3. Restart the computer. 4. If the alarm continues, contact service personnel.
high barometric pressure	Low	C	The ambient pressure exceeds the operating pressure range or a failure has occurred in the CO2 module. 1. Ensure that the ambient pressure meets specifications and look for potential sources that may affect the ambient pressure. 2. Restart the computer. 3. If the alarm continues, contact the service personnel.
low barometric pressure	Low	C	The ambient pressure exceeds the operating pressure range or a failure has occurred in the CO2 module. 1. Ensure that the ambient pressure meets specifications and look for potential sources that may affect the ambient pressure. 2. Restart the computer. 3. If the alarm continues, contact the service personnel.
Airways CO2 occluded	Low	C	1. Check if the sampling tube is twisted or obstructed. 2. Replace the sampling tube. 3. Restart the computer. 4. If the alarm continues, contact service personnel.

Alarm message	Default priority	Alarm reset indication	Cause and solution
CO2 without filter	Low	TO	Make sure the sampling tube is connected.
CO2 calibration required	Low	C	Perform a calibration.
CO2 airway error	Low	C	1. Check if the sampling tube is twisted or obstructed. 2. Replace the sampling tube. 3. Restart the computer. 4. If the alarm continues, contact service personnel.
CO2 adapter error	Low	TO	Check the airway adapter, clean it, or replace it. Perform a zero calibration.
Without CO2 sensor	Low	TO	Check that the CO2 transducer is connected.

D.2.7 Technical stimulation alarm messages

Alarm message	Priority default	Indication of restoration alarm	Cause and solution
Electric cable	High	C	Check the therapy cable connection.
Electronic desc	High	C	Check the electrode connection.
ECG disconnected.	High	C	Check the ECG electrode connections and lead wires.
Abnormal arrest marcap	High	C	Check the contact between the electrodes and the patient's skin. Make sure the electrodes have been applied correctly, and then restart the stimulation.

D.2.8 Technical alarm messages from the CPR sensor

Alarm message	Default priority	Alarm reset indication	Cause and solution
RCP sensor error	High	C	There is a self-test error or a communication problem with the CPR sensor. Please contact service personnel.
Low battery CPR sensor	Half	C	The battery charge of the CPR sensor is low. Charge the battery by connecting the CPR sensor to the equipment.
CPR sensor required maintenance	High	C	The compressions using the CPR sensor exceed the expected number. Contact the service personnel.
sensor cable error CPR	Low	C	There is an error in the CPR sensor cable. Replace the CPR sensor cable.
Replace battery sensor CPR Low		C	The CPR sensor battery is deteriorating. Please contact the service staff.
Battery sensor RCP error charge .ow		C	The CPR sensor cannot be charged. Please contact service personnel.

D.2.9 Power supply technical alarm messages

Alarm message	Priority default	Indication of restoration alarm	Cause and solution
Common mistake power plate	High	C	Restart the equipment. If the alarm continues, contact service personnel.
Common mistake power plate	High	C	There has been an error in the power board or there is a problem with the communication between the board and the main unit. Restart your computer.
Err autocompr pan poten	High	C	There has been an error in the system power supply. Please restart the computer.
Voltage error	Low	C	
Without battery	Low	C	The battery is not installed. Install the battery.
Battery error	High	C	The battery is faulty. Replace the battery.
Battery wear	Low	C	The battery has reached the end of its useful life. Replace the battery.
Battery charging error	Half	C	The battery or charging circuit is faulty. Replace the battery. If the problem persists, contact service personnel.
Reset RT clock	High	C	Please contact the service staff.
RT Watch does not exist	High	C	Please contact the service staff.
Lower battery capacity 60%	Indication	/	To avoid low battery, connect the device to an external power source.

D.2.10 Technical alarm messages from the recorder

Alarm message	Priority default	Indication of restoration alarm	Cause and solution
Error starting registration	Low	TO	An error occurred during the recorder initialization. Restart the equipment. If the alarm continues, contact service personnel.
Error communication register	Low	TO	Restart the equipment. If the alarm continues, contact service personnel.
Hot recording head: please wait	Low	C	The recorder has been running for too long. Stop recording and resume it once the print head has cooled down.
Initializing registration	Indication	/	Wait until the logger initialization is complete.
Paperless register	Indication	/	No paper has been loaded into the recorder or the recorder door is not closed. Check the recorder, load paper into the recorder, or close the recorder door.
Register occupied	Indication	/	The log buffer queue is full.

D.2.11 Network technical alarm messages

Alarm message	Default priority	Alarm reset indication	Cause and solution
Without SMC	Low	B	The device is disconnected from the CMS. Check the network connection.
IP address conflict of WLAN	Low	C	Wireless network IP address conflicts. Check your network settings.
IP address conflict of LAN1	Low	C	Network conflict of the IP address of the wireless network LAN1. Check the network configuration.
Could not obtain WLAN IP address	Low	C	The wireless network IP address could not be obtained automatically. Please check your network settings.
Could not obtain LAN1 IP address	Low	C	The IP address for wired network LAN1 could not be obtained automatically. Please check your network settings.

D.2.12 Special technical alarm messages

Special technical alarms are unaffected by the alarm status, meaning that the alarm volume, alarm lights, and alarm messages cannot be modified. Special technical alarms only disappear when the alarm conditions are cleared.

Alarm message	Default priority	Alarm reset indication	Cause and solution
Low battery	High	C	Connect the device to an external power source and allow the battery to charge.
Very low battery	High	C	Immediately connect the device to the external power source and charge the battery.
Common error, therapy module	High	C	Restart your computer. If the problem persists, contact your service personnel.
Self-purchase therapy equipment error	High	C	An error occurred during the therapy module self-test. Restart the device or replace the therapy module's low-voltage board.
Defibrillation failure	High	C	A failure has occurred in the defibrillation function, or in both the defibrillation and pacing functions simultaneously. Restart the device. If the problem persists, contact service personnel.
Tickout failure	High	C	Stimulation function failure. Restart the device. If the problem persists, contact service personnel.

D.2.13 Technical alarm messages from other systems

Alarm message	Default priority	Alarm reset indication	Cause and solution
Err autocompr control ppal Alto		C	There has been an error in the main control voltage. Replace the main control board.

Alarm message	Default priority	Alarm reset indication	Cause and solution
Failure to deactivate	High	C	There is a problem with the therapy module's deactivation circuit. Replace the therapy module's high and low voltage boards.
Err autocompr mod monitor	High	C	An error occurred during the self-test of the multi-parameter monitoring module's power-on. Replace the multi-parameter monitoring module.
Err reboot mod monitor	High	C	The multi-parameter monitoring module is resetting abnormally. In this case, the multi-parameter module restores the default settings. You can ignore this issue.
Err voltage module monitor	Low	C	An error has occurred in the voltage of the multi-parameter monitoring module. Replace the multi-parameter monitoring module.
Last user test failed	Low	C	Perform a proper user test.
Last autocomment error	Low	C	Perform another successful user test.
Last energy test error	Low	C	Check the equipment connection and perform a user test to eliminate errors.
XX1 offline	High	TO	The corresponding external device is disconnected. Check the connection between the computer and the external device.
Error stored.	High	C	Storage card error or corrupted files. Restart the computer to format the storage card. If the alarm persists, contact service personnel.
Patient data storage space is almost full. Delete some discharged patients.	Half	B	Delete any previous patients you don't need.
Error loading default configuration.	Low	TO	The default settings were not loaded correctly. The device will be restored to the factory default settings corresponding to the current patient category.
The XX2 measurement has been closed	Indication	/	The parameter module has been deactivated. Activate the module if you wish to use it. For more information, see 9.2.2 Configuring parameter activation.
XX2's display settings have been disabled.	Indication	/	The parameter is not displayed on the screen. Select the area where you want to display the numerical values and waveforms for the parameter. For more information, see 9.2.3 Defining the Normal Display.
Do not load/unload frequently	Indication	/	The device has been frequently charged and discharged in Manual Defibrillation mode.
User testing required	Indication	/	The time period of the last user test exceeds the recommended period. Please perform a proper user test.

[1] XX represents the name of the external device.

[2] XX represents the label of a parameter, such as FC, NIBP, FR, SpO2, FP, etc.

E Defibrillator Checklist

Team name: _____ **Serial number** _____ **Department:** _____

Element	Correct/ incorrect/ N/A	Corrective actions/ observations
1. Equipment appearance • Clean, free of foreign bodies and without cracks		
2. Cables/connectors • Cables not worn, connectors and pins neither broken nor loosened • The connectors connect securely		
3. Batteries • Battery installed with at least 60% of its capacity battery • Fully charged spare battery available		
4. Necessary accessories (electrodes, paddles, branch cables) ECG or recorder paper) • Included and sufficient • Inspected for normal use		
5. Self-check • The Status Indicator lights up in green		
6. Download test y **If external blades are used:** 1. Connect the device to an external power source and the power indicator will light up. 2. Connect the blade cable to the equipment and place the external blades in the blade tray. 3. Press the external blade charging button and charge the equipment to **50** J. 4. Press the External Blades Download button. 5. The system indicates that the download can be managed normally.		
y **If electrodes are used:** 1. Connect the device to an external power source and the power indicator will light up. 2. Connect the electrode cable to the equipment. 3. Perform the user test with the test load connected. 4. The system indicates that the energy test was passed.		
5. Monthly check of the expiry date • The electrodes are not expired.		
Verified by: _____ **Date:** _____		

This page has been intentionally left blank.

F Accessories

The material of the accessories that comes into contact with patients has been biocompatibility tested and has been found to comply with ISO 10993-1.

WARNING

- **Use the accessories specified in this chapter. Using other accessories could cause problems.**
  damage to the equipment or failure to meet the stated specifications.
- **Single-use accessories should not be reused. If they are reused, there is a risk of contamination, which may affect the accuracy of the measurements.**

CAUTION

- **Accessories may not meet performance specifications if stored or used outside the specified temperature and humidity ranges. If accessory performance degrades due to aging or environmental conditions, contact service personnel.**
- **Check the accessories and their packaging for any signs of damage. If you find any damage, do not use them.**
- **Use the accessories before the expiration date if one is indicated.**
- **Disposable accessories must be disposed of in accordance with hospital regulations.**

F.1 ECG accessories

F.1.1 ECG electrodes

Model	Part No.	Description	Indicated patient
31499224	0010-10-12304	Kendall Electrode, 10 units/pack	Adults
2245 - 50	9000-10-07469	3M Electrode, 50 units/pack	Children
1050NPSMKittycat	0681-00-0098-01	NEO radiopaque pre-wired electrode	Newborn
1051NPSMKittycat	0681-00-0098-02	NEO radiotranslucent pre-wired electrode	Newborn
SF06	040-002711-00	Electrode, 5 units/pack	Adults
SF07	040-002833-00	Electrode, Intco	Children, newborns
H124SG	900E-10-04880	Electrode, Kendall, 50 units/pack	Newborn
EMG-SN10-20×20	040-003254-00	NEO radiotranslucent pre-wired electrode, AHA Newborn	
EMG-SN10-20×20	040-003255-00	NEO Radiotranslucent Prewired Electrode, IEC	Newborn
EMG-SN09-20×28	040-003251-00	NEO radiotranslucent pre-wired electrode, AHA Newborn	
EMG-SN09-20×28	040-003252-00	NEO Radiotranslucent Prewired Electrode, IEC	Newborn

F.1.2 12-pin detachable jumper wires

Model	Part No.	Description	Indicated patient
EV6201	0010-30-42719	ECG cable, 12-pin, 3/5-lead, defibrillation-proof, AHA/IEC	Adult, pediatric
EV6202	0010-30-42720	ECG cable, 12 pins, 3 leads, defibrillation proof, AHA/IEC.	Newborns, infants
EV6211	0010-30-42723	ECG cable, 12 pins, 3/5 leads, ESU proof, AHA/IEC.	Adult, pediatric
EV6212	0010-30-42724	ECG cable, 12 pins, 3 leads, ESU proof, AHA/IEC.	Newborns, infants
EV6222	040-000754-00	ECG cable, 12 pins, 3 leads, defibrillation proof, DIN connector	Newborn
EV6203	0010-30-42721	ECG cable, 12 leads, defibrillation-proof, AHA	Adults
EV6204	0010-30-42722	ECG cable, 12 leads, defibrillation-proof, IEC	Adults

F.1.3 Integrated 12-pin jumper wires

Model	Part No.	Description	Indicated patient
EA6251B	040-000961-00	ECG cables, 12 pins, 5 leads, AHA, clip	Adult, pediatric
EA6252B	040-000963-00	ECG cables, 12-pin, 5-lead, IEC, snap closure, Adult, Pediatric	
EA6251A	040-000960-00	ECG cables, 12 pins, 5 leads, AHA, clamp, Adult, pediatric	
EA6252A	040-000962-00	ECG cables, 12-pin, 5-lead, IEC, clamp	Adult, pediatric
EA6231B	040-000965-00	ECG cables, 12 pins, 3 leads, AHA, clip	Adult, pediatric
EA6232B	040-000967-00	ECG cables, 12-pin, 3-lead, IEC, snap closure, Adult, pediatric	
EA6231A	040-000964-00	ECG cables, 12 pins, 3 leads, AHA, clamp, Adult, pediatric	
EA6232A	040-000966-00	ECG cables, 12-pin, 3-lead, IEC, clamp	Adult, pediatric

F.1.4 3-lead ECG lead cables

Model	Part No.	Description	Length	Indicated patient
EL6302A	0010-30-42725	ECG lead cables, 3 leads, IEC, clamp	0.6 m	Adult, pediatric
EL6301A	0010-30-42726	ECG lead wires, 3 leads, AHA, clamp	0.6 m	Adult, pediatric
EL6307A	0010-30-42898	ECG lead wires, 3 leads, AHA, clamp	0.6 m	Children
EL6308A	0010-30-42899	ECG lead cables, 3 leads, IEC, clamp	0.6 m	Children
EL6305A	0010-30-42896	ECG lead wires, 3 leads, AHA, clamp, long	1 m	Newborns, infants
EL6306A	0010-30-42897	ECG lead wires, 3 leads, ICE, clamp, long	1 m	Newborns, infants
EL6303A	0010-30-42731	ECG lead wires, 3 leads, AHA, clamp, long	1 m	Adult, pediatric

Model	Part No.	Description	Length	Indicated patient
EL6304A	0010-30-42732	ECG lead wires, 3 leads, ICE, clamp, long	1 m	Adult, pediatric
EL6301B	0010-30-42734	ECG lead wires, 3 leads, AHA, clip, long	1 m	Adult, pediatric
EL6302B	0010-30-42733	ECG lead cables, 3 leads, IEC, clip, long	1 m	Adult, pediatric
EL6307B	0010-30-42900	ECG lead wires, 3 leads, AHA, clip	0.6 m	Children
EL6308B	0010-30-42901	ECG lead cables, 3 leads, IEC, clip	0.6 m	Children
EL6311B	040-000146-00	ECG lead wires, 3 leads, AHA, clip, long, disposable	1 m	Newborns, infants
EL6312B	040-000147-00	ECG lead wires, 3 leads, IEC, clip, long, disposable	1 m	Newborns, infants
EL6311A	040-000148-00	ECG lead wires, 3 leads, AHA, clip, long, disposable	1 m	Newborns, infants
EL6312A	040-000149-00	ECG lead wires, 3 leads, IEC, clip, long, disposable	1 m	Newborns, infants

F.1.5 5-lead ECG lead cables

Model	Part No.	Description	Length	Indicated patient
EL6503A	0010-30-42729	ECG lead wires, 5 leads, AHA, clamp, long	From 1 m to 1.4 m	Adult, pediatric
EL6504A	0010-30-42730	ECG lead cables, 5 leads, IEC, clamp, long	From 1 m to 1.4 m	Adult, pediatric
EL6502A	0010-30-42728	ECG lead cables, 5 leads, IEC, clamp	From 0.6m to 1m	Adult, pediatric
EL6501A	0010-30-42727	ECG lead wires, 5 leads, AHA, clamp	From 0.6m to 1m	Adult, pediatric
EL6501B	0010-30-42735	ECG cables, 5 leads, AHA, brooch	From 1 m to 1.4 m	Adult, pediatric
EL6502B	0010-30-42736	ECG lead cables, 5 leads, IEC, clip	From 1 m to 1.4 m	Adult, pediatric

F.1.6 12-lead ECG lead cables

Model	Part No.	Description	Length	Indicated patient
EL6801A	0010-30-42902	ECG lead wires, 12 leads, limb lead, AHA, clamp	From 0.78m to 0.98m	Adult, pediatric
EL6803A	0010-30-42904	ECG lead cables, 12 leads, precordial lead, AHA, clamp	0.58 m 0.78 m	Adult, pediatric
EL6802A	0010-30-42903	ECG lead cables, 12 leads, limb lead, IEC, clamp	From 0.78m to 0.98m	Adult, pediatric

Model	Part No.	Description	Length	Indicated patient
EL6804A	0010-30-42905	ECG lead cables, 12 leads, precordial lead, IEC, clamp	From 0.58m to 0.78m	Adult, pediatric
EL6801B	0010-30-42906	ECG lead wires, 12 leads, limb lead, AHA, clip	From 0.78m to 0.98m	Adult, pediatric
EL6803B	0010-30-42908	ECG lead wires, 12 leads, precordial lead, AHA, clip	From 0.58m to 0.78m	Adult, pediatric
EL6802B	0010-30-42907	ECG lead cables, 12 leads, limb lead, IEC, clip	From 0.78m to 0.98m	Adult, pediatric
EL6804B	0010-30-42909	ECG lead cables, 12 leads, precordial lead, IEC, clip	From 0.58m to 0.78m	Adult, pediatric

F.2 SpO2 Accessories

The wavelength emitted by the sensors is between 600 nm and 1000 nm. The maximum power consumption of the sensor is less than 18 mW.

Information on wavelength range and maximum photopower consumption can be especially useful for healthcare personnel, for example, when performing photodynamic therapies.

F.2.1 Extension cables

Model	Serial number	Description	Indicated patient
562 A	0010-20-42710	7-pin, Mindray	All
572A	0010-20-42712	8-pin, Nellcor	All
582A	040-000332-00	8 pins, Masimo	All
583A	040-005973-00	8-pin, Masimo (RD SET)	All

F.2.2 Mindray SpO2 Sensors

Model	Part No.	Description	Indicated patient	Application area
512F	512F-30-28263	Reusable SpO2 sensor	Adults	Finger of the hand
512H	512H-30-79061	Reusable SpO2 sensor	Children	Finger of the hand
512E	512E-30-90390	Reusable SpO2 sensor	Adults	Finger of the hand
512G	512G-30-90607	Reusable SpO2 sensor	Children	Finger of the hand
518B	518B-30-72107	Reusable SpO2 sensor	Adult, newborn	Foot
520 A	009-005087-00	Disposable SpO2 sensor	Adults	Finger of the hand
520P	009-005088-00	Disposable SpO2 sensor	Children	Finger of the hand
520I	009-005089-00	Disposable SpO2 sensor	Infant	Big toe

Model	Part No.	Description	Indicated patient Application area
520N	009-005090-00	Disposable SpO2 sensor	Newborn Foot
521 A	009-005091-00	Disposable SpO2 sensor	Adults Finger of the hand
521P	009-005092-00	Disposable SpO2 sensor	Children Finger of the hand
521I	009-005093-00	Disposable SpO2 sensor	Infant Big toe
521N	009-005094-00	Disposable SpO2 sensor	Newborn Foot
518C	040-000330-00	Reusable SpO2 sensor	Newborn Foot
518C	115-004895-00	Disposable tape, for sensor SpO2 518C	Newborn Foot
513 A	115-033848-00	Reusable SpO2 sensor	Adult, Pediatric Ear
512FLH	115-012807-00	Reusable SpO2 sensor	Adults Finger of the hand
518BLH	115-020887-00	Reusable SpO2 sensor	Newborn Foot
518BLH	115-050154-00	Reusable SpO2 sensor	Newborn Foot

F.2.3 Nellcor SpO2 Sensors

Model	Part No.	Description	Indicated patient	Zone of application
DS100A	9000-10-05161	Reusable SpO2 sensor	Adults	Finger of the hand
OXI-P/I	9000-10-07308	Reusable SpO2 sensor	Child, infant	Finger of the hand
OXI-A/N	9000-10-07336	Reusable SpO2 sensor	Adult, newborn Finger of the hand, foot	
MAXAI	0010-10-12202	Disposable SpO2 sensor	Adults (>30 kg)	Finger of the hand
MAXPI	0010-10-12203	Disposable SpO2 sensor	Children (10 to 50 kg) Finger of the hand	
MAXII	0010-10-12204	Disposable SpO2 sensor	Infant (3 to 20 Kg) Big toe	
MAXNI	0010-10-12205	Disposable SpO2 sensor	Newborn (<3 Kg), Adult (>40 Kg)	Foot Finger of the hand

F.2.4 Masimo SpO2 Sensors

Model	Part No.	Description	Indicated patient Application area
LNCS DCI	0010-10-42600	Reusable SpO2 sensor	Adults (>30 kg) Finger of the hand
LNCS DCIP	0010-10-42634	Reusable SpO2 sensor	Children (10 to 50 kg) Finger of the hand

F.3 PANI Accessories

F.3.1 PANI tubes

Model	Serial number	Description	Indicated patient
CM1903	6200-30-09688 115-012522-00	Reusable PANI tube (3 m)	All

F.3.2 Sleeves

Model	Serial number	Description	Limb circumference	Bladder width	Indicated patient
CM1200	115-002480-00	Reusable sleeve, 7cm to 13cm		3.8 cm	Young infant
CM1201	0010-30-12157	Reusable sleeve, 10cm to 19cm		7.2 cm	Infant
CM1202	0010-30-12158	Reusable sleeve, 18cm to 26cm		9.8 cm	Children
CM1203	0010-30-12159	Reusable sleeve, 24cm to 35cm		13.1 cm	Adults
CM1204	0010-30-12160	Reusable sleeve, from 33cm to 47cm		16.5 cm	Large adult
CM1205	0010-30-12161	Reusable sleeve, from 46cm to 66cm		20.5 cm	Adult thigh
CM1300	040-000968-00	Reusable sleeve, without inner tube	From 7cm to 13cm	3.8 cm	Young infant
CM1301	040-000973-00	Reusable sleeve, without inner tube	From 10cm to 19cm	7.2 cm	Infant
CM1302	040-000978-00	Reusable sleeve, without inner tube	From 18cm to 26cm	9.8 cm	Children
CM1303	040-000983-00	Reusable sleeve, without inner tube	From 24cm to 35cm	13.1 cm	Adults
CM1304	040-000988-00	Reusable sleeve, without inner tube	From 33cm to 47cm	16.5 cm	Large adult
CM1305	040-000993-00	Reusable sleeve, without inner tube	From 46cm to 66cm	20.5 cm	Adult thigh
CM1306	115-015930-00	Reusable sleeve, without inner tube	From 24cm to 35cm	13.1 cm	Adults
CM1307	115-015931-00	Reusable sleeve, without inner tube	From 33cm to 47cm	16.5 cm	Large adult
CM1501	001B-30-70697	Disposable PANI cuff, 10 units/box	From 10cm to 19cm	7.2 cm	Infant
CM1502	001B-30-70698	Disposable PANI cuff, 10 units/box	From 18cm to 26cm	9.8 cm	Children
CM1503	001B-30-70699	Disposable PANI cuff, 10 units/box	From 25cm to 35cm	13.1 cm	Adults

Model	Serial number	Description	Limb circumference	Bladder width	Indicated patient
CM1504	001B-30-70700	Disposable PANI cuff, 10 units/box	From 33cm to 47cm	16.5 cm	Adults
CM1505	001B-30-70701	Disposable PANI cuff, 10 units/box	From 46cm to 66cm	20.5 cm	Adult thigh
CM1506	115-016969-00	Disposable PANI cuff, 10 units/box	From 25cm to 35cm	13.1 cm	Adults
CM1507	115-016970-00	Disposable PANI cuff, 10 units/box	From 33cm to 47cm	16.5 cm	Adults
CM1500A	125-000051-00	Disposable PANI cuff, size 1, 20 units/box	From 3.1cm to 5.7cm	2.2 cm	Newborn
CM1500B	125-000052-00	Disposable PANI cuff, size 2, 20 units/box	From 4.3cm to 8.0cm	2.9 cm	Newborn
CM1500C	125-000053-00	Disposable PANI cuff, size 3, 20 units/box	From 5.8cm to 10.9cm	3.8 cm	Newborn
CM1500D	125-000054-00	Disposable PANI cuff, size 4, 20 units/box	From 7.1cm to 13.1cm	4.8 cm	Newborn
CM1500E	125-000055-00	Disposable PANI cuff, size 5, 20 units/box	From 8.0cm to 15.0cm	5.4 cm	Newborn
CM1500A	125-000046-00	Disposable PANI sleeve	From 3.1cm to 5.7cm	2.2 cm	Newborn
CM1500B	125-000047-00	Disposable PANI sleeve	From 4.3cm to 8.0cm	2.9 cm	Newborn
CM1500C	125-000048-00	Disposable PANI sleeve	From 5.8cm to 10.9cm	3.8 cm	Newborn
CM1500D	125-000049-00	Disposable PANI sleeve	From 7.1cm to 13.1cm	4.8 cm	Newborn
CM1500E	125-000050-00	Disposable PANI sleeve	From 8.0cm to 15.0cm	5.4 cm	Newborn
CM1501	001B-30-70682	Disposable PANI sleeve	From 10cm to 19cm	7.2 cm	Infant
CM1502	001B-30-70683	Disposable PANI sleeve	From 18cm to 26cm	9.8 cm	Children
CM1503	001B-30-70684	Disposable PANI sleeve	From 25cm to 35cm	13.1 cm	Adults
CM1504	001B-30-70685	Disposable PANI sleeve	From 33cm to 47cm	16.5 cm	Adults
CM1505	001B-30-70686	Disposable PANI sleeve	From 46cm to 66cm	20.5 cm	Adult thigh
CM1506	115-015940-00	Disposable PANI sleeve	From 25cm to 35cm	13.1 cm	Adults
CM1507	115-015941-00	Disposable PANI sleeve	From 33cm to 47cm	16.5 cm	Adults

F.4 CO2 Accessories

Model	Serial number	Description	Indicated patient
GA3501	045-003134-00	Reusable CO2 adapter	/
MVIIHL	040-006160-00	Airway sampling tube, disposable, long, humidified	Newborns, infants
MVAIHL	040-006161-00	Airway sampling tube, disposable, long, humidified	Adult, pediatric
MVAIL	040-006162-00	Airway sampling tube, disposable, humidified	Adult, pediatric
MVIIH	040-006163-00	Airway sampling tube, disposable, humidified	Newborns, infants
MVAIH	040-006164-00	Airway sampling tube, disposable, humidified	Adult, pediatric
MVAI	040-006165-00	Disposable airway sampling tube	Adult, pediatric
MVPN	040-006166-00	Disposable nasal sampling tube	Children
MVAN	040-006167-00	Disposable nasal sampling tube	Adults
MVANH	040-006168-00	Nasal sampling tube, disposable, humidified	Adults
MVA	040-006169-00	Disposable nasal sampling tube	Adults
MVP	040-006170-00	Disposable nasal sampling tube	Children
MVPNOH	040-006171-00	Disposable, humidified nasal sampling tube, plus O2	Children
MVAOL	040-006172-00	Disposable nasal sampling tube, long, plus O2 Adults	
MVAO	040-006173-00	Disposable nasal sampling tube, plus O2	Adults
MVANOH	040-006174-00	Disposable, humidified nasal sampling tube, plus O2	Adults
MVINH	040-006175-00	Nasal sampling tube, disposable, humidified	Newborns, infants
MVPO	040-006176-00	Disposable nasal sampling tube, plus O2	Children
MVPOL	040-006177-00	Disposable nasal sampling tube, long, plus O2 Children	

F.5 Therapy accessories

Model	Serial number	Description	Indicated patient
MR6601	125-000130-00	Reusable external shovels (for hospitals)	Adult, pediatric
MR6501	115-018366-00	Reusable internal paddles, 1 inch without button	Newborn
	125-000166-00	Reusable internal paddles, 1 inch with button	
MR6502	115-018367-00	Reusable internal paddles, 2 inches without button	Children
	125-000167-00	Reusable internal paddles, 2 inches with button	
MR6503	115-018368-00	Reusable internal paddles, 3 inches without button	Adults
	125-000168-00	Reusable internal paddles, 3 inches with button	
MR60	0651-30-77007	Disposable multifunction electrodes, 5 sets/ pack	Adults

Model	Serial number	Description	Indicated patient
MR61	0651-30-77008	Disposable multifunction electrodes, 5 sets/ pack	Children
MR62	115-035426-00	Disposable multifunction electrodes, 5 sets/ pack	Adults
MR63	115-035427-00	Disposable multifunction electrodes, 5 sets/ pack	Children
MR6701	115-006578-00	Reusable electrode cable with 50 y test load	Adult, pediatric
15 - 25	0000-10-10775	Reusable electrode gel	Adult, pediatric
MR6311	125-000255-00	Reusable carrying case	All

F.6 Other accessories

Serial number	Description
115-084255-00	Easy assembly
0010-30-12471	DC/AC Converter
115-084253-00	Transport coupling
0651-20-77122	Analog output cable
0651-20-77046	Synchronous defibrillation input cable
115-067930-00	4G Wi-Fi router kit
115-084254-00	Charger
115-039575-00	Barcode reader
A30-000001---	Register paper, 50 mm×20 m
022-000550-00	Rechargeable lithium-ion battery
040-000413-00	Burden of proof

This page has been intentionally left blank.

G Electrical safety inspection

The following electrical safety tests are recommended as part of a comprehensive preventive maintenance program. They are a proven method for detecting anomalies that, if left undetected, could pose a risk to the patient or operator. Additional testing may be required depending on local regulations.

All tests can be performed using commercially available safety analyzers. To carry out these procedures, use the 601PROXL International Safety Analyzer or an equivalent. In some cases, modifications may be required to other commonly used analyzers in Europe that are compliant with IEC 60601-1 (such as those from Fluke, Metron, or Gerb). Follow the analyzer manufacturer's instructions.

Electrical safety inspections should be performed annually. A safety analyzer is also an excellent tool for troubleshooting issues related to line voltage anomalies, grounding, and total current load.

G.1 Power cord plug

Evidence item		Acceptance criteria
Power plug	Power plug pins	There are no broken or bent pins. There are no discolored pins.
	Plug insulator	The plug casing shows no physical damage.
	cable grommet ring	The ring shows no physical damage. The device does not appear to heat up during use.
	Power plug. There is no loose connection.	
Power cable		The cable shows no physical damage. The cable shows no deterioration.
		For devices with detachable power cords, inspect the device connection.
		For devices with fixed power cords, inspect the cable gland ring on the device.

G.2 Device casing and accessories

G.2.1 Visual inspection

Evidence item	Acceptance criteria
Case and accessories	Neither the casing nor the accessories show any physical damage.
	No physical damage is apparent on the meters, switches, connectors, etc.
	There is no residue of spilled liquids (such as water, coffee, chemicals, etc.).
	No parts are missing or loose (such as controls, dials, terminals, etc.).

G.2.2 Environmental inspection

Evidence item	Acceptance criteria
Case and accessories	No unusual noises are heard (such as a rattling inside the casing).
	No strange smell is perceived (such as a burning smell, especially coming from the ventilation holes).
	No note has been posted suggesting that the device has faults or that the operator has doubts about its operation.

G.3 Device labels

Check that the labels supplied by the manufacturer or sanitary facilities are in place and easily readable.

y Main unit label

y Built-in warning labels

G.4 Protective earth resistance

1. Connect the analyzer probes to the device's ground terminal and to the ground terminal.
   AC power cord ground.

2. Test the grounding resistance with a current of 25 A.

3. Check that the resistance is below the established limits.

BOUNDARIES

For all countries: R = 0.2 y maximum

G.5 Ground fault test

Perform the ground leakage test on the device before performing any other leakage tests.

The following conditions apply to the sockets in the earth leakage test:

y Normal polarity (normal state)

y Reverse polarity (normal state)

y Normal polarity with open neutral (single fault state)

y Reverse polarity with open neutral (single fault state)

BOUNDARIES

According to UL60601-1:

- 300 yA in normal state
- 1,000 yA in single fault state

According to IEC60601-1:

- 500 yA in normal state
- 1,000 yA in single fault state

G.6 Leakage current to the patient

Patient leakage currents are measured between a specific applied component and the mains ground. All measurements are true RMS only.

The following conditions apply to the connections in the patient leakage current test:

y Normal polarity (normal state)

y Reverse polarity (normal state)

y Normal polarity with open neutral (single fault state)

y Reverse polarity with open neutral (single fault state)

y Normal polarity with open ground (single fault state)

y Reverse polarity with open ground (single fault state)

BOUNDARIES

For CF type applied parts 

- 10 yA in normal state
- 50 yA in single fault state

For applied parts of type BF 

- 100 yA in normal state
- 500 yA in single fault state

G.7 Network leak to applied part

The mains leakage test to a specific component applies a test voltage, corresponding to 110% of the mains voltage, to the terminals of a particular component via a limiting resistor. Current measurements are then taken between the component and ground. These measurements are performed with the test voltage (110% of the mains voltage) applied to the components in both normal and reverse polarity states.

The following conditions apply to the taps in the applied part network leakage test:

y Normal polarity

y Reverse polarity

BOUNDARIES

y In the case of applied CF type parts  : 50 yA

y In the case of applied parts of type BF  : 5,000 yA

G.8 Auxiliary current to the patient

The auxiliary currents to the patient are measured between one connector of a specific applied device and the other connectors of that device. It is possible that all measurements will have only one true RMS response.

The following conditions apply to the connections in the auxiliary current test to the patient:

y Normal polarity (normal state)

y Reverse polarity (normal state)

y Normal polarity with open neutral (single fault state)

y Reverse polarity with open neutral (single fault state)

y Normal polarity with open ground (single fault state)

y Reverse polarity with open ground (single fault state)

BOUNDARIES

For CF type applied parts  :

- 10 yA in normal state
- 50 yA in single fault state

For applied parts of type BF  :

- 100 yA in normal state
- 500 yA in single fault state

NOTE

- **Ensure that the safety analyzer is certified and meets the requirements of IEC60601-1.**
- **Follow the analyzer manufacturer's instructions.**

This page has been intentionally left blank.

H Abbreviations

Abbreviation	Full name
°C	centigrade
°F	Fahrenheit
yA	microampere
yV	microvolt
ys	microseconds
y	ohm
TO	amp
AC	AC
Adu	adults
DEA	Semi-automatic external defibrillation
AHA	American Heart Association
Ao	aortic pressure
Art	arterial
aVF	increased left foot shunt
AVL	augmented left arm shunt
aVR	augmented right arm shunt
FRVa	respiratory rate of the airways
BAP	brachial blood pressure
PS	blood pressure
lpm	beats per minute
bps	bits per second
BPSK	binary phase-shift transmission
BTPS	saturated body pressure and temperature
CAA	clinical assistance application
EC	European conformity
CISPR	International Special Committee of Radioelectric Pertubations (Committee International Special on Radio Interference)
CMS	central monitoring system
CO2	carbon dioxide
COHb	carboxyhemoglobin
COPD	chronic obstructive pulmonary disease
CPR	Cardiopulmonary resuscitation
CPR Quality Index	CPR quality index
PVC	central venous pressure
dB	decibel

Abbreviation	Full name
DC	direct current
Defib.	defibrillation
Des	desflurane
Days	diastolic
ppp	dots per inch
DVI	digital video interface
ECG	electrocardiogram
EEC	European Economic Community
EMC	electromagnetic compatibility
EMG	electromyography
IEM	electromagnetic interference
Nurse	enflurane
ESU	electrosurgical unit
And	end of expiration
EtCO2	carbon dioxide at the end of exhalation
PAF	femoral artery pressure
FCC	Federal Communication Commission
FiCO2	fraction of inspired carbon dioxide
g	gram
GCS	Glasgow Coma Scale
GHz	gigahertz
h	hour
Hal	halothane
HIS	Hospital Information System
FC	heart rate
Hz	hertz
I:E	inspiration/expiration ratio
BCIA	intra-aortic balloon pump
PAI	invasive blood pressure
PIC	intracranial pressure
ID	ID
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronic Engineers (Institute of Electrical and Electronic Engineers) Electrical and Electronic)
in	inch
IP	Internet protocol
ISO	isoflurane
J	July
k	kilo

Abbreviation	Full name
kg	kilogram
kPa	kilopascal
L	liter
THE	left arm
PRAI	left atrial pressure
lb	pound
LCD	Liquid Crystal Display
LED	light emitting diode
LL	left leg
m	metro
CAM	minimum alveolar concentration
PAM	mean arterial pressure
mAh	milliampere-hours
Mb	megabyte
MetHb	methemoglobin
MEWS	Modified Early Warning Score
min	minute
ml	milliliter
mm	millimeter
mmHg	millimeters of mercury
ms	millisecond
mV	millivolt
MRI	magnetic resonance imaging
N/A	not applicable
N2O	nitrous oxide
Neo	newborn
PANI	non-invasive blood pressure
O2	oxygen
AP	pulmonary artery
Ped	children
Plet	plethysmogram
MNC	pacemaker not captured
MNF	unmeasured pacemaker
FP	pulse rate
CVP	premature ventricular complex
R	right
AR	right arm
PAD	right atrial pressure
Resp	breathing

Abbreviation	Full name
RL	right leg
FR	respiratory rate
rpm	breaths per minute
s	second
Sev	sevoflurane
ES	systolic index
SpO2	arterial oxygen saturation pulse oximetry
ICS	signal quality index
MR	percentage of suppression
Sync.	synchronization
System	Systolic pressure
TB	blood temperature
TBI	Traumatic brain injury
TD	temperature difference
Temp	temperature
UAP	umbilical blood pressure
USB	universal series bus
UVP	umbilical venous pressure
V	volt
VCA	alternating current volts

Yo

Declaration of conformity

Declaration of Conformity V1.0

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:	Defibrillator/Monitor
Model:	BeneHeart D30/BeneHeart D20/BeneHeart D20A/BeneHeart D20C/BeneHeart D60/BeneHeart D50/ BeneHeart D50A/BeneHeart D50C/BeneHeart DX/ BeneHeart DM

We herewith declare 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	☒ ETSI EN 301 489-1 V2.2.3
☒ ETSI EN 301 489-3 V2.2.0	☒ ETSI EN 301 489-17 V3.1.1
☒ ETSI EN301 489-19V2.1.1	☒ ETSI EN301 489-52V1.1.0
☒ ETSI EN301 908-1 V13.1.1	☒ ETSI EN 301 908-2 V13.1.1
☒ ETSI EN 301 908-13 V13.1.1	☒ EN301 908-25 V15.1.1_15.0.2
☒ ETSI EN 301 893 V2.1.1	☒ ETSI EN301 511 V12.5.1
☒ EN 300 330V2.1.1	☒ ETSI EN303 413 V1.1.1
☒ ETSI EN 300 328 V2.2.2	/

Place, Date of Issue: Shenzhen, 2023.1.1

Signature:

Name of Authorized Signatory: Wang Xinbing

Position Held in Company: Deputy director, Technical Regulation

This page has been intentionally left blank.

P/N: 046-026182-00(1.0)