BeneView T5/T5 OR
BeneView T8
BeneView T9/T9 OR

Patient Monitor

Operator’s Manual

CE 0123

For this Operator's Manual, the issue date is 2019-1.

⚠ WARNING

- **Federal Law (USA) restricts this device to sale by or on the order of a physician.**

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- the product is used in accordance with the instructions for use.

⚠ WARNING

- **This equipment must be operated by skilled/trained clinical professionals.**
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Preface

Manual Purpose

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

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

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

Intended Audience

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

Illustrations

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

Conventions

- ***Italic text*** is used in this manual to quote the referenced chapters or sections.
- [ ] is used to enclose screen texts.
- → is used to indicate operational procedures.

Contents

FOR YOUR NOTES

1 Safety

1.1 Safety Information

⚠ WARNING

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

⚠ CAUTION

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

NOTE

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

1.1.1 Warnings

⚠ WARNINGS

- **This equipment is used to one patient at a time.**
- **Before putting the system into operation, the operator must verify that the equipment, connecting cables and accessories are in correct working order and operating condition.**
- **To avoid risk of electric shock, this equipment must only be connected to a supply mains with protective earth. If the installation does not provide for a protective earth conductor, disconnect it from the power line and operate it on battery power, if possible.**
- **Ensure that the patient monitor is supplied with continuous electric power during work. Sudden power failure may lead to data loss. To avoid explosion hazard, do not use the equipment in the presence of oxygen-rich atmospheres, flammable anesthetics, or other flammable agents (such as gasoline).**
- **Use and store the equipment in specified environmental condition. The monitor and accessesories may not meet the performance specification due to aging, stored or used outside the specified temperature and humidity range.**
- **Do not open the equipment housings. All servicing and future upgrades must be carried out by the personnel trained and authorized by our company only.**
- **Do not come into contact with patients during defibrillation. Otherwise serious injury or death could result.**
- **Do not rely exclusively on the audible alarm system for patient monitoring. Adjustment of alarm volume to a low level or off may result in a hazard to the patient. Remember that alarm settings should be customized according to different patient situations and always keeping the patient under close surveillance is the most reliable way for safe patient monitoring.**
- **The physiological data and alarm messages displayed on the equipment are for reference only and cannot be directly used for diagnostic interpretation.**
- **To avoid inadvertent disconnection, route all cables in a way to prevent a stumbling hazard. Wrap and secure excess cabling to reduce risk of entanglement or strangulation by patients or personnel.**
- **When disposing of the package material, be sure to observe the applicable waste control regulations and keep it out of children's reach.**
- **Do not touch the equipment's metal parts or connectors when in contact with the patient; otherwise patient injury may result.**
- **Never mix patient electrode types or brands. Dissimilar metals or other incompatibilities may cause considerable baseline drift and may increase trace recovery time after defibrillation.**

1.1.2 Cautions

⚠ CAUTIONS

- **To ensure patient safety, use only parts and accessories specified in this manual.**
- **At the end of its service life, the equipment, as well as its accessories, must be disposed of in compliance with the guidelines regulating the disposal of such products. If you have any questions concerning disposal of the equipment, please contact us.**
- **Magnetic and electrical fields are capable of interfering with the proper performance of the equipment. For this reason make sure that all external devices operated in the vicinity of the equipment comply with the relevant EMC requirements. Mobile phone, X-ray equipment or MRI devices are a possible source of interference as they may emit higher levels of electromagnetic radiation.**
- **Before connecting the equipment to the power line, check that the voltage and frequency ratings of the power line are the same as those indicated on the equipment's label or in this manual.**
- **Always install or carry the equipment properly to avoid damage caused by drop, impact, strong vibration or other mechanical force.**
- **Dry the equipment immediately in case of rain or water spray.**

1.1.3 Notes

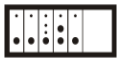
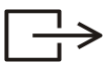
NOTES

- **Put the equipment in a location where you can easily view and operate the equipment.**
- **The equipment use a mains plug as isolation means to the mains power supply. Do not locate the equipment in a place difficult to operate the mains plug.**
- **In normal use, the operator shall stand in front of the equipment.**
- **Keep this manual in the vicinity of the equipment so that it can be obtained conveniently when needed.**
- **The software was developed in compliance with IEC60601-1-4. The possibility of hazards arising from software errors is minimized.**
- **This manual describes all features and options. Your equipment may not have all of them.**

1.2 Equipment Symbols

NOTE

- **Some symbols may not appear on your equipment.**

	Caution		Refer to instruction manual/booklet
	Power ON/OFF (for a part of the equipment)		Battery indicator
	Alternating current		ALARM PAUSED
	Alarm Reset		Graphical record
	Freeze/unfreeze waveforms		Main menu
	NIBP start/stop key		Connector for satellite module rack
	Equipotentiality		Video output
	USB connector		Network connector
	iView network connector		Output
	Defibrillator		Zero key
	Check sensor		Calibrate key
	Measure/standby		Inserted direction
	Gas outlet		Serial number
	CIS connector		DATE OF MANUAFACTURE
	General warning sign		
	The product bears CE mark indicating its conformity with the provisions of the Council Directive 93/42/EEC concerning medical devices and fulfils the essential requirements of Annex I of this directive. Note: The product complies with the Council Directive 2011/65/EU.		
	AUTHORISED REPRESENTATIVE IN THE EUROPEAN COMMUNITY		

	Non-ionizing electromagnetic radiation
	DEFIBRILLATION-PROOF TYPE CF APPLIED PART
	DEFIBRILLATION-PROOF TYPE BF APPLIED PART
	The following definition of the WEEE label applies to EU member states only. This symbol indicates that this product should not be treated as household waste. By ensuring that this product is disposed of correctly, you will help prevent bringing potential negative consequences to the environment and human health. For more detailed information with regard to returning and recycling this product, please consult the distributor from whom you purchased it. * For system products, this label may be attached to the main unit only.

FOR YOUR NOTES

2 The Basics

2.1 Monitor Description

2.1.1 Intended Use

This patient monitor is intended to be used for monitoring, displaying, reviewing, storing and transferring of multiple physiological parameters including ECG, heart rate (HR), respiration (Resp), temperature (Temp), pulse oxygen saturation (SpO_2), pulse rate (PR), non-invasive blood pressure (NIBP), invasive blood pressure (IBP), cardiac output (C.O.), carbon dioxide (CO_2), oxygen (O_2), anesthetic gas (AG), impedance cardiograph (ICG), bispectral index (BIS), respiration mechanics (RM), continuous cardiac output(PiCCO), central venous oxygen saturation($ScvO_2$), electroencephalograph (EEG), and neuromuscular transmission (NMT).

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

⚠ WARNING

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

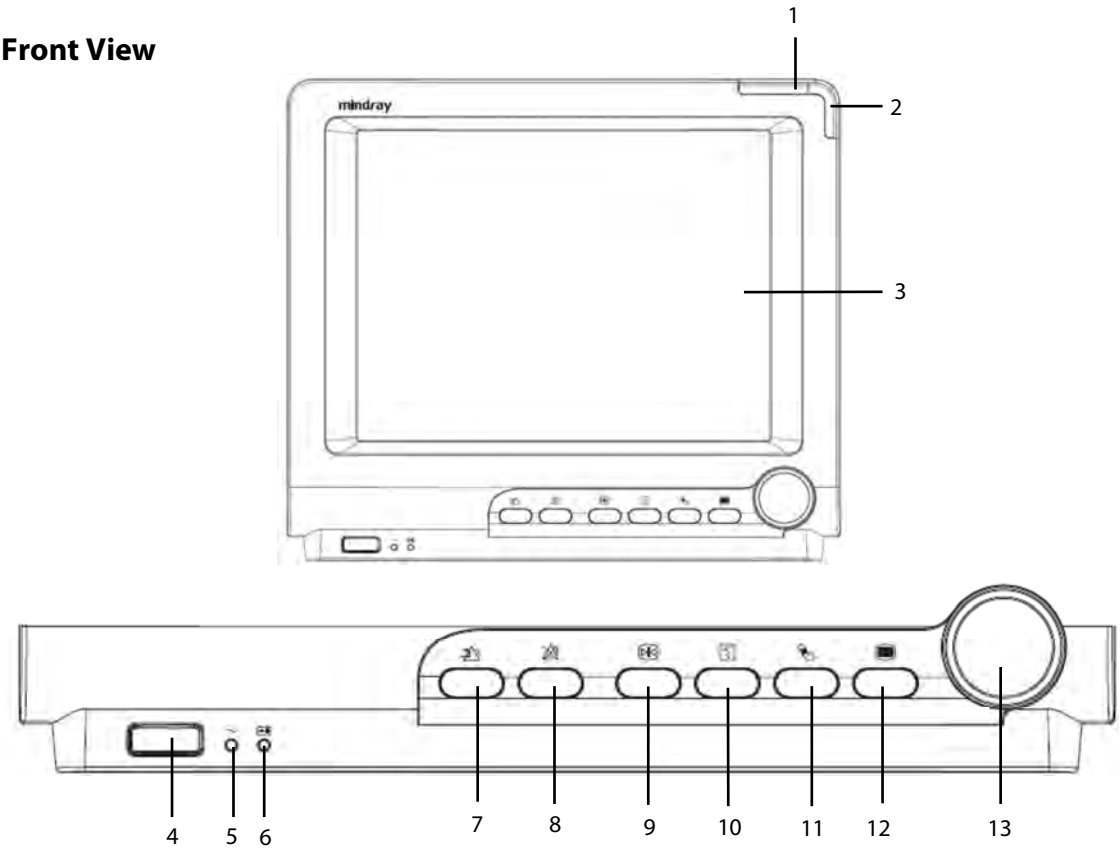
2.1.2 Applied Parts

The applied parts of the BeneView series patient monitors are:

- ECG electrodes and leadwires,
- SpO_2 sensor
- NIBP cuff
- Temp probes
- IBP/ICP transducer,
- C.O. sensor
- CO_2 sampling line/Nasal sampling cannula, water trap, airway adapter, mainstream sensor, and mask
- AG sampling line, water trap, and airway adapter
- ICG leadwire and electrodes
- BIS sensor
- RM sensor
- $ScvO_2$ sensor

2.2 Main Unit

2.2.1 Front View



1. Alarm lamp

   When a physiological alarm or technical alarm occurs, this lamp will flash as defined below.

   - High level alarms: the lamp quickly flashes red.
   - Medium level alarms: the lamp slowly flashes yellow.
   - Low level physiological alarms: the lamp lights yellow without flashing.
   - Low level technical alarms: the lamp does not light.

2. Technical alarm lamp

   This lamp will light blue when a technical alarm occurs.

3. Display Screen

4. Power On/Off Switch

   Press this switch to turn the patient monitor on. Press it again and hold for 2 seconds to turn the patient monitor off. An indicator is built in this switch. It turns on when the patient monitor is on and turns off when the patient monitor is off.

5. AC power LED

   It turns on when AC power is connected.

6. Battery LED

   - On: when at least a battery is installed to BeneView T5 monitor and the AC source is connected; when two batteries are installed to BeneView T8 or BeneView T9 monitor and the AC source is connected.
   - Off: when no battery is installed, only one battery is installed to the BeneView T8 or BeneView T9 monitor, the installed battery is malfunction, or no AC source is connected when the patient monitor is power off.

- Flash: when the patient monitor operates on battery power.

7. Press to reset the alarm system.
8. Press to pause or restore alarms.
9. Press to freeze or unfreeze waveforms.
10. Press to start or stop recordings.
11. Press to start or stop NIBP measurements.
12.

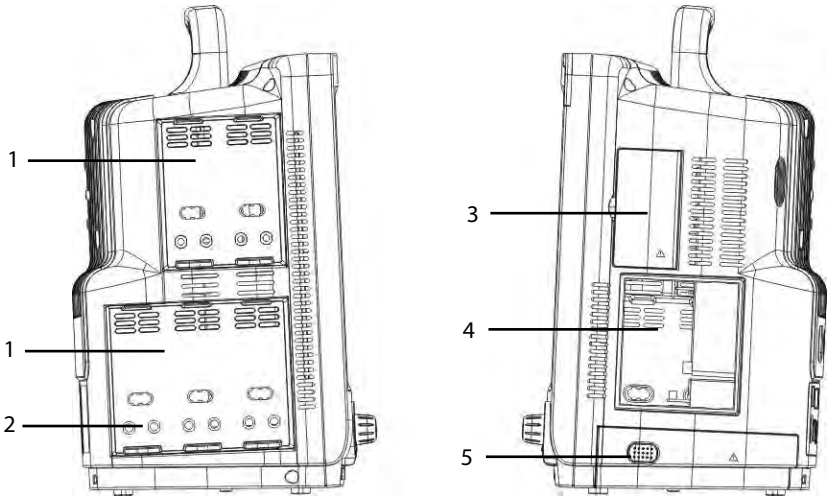
    If no menu is displayed on the screen, pressing it will enter the main menu. If there is a menu displayed on the screen, pressing it will close that menu.

13. Knob

    Rotate the Knob clockwise or anti-clockwise. With each click, the highlight jumps to the neighboring item. When you reach your desired item, press the Knob to select it.

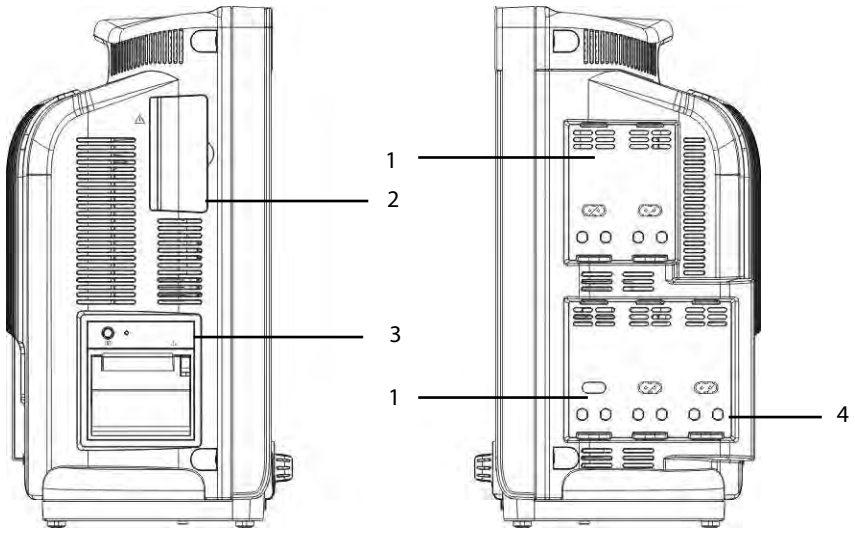
2.2.2 Side View

BeneView T5



1. Integral Module Racks
2. Contact
3. Compartment for CF storage card slot
4. Recorder
5. Battery compartment

BeneView T8/BeneView T9



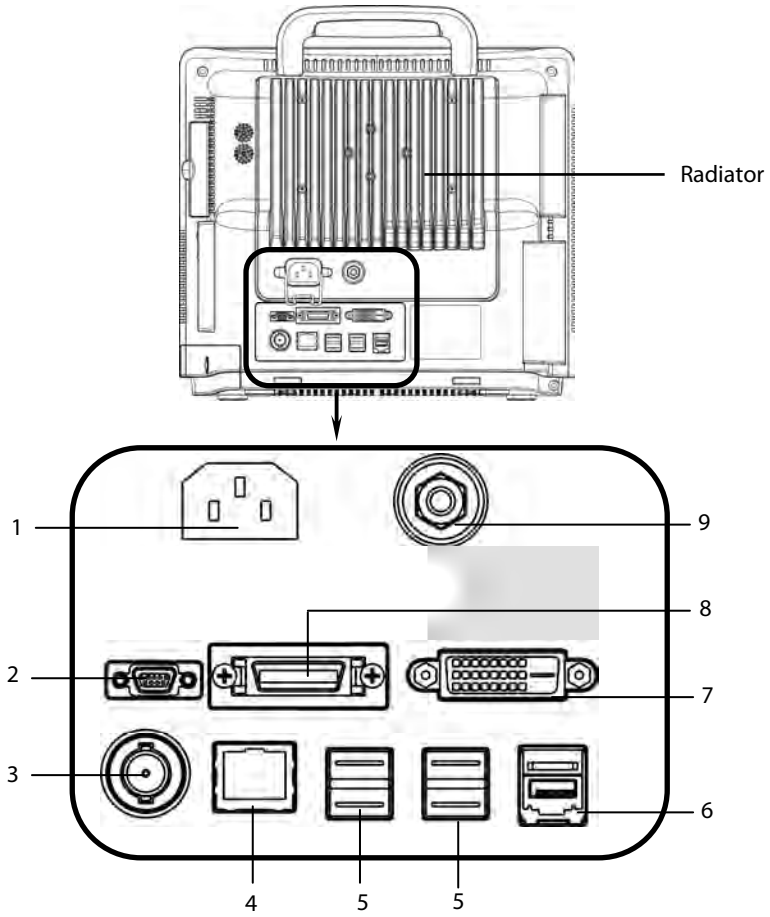
1. Integral Module Racks
2. Compartment for CF storage card slot
3. Recorder
4. Contact

NOTE

- **To ensure a good contact, clean the contacts regularly, as dust and dirt may collect on them. When cleaning the contacts, wipe them with cotton, dampened with alcohol. (using forceps is recommended)**

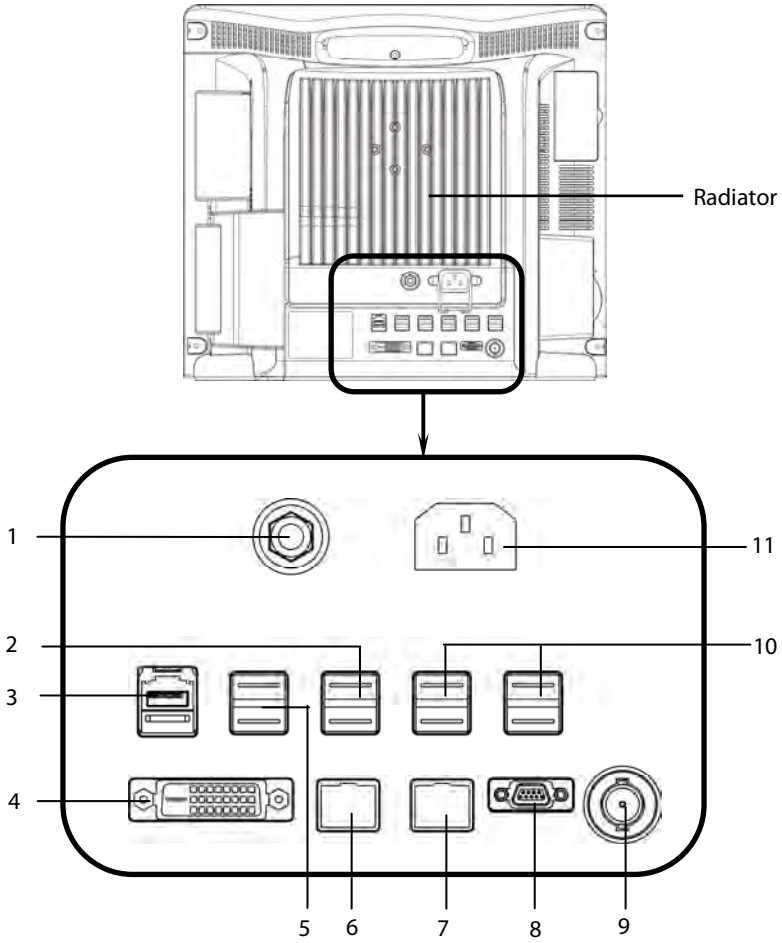
2.2.3 Rear View

BeneView T5



1. AC Power Input
2. Micro-D Connector: It outputs ECG, IBP and defibrillator synchronization signals simultaneously, among which the ECG signals supports pace pulses to be enhanced.
3. Nurse Call Connector: It connects the patient monitor to the hospital's nurse call system through the nurse call cable (***PN: 8000-21-10361***). Alarms indications are alerted to nurses through the nurse call system, if configured to do so.
4. Network Connector: It is a standard RJ45 connector that connects the patient monitor to the other devices such as CMS or network printer through the LAN.
5. USB Connectors: They connect such devices as the USB mice, USB keyboard, barcode scanner, etc.
6. SMR Connector: It connects the satellite module rack (SMR).
7. Digital Video Interface (DVI): It connects a secondary display, which extends the display capability of your monitor. The contents displayed on the secondary display screen accords with those displayed on the monitor screen.
8. CIS Box Connector: It is used to connect the hospital's clinical information system (CIS).
9. Equipotential Grounding Terminal: When using the monitor together with other devices, connect their equipotential grounding terminals together to eliminate the potential differences between them.

BeneView T8/BeneView T9



1. Equipotential Grounding Terminal: When the patient monitor and other devices are to be used together, their equipotential grounding terminals should be connected together, eliminating the potential difference between them.
2. iView USB Connectors: They are used for iView maintenance and data transfer. They can be also connected to the USB mouse and USB keyboard for the iView system. If a secondary display is connected to the monitor:

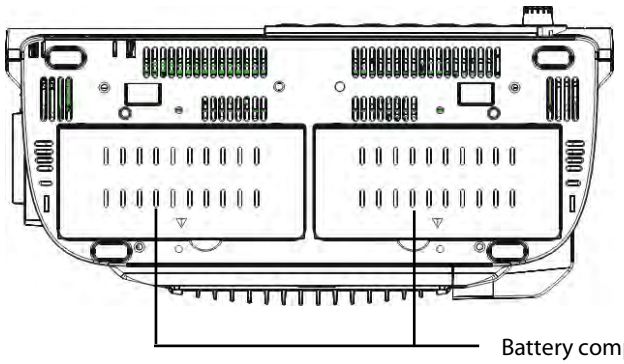
◆ When the iView window is open, the mouse is for both the iView window and screen where the iView window locates; the keyboard is only for the iView window.

◆ When the iView window is closed, the mouse and keyboard can be used for either the monitor or secondary display. You can configure the mouse and keyboard by selecting [**Main Menu**]→[**Screen Setup**]→[**Use iView Mouse&Key on Monitor**] or [**Use iView Mouse&Key on Sec Display**].

3. SMR Connector: It connects the satellite module rack (SMR).
4. Digital Video Interface (DVI): It connects a secondary display, which extends the display capability of your monitor. The secondary display can be independently operated and controlled, and also display the contents different from the monitor screen.
5. USB Connectors: They connect the controlling devices (USB mouse and USB keyboard) of the secondary display.
6. iView Network Connector: It is a standard RJ45 connector that connects the iView system to external network.
7. Network Connector: It is a standard RJ45 connector that connects the patient monitor to the other devices such as CMS or network printer through the LAN.
8. Micro-D Connector: It outputs ECG, IBP and defibrillator synchronization signals simultaneously, among which the ECG signals supports pace pulses to be enhanced.

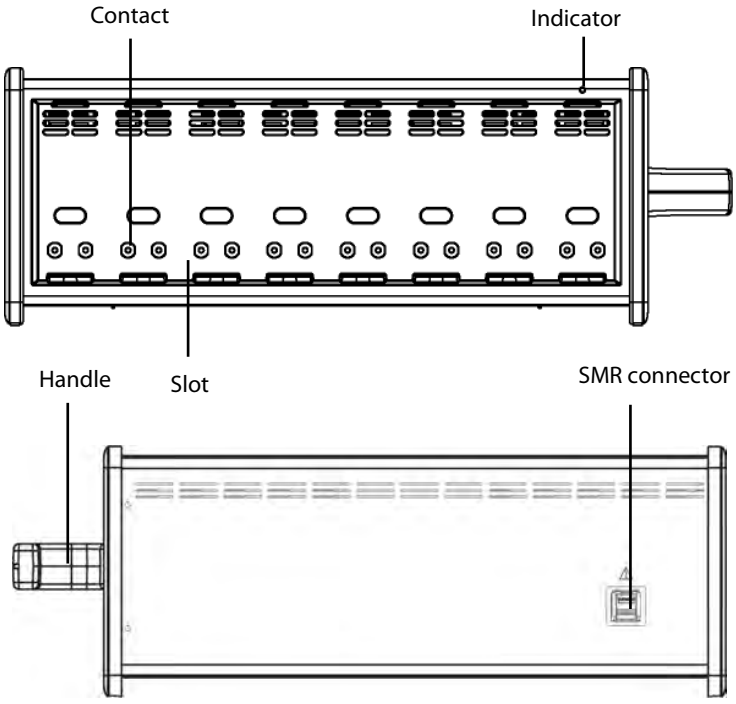
9. Nurse Call Connector: It connects the patient monitor to the hospital's nurse call system through the nurse call cable (***PN: 8000-21-10361***). Alarms indications are alerted to nurses through the nurse call system, if configured to do so.
10. USB Connectors: They connect such devices as the USB mouse, USB keyboard, barcode scanner, etc.
11. AC Power Input

2.2.4 Bottom View（BeneView T8/BeneView T9）



2.3 Satellite Module Rack

The Satellite Module Rack (SMR) provides 8 slots for mounting measurement modules. The number of modules mounted in the SMR depends, as different modules may need different slots.



As shown in the figure above, there is an indicator telling the status of the SMR:

- On: when the SMR works normally.
- Off: when the SMR disconnects from the patient monitor, there is a problem with the power, or the patient monitor shuts down.

The SMR can be connected to the patient monitor through their SMR connectors via a SMR cable.

NOTE

- **To ensure a good contact, clean the contacts regularly, as dust and dirt may collect on them. When cleaning the contacts, wipe them with cotton, dampened with alcohol. (using forceps is recommended)**

2.4 Modules

As shown below, the patient monitor supports the following modules:

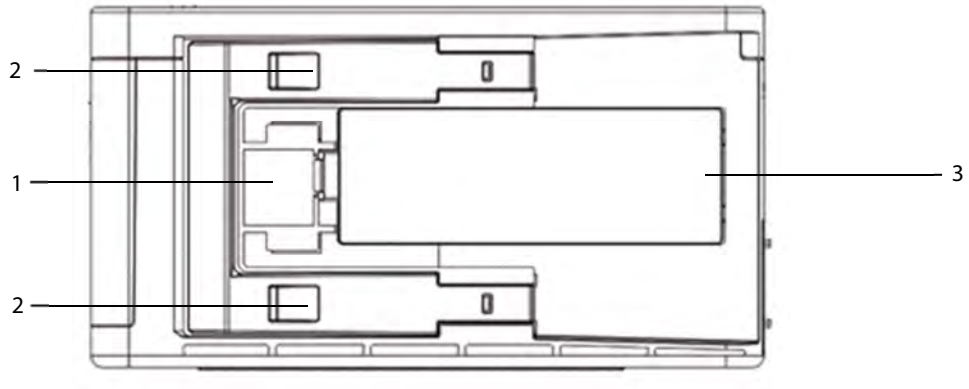
- BeneView T1: Used as a multi-measurement module for monitoring ECG, respiration, SpO_2, temperature, NIBP and IBP.
- MPM: Multi-parameter module. It can simultaneously monitor ECG, respiration, SpO_2, temperature, NIBP and IBP.
- IBP module: Invasive blood pressure module.
- PiCCO module : PiCCO module, used to measure cardiac output continuously.
- C.O. module: Cardiac output module.
- CCO/SvO_2 module: CCO/SvO_2 interface module, used to interface with Edwards Vigilance II® or Vigileo™ monitor.
- NMT module: Neuromuscular transmission module.
- SpO_2 module: Pulse oxygen saturation module.
- Temp module: Temperature module.
- BIS module: Bispectral index module.
- RM module: Respiration mechanics module.
- AG module: Anaesthesia gas module. The functions of the O_2 and BIS modules can be incorporated into it.
- CO_2 module: Carbon dioxide module (including sidestream, microstream and mainstream).
- $ScvO_2$ module: Central venous oxygen saturation module.
- EEG module: Electroencephalograph module.
- ICG module: Impedance cardiography module.
- BeneLink module: BeneLink module is used for transmitting information from a connected external device to the BeneView patient monitor.

Under the maximum configuration, the patient monitor has one two-slot module rack, one three-slot module rack and one satellite module rack. The number of modules mounted in the patient monitor depends, as different modules may need different slots.

2.4.1 Inserting or removing modules

You can insert or remove modules during patient monitoring.

Inserting or removing the T1



1. Latch: locks the T1 when it is in use with the monitor. Lifting the latch releases the T1 so that you can remove the T1 from the monitor.
2. Clip: locks the T1 when it is in use with the monitor.
3. Battery door

Follows these instructions to insert or remove the T1:

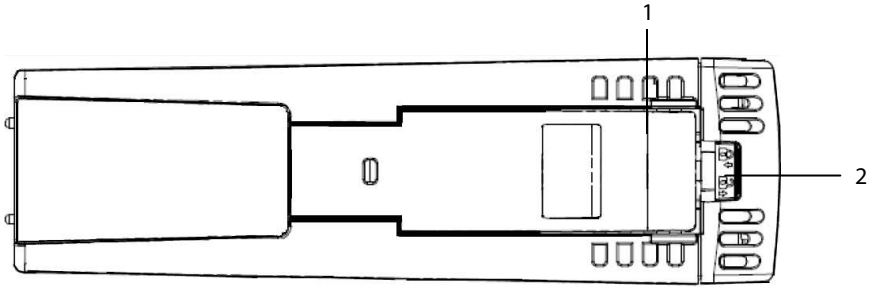
- To insert the T1 to the monitor's module rack or satellite module rack, firmly push the T1 until you hear that the clip engages the module rack. To ensure that the T1 is properly connected, try to pull the T1 outward. The T1 properly engages the module rack if you cannot pull it out.
- To remove the T1 from the monitor, lift the latch at the bottom of the T1 and pull it out.

CAUTION

- **To prevent the T1 from falling off, after inserting the T1 into the module rack, always check that the T1 properly engages the module rack.**

Inserting or removing other modules

The figure below shows the bottom view of one-slot modules:



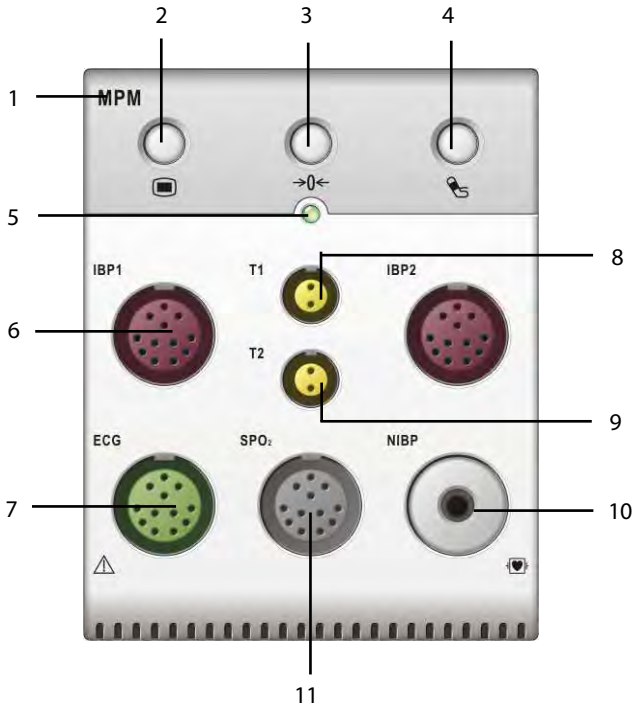
1. Latch: locks a module when the module is in use with the monitor.
2. Lock: locks a module when the module is in use with the monitor.

- To insert a module to the monitor's module rack or satellite module rack, push the module until the latch on the module clicks into place and then push the lock key at the bottom in position to lock the module.
- To remove a module, release the lock, lift the latch and pull the module out.

Make sure that the indicator on the module is on after the module is plugged in. Otherwise, re-insert the module properly until the indicator light is on.

2.4.2 Multi-Parameter Module

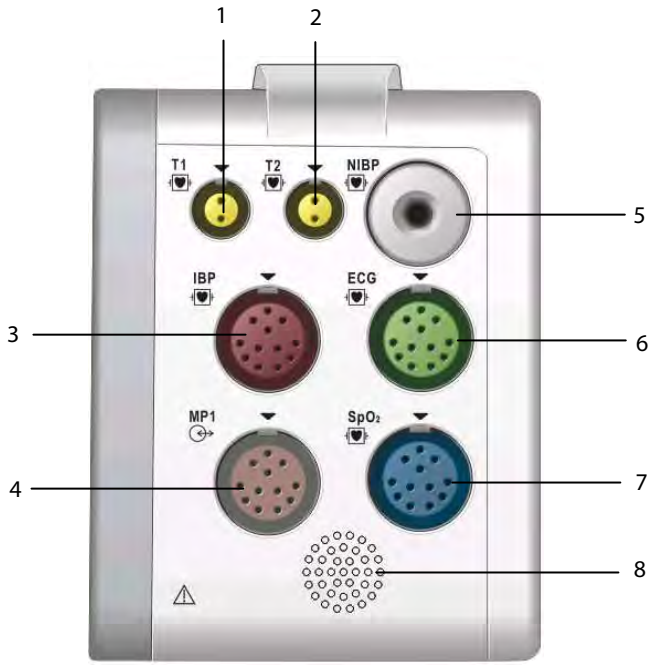
The multi-parameter module (MPM) incorporates multiple measurement modules. As shown below, the module name is located at the upper left corner, all hardkeys on the upper part, and all measurement connectors on the lower part. Other measurement modules look similar to the MPM.



1. Module name
2. Setup key: press to enter the [**MPM Setup**] menu.
3. Zero key: press to enter the [**Zero IBP**] menu.
4. NIBP start/stop key: press to start or stop NIBP measurements.
5. Indicator
   - On: when the patient monitor works correctly.
   - Flash: when the module is being initialized.
   - Off: when the module is either unconnected or broken.
6. Connector for IBP cable
7. Connector for ECG cable
8. Connector for Temp probe 1
9. Connector for Temp probe 2
10. Connector for NIBP Cuff
11. Connector for SpO_2 cable

2.4.3 BeneView T1

BeneView T1 can be connected to T5, T8 or T9 either through the module rack or through the T1 dock. It is used as a multi-measurement module of T5, T8 or T9.



1. Connector for Temp probe 1
2. Connector for Temp probe 2
3. Connector for IBP cable
4. Multifunctional connector, connecting external parameter module and outputting analog and defib synchronization signal.
5. Connector for NIBP cuff
6. Connector for ECG cable
7. Connector for SpO_2 cable
8. Speaker

When the T1 is connected to the T5, T8 or T9 monitor through the T1 dock, some functions, including setting alarms, parameters, patient information, and etc, can be achieved by operating either the T1 or T5/T8/T9.

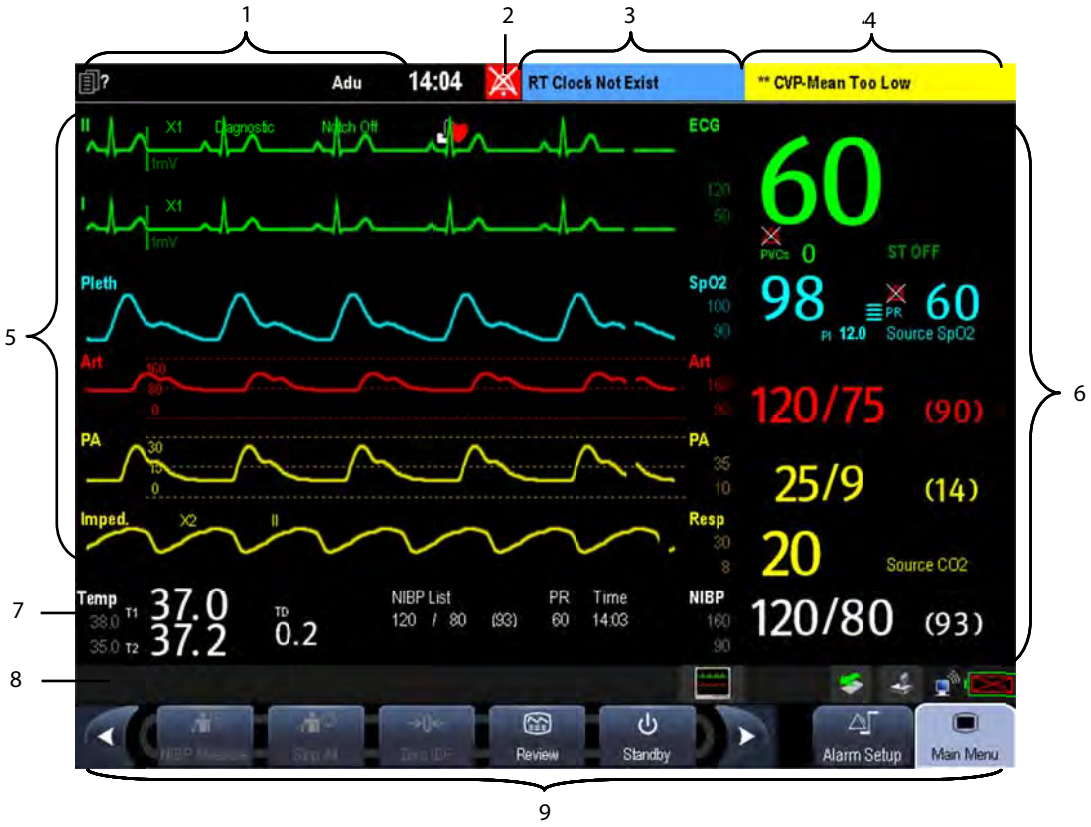
When the T1 is disconnected from BeneView T5, T8 or T9, it can continue to monitor a patient as a stand-alone monitor running on battery power or external DC power supply. For details of using T1 as a stand-alone monitor, refer to ***BeneView T1 Operating Manual***.

NOTE

- **Micro-D connector is disabled when T1 is in use.**
- **Please do not charge more than one BeneView T1 simultaneously with the module rack.**

2.5 Display Screen

This patient monitor adopts a high-resolution TFT LCD to display patient parameters and waveforms. A typical display screen is shown below.



1. Patient Information Area

   This area shows the patient information such as department, bed number, room number, patient name and patient category.  indicates that no patient is admitted or the patient information is incomplete. If no patient is admitted, selecting this area will enter the [**Patient Setup**] menu. If a patient has been admitted, selecting this area will enter the [**Patient Demographics**] menu.

2. Alarm Symbols

   -  indicates alarms are paused.
   -  indicates alarms are reset.
   -  indicates alarm sounds are turned off.
   -  indicates the system is in alarm off status.

3. Technical Alarm Area

   This area shows technical alarm messages and prompt messages. When multiple messages come, they will be displayed circularly. Select this area and the technical alarm list will be displayed.

4. Physiological Alarm Area

   This area shows physiological alarm messages. When multiple alarms occur, they will be displayed circularly. Select this area and the physiological alarm list will be displayed.

5. Waveform Area

   This area shows measurement waveforms. The waveform name is displayed at the left upper corner of the waveform. Select this area and the corresponding measurement setup menu will be displayed.

6. Parameter Area A

   This area shows measurement parameters. Each monitored parameter has a parameter window and the parameter name is displayed at the upper left corner. The corresponding waveform of each parameter is displayed in the same row in the waveform area. Select this area and the corresponding measurement setup menu will be displayed.

7. Parameter Area B

   For the parameters displayed in this area, their corresponding waveforms are not displayed.

8. Prompt Message Area

   This area shows the current configuration name, prompt messages, network status icons, battery status icons, etc. This area also shows the currently selected CMS if the [**Select CMS**] function is enabled. If the CMS you select does not have a name, this area displays "???". Refer to ***31.9.3.1 Selecting CMS*** for detail.

For details about battery status symbols, refer to the chapter ***33 Batteries.***

-  indicates patient monitor is connected to a wire network successfully.
-  indicates the patient monitor has failed to connect a wire network.
-  indicates the wireless function is working.
-  indicates the wireless function is not working.
-  indicates a CF storage card is inserted.
-  indicates a USB disk is inserted.
-  [**Screen Setup**] button
-  indicates a secondary display is connected to T5/T8/T9 monitor.
-  indicates a secondary display is connected to the T8 or T9 monitor, and all the settings can be performed through the monitor.
-  indicates a secondary display is connected to the T8 or T9 monitor, and all the settings can be performed through the secondary display.

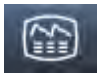
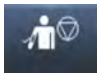
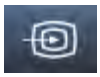
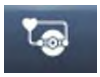
9. QuickKeys Area

   This area contains QuickKeys that give you fast access to functions.

2.6 QuickKeys

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

The following QuickKeys can be displayed on the screen:

	Scroll left to display more QuickKeys.		Scroll right to display more QuickKeys.
	Enter the main menu		Enter standby mode
	Change alarm settings		Review the patient's data
	Enter the NIBP measurement menu		Stop all NIBP measurement
	Zero IBP		Reset the alarm system
	Pause or restore alarms		Change screen
	Enter the patient setup menu		Trigger a manual event
	Start the realtime print		Print Setup
	Have a split-screen view of minitrends		Enter the volume setup menu
	Load configurations		Have the iView
	Start cardiac output procedure		View respiratory loops
	Perform calculations		Have a split-screen view of another patient's conditions
	Enter the full-screen 7-lead ECG screen		Have a split-screen view of oxyCRG trends
	Enter the [**Parameters**] menu		Enter the interpretation of resting 12-lead ECG screen
	Start NIBP STAT measurement		Enter the [**Unit Setup**] menu
	Enter the PAWP measurement screen		Enter the CPB mode
	Enter the privacy mode		Enter the night mode
	Enter the intubation mode		Enter the BOA screen (only available for BeneView T5 OR and BeneView T9 OR monitors)

You can also select your desired QuickKeys to display on the screen.

1. Select [**Main Menu**]→[**Maintenance >>**]→[**Manage Configuration >>**]→enter the required password→[**Ok**].
2. In the [**Manage Configuration**] menu, select [**Edit Config.>>**].
3. In the pop-up menu, select the desired configuration and then select [**Edit**].
4. In the pop-up menu, select [**Screen Setup >>**].
5. In the [**Select QuickKeys**] screen, select your desired QuickKeys and the order of them.

3 Basic Operations

3.1 Installation

⚠ WARNING

- **The equipment shall be installed by personnel authorized by us.**
- **The software copyright of the equipment is solely owned by us. No organization or individual shall resort to altering, copying, or exchanging it or to any other infringement on it in any form or by any means without due permission.**
- **Devices connected to the equipment must meet the requirements of the applicable IEC standards (e.g. IEC 60950 safety standards for information technology equipment and IEC 60601-1 safety standards for medical electrical equipment). The system configuration must meet the requirements of the IEC 60601-1 medical electrical systems standard. Any personnel who connect devices to the equipment's signal input/output port is responsible for providing evidence that the safety certification of the devices has been performed in accordance to the IEC 60601-1. If you have any question, please contact us.**
- **If it is not evident from the equipment specifications whether a particular combination with other devices is hazardous, for example, due to summation of leakage currents, please consult the manufacturers or else an expert in the field, to ensure the necessary safety of patients and all devices concerned will not be impaired by the proposed combination.**
- **Not using screw and bracket specified by Mindray may cause the screw to touch the internal battery and lead to monitor damage.**

3.1.1 Unpacking and Checking

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

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

NOTE

- **Save the packing case and packaging material as they can be used if the equipment must be reshipped.**

⚠ WARNING

- **When disposing of the packaging material, be sure to observe the applicable waste control regulations and keep it out of children's reach.**
- **The equipment might be contaminated during storage and transport. Before use, please verify whether the packages are intact, especially the packages of single use accessories. In case of any damage, do not apply it to patients.**

3.1.2 Environmental Requirements

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

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

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

⚠ WARNING

- **Make sure that the operating environment of the equipment meets the specific requirements. Otherwise unexpected consequences, e.g. damage to the equipment, could result.**
- **The equipment use a mains plug as isolation means to the mains power supply. Do not locate the equipment in a place difficult to operate the mains plug.**

3.2 Getting Started

3.2.1 Turning Power On

Once the patient monitor is installed, you can get ready for monitoring:

1. Before you start to make measurements, check the patient monitor, SMR and plug-in modules for any mechanical damage and make sure that all external cables, plug-ins and accessories are properly connected.
2. Plug the power cord into the AC power source. If you run the patient monitor on battery power, ensure that the battery is sufficiently charged.
3. Press the power on/off switch on the monitor's front. The start-up screens are displayed, and the technical alarm lamp and alarm lamp are lit in blue and yellow respectively. Then, the alarm lamp turns into red, and turns off together with the technical alarm lamp after the system gives a beep.
4. The monitor enters the main screen.

⚠ WARNING

- **Do not use the patient monitor for any monitoring procedure on a patient if you suspect it is not working properly, or if it is mechanically damaged. Contact your service personnel or us.**

NOTE

- **Check that visual and auditory alarm signals are presented correctly when the equipment is powered on. Do not use the patient monitor for any monitoring procedure on a patient if you suspect it is not working properly, or if it is mechanically damaged. Contact your service personnel or us.**

3.2.2 Starting Monitoring

1. Decide which measurements you want to make.
2. Connect the required modules, patient cables and sensors.
3. Check that the patient cables and sensors are correctly connected.
4. Check that the patient settings such as [**Patient Cat.**], [**Paced**], etc, are appropriate for your patient.
5. Refer to the appropriate measurement section for details of how to perform the measurements you require.

3.3 Disconnecting from Power

To disconnect the patient monitor from the AC power source, follow this procedure:

1. Confirm that the patient monitoring is finished.
2. Disconnect patient cables and sensors from the patient.
3. Make sure to save or clear the patient monitoring data as required.
4. Press and hold the power on/off switch for above 2 seconds. The patient monitor shuts down and you can unplug the power cable.

⚠ CAUTION

- **Although not recommended, you can press and hold the power on/off switch for 10 seconds to forcibly shut down the monitor when it could not be shut down normally or under some special situations. This may cause loss of data of the patient monitor.**

NOTE

- **To completely disconnect the power supply, unplug the power cord.**

3.4 Using a Mouse

You can use the USB mouse supplied with the equipment as a monitor input device. The USB mouse can be plugged and unplugged with the monitor on.

When you are using a mouse:

- By default, the left mouse-button is the primary button and the right one the secondary button.
- Clicking the primary button is equal to pressing the knob or selecting the touchscreen.
- The secondary button is disabled.

You can also define the right mouse-button as the primary button by following this procedure:

1. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password.
2. Select [**Others >>**] to enter the [**Others**] menu.
3. Select [**Primary Button**] and then select [**Right**] from the popup list.

3.5 Using Keys

The monitor has three types of keys:

- Softkey: A softkey is a graphic key on the screen, giving you fast access to certain menus or functions. The monitor has two types of softkeys:
  - Parameter keys: Each parameter area or waveform area can be seen as a softkey. You can enter a parameter setup menu by selecting its corresponding parameter area or waveform area.
  - QuickKeys: QuickKeys are configurable graphical keys, located at the bottom of the main screen. For details, refer to the section ***2.6 QuickKeys.***
- Hardkeys: A hardkey is a physical key on a monitoring device, such as the main menu hardkey on the monitor's front.
- Pop-Up Keys: Pop-up keys are task-related keys that appear automatically on the monitor screen when required. For example, the confirm pop-up key appears only when you need to confirm a change.

3.6 Using Keyboards

The on-screen keyboard enables you to enter information.

- Use the  key to delete the previously entered character.
- Use the  key to toggle between uppercase and lowercase letters.
- Select  to confirm what you have entered and close the on-screen keyboard.
- Select  to access the symbol keyboard.
- Select  to exit the symbol keyboard.

3.7 Using the Touchscreen

Select screen items by pressing them directly on the patient monitor's screen. You can enable or disable touchscreen operation by pressing and holding the [**Main Menu**] QuickKey for 3 seconds. A padlock symbol  is displayed if touchscreen operation is disabled.

3.8 Using the secondary display

You can connect a secondary display to this monitor for viewing or operating.

For T5 monitor, the contents showed on the monitor and the secondary display are the same. You can only perform the setting on the monitor. The secondary display is for viewing only.

For T8 or T9 monitor, the contents showed on the main display and the secondary display can be different. Both the secondary display and main display can be individually configured. However, only one display can be configured as the main control display. All the operations are available through the main control display, yet only some operations are available through the other display. To specify the main control display, you can select the icon  or  in the prompt message area. In the icon, 1 represents the monitor and 2 represents the secondary display. The display in red background is the main control display.

3.9 Remote Display

You can connect a remote display to the monitor through the remote display driver. The information coming from the monitor will be displayed on the remote display so that you can conveniently observe the patient's conditions from distance.

For details about remote display features, refer to the operating manual (PN: H-M11A-20-75034) accompanying the remote display driver.

NOTE

- **The contents displayed on the remote display are for convenient observance only and cannot be used for diagnostic interpretation.**
- **The user cannot operate the monitor through the remote display driver, namely, any operations performed through the remote display driver will not affect the monitor you observe.**

3.10 Setting the Screen

You can enter the [**Screen Setup**] window as shown below by selecting the [**Screen Setup**] button  in the prompt message area. In this window, you can allocate the positions of the parameters and waveforms. The parameters or waveforms whose positions are not allocated will not be displayed.

The ECG parameter and the first ECG waveform always display in the first row. The configurable areas can be classified as Area A, Area B, and Area C.

- In Area A, you can choose to display the parameters (having waveforms) and their waveforms. Each parameter and the associated waveform are displayed in the same row.
- In Area B, you can choose to display the parameters and their waveforms. When there is no parameter displayed in area C, both the parameters and their waveforms will be displayed in area B. Otherwise, only the parameters will be displayed.
- In Area C, you can choose to display Timer and all the parameters whose associated waveforms will not be displayed.

The screen automatically adjusts to ensure the best view based on your screen setup.

If no corresponding parameter or waveform is displayed after the module is inserted, you should perform the following inspections:

- Check the connection between the module and lead, cable, sensor, or external device.
- Check whether there are the [**The display setup for XX is disabled**] message and the flashing [**Screen Setup**] button  in the prompt message area. If yes, select this button to enter the [**Screen Setup**] window for the desired display configuration.
- Check that the parameter is switched on in the [**Parameters Switch**] window.

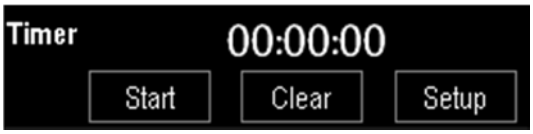
WARNING

- **The parameters whose positions are not allocated in the [Screen Setup] window will not be displayed. However, the monitor can still give alarms of these parameters.**

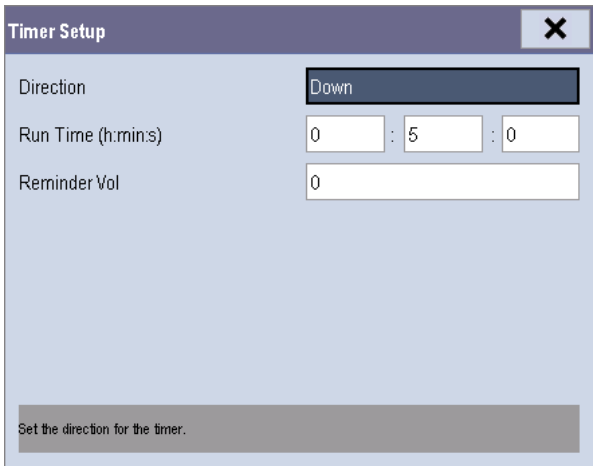
3.11 Displaying the Timer

The monitor has a function of displaying a Timer. To display the timer in the main screen, follow this procedure:

1. Select the [**Screens**] button  in prompt message area to access the [**Screens**] window.
2. Select [**Screen Setup**] tab.
3. In the Area C, select [**Timer**] from the drop-down list of the desired parameter area. Refer to ***3.8 Setting the Screen*** for Area C.
4. Select ✕ to exit the window. The main screen will display the timer.



- Select [**Start**] or [**Pause**] to start or pause timing.
- Select [**Clear**] to clear current timing result.
- Select [**Setup**] to access the [**Timer Setup**] window, in which you can set the [**Direction**] to [**Up**] or [**Down**]. If you select [**Down**], you should set:
  - [**Run Time(h:min:s)**]: The available time range is 0 to 100 hours, and the default time is 5 minutes.
  - [**Reminder Vol**]: During the last 10 seconds of the countdown, the system issues reminder tone. The available volume range is 0 to 10. 0 means off, and 10 the maximum volume.



Note

- **Corresponding events are created when the timer is started, paused or stopped. You can review these events in the [Events] page of the [Review] window.**

3.12 Using the Main Menu

To enter the main menu, select the on-screen QuickKey or the hardkey on the monitor's front. Most of monitor operations and settings can be performed through the main menu.

Other menus are similar to the main menu and contain the following parts:

1. Heading: gives a sum-up for the current menu.
2. Main body: displays options, buttons, prompt messages, etc. The menu button with ">>" enlarges a secondary window to reveal more options or information.
3. Online help area: displays help information for the highlighted menu item.
4. ✕: select to exit the current menu.

3.13 Setting Parameters

3.13.1 Switching the Parameters On/Off

To switch the parameters on or off:

1. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password→[**Others >>**].
2. Configure the [**Para Switch Authority**] to [**Unprotected**] or [**Protected**].

- If [**Para Switch Authority**] is configured to [**Unprotected**], select[**Main Menu**]→[**Screen Setup>>**]→[**Screen Layout >>**]→[**Parameters Switch**], or [**Screen Layout**] QuickKey →[**Parameters Switch**] to switch the parameters on or off.
- If [**Para Switch Authority**] is configured to [**Protected**], the parameter switch is password protected. To switch the parameters on or off, you can select[**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password→[**Others >>**]→[**Parameters Switch Setup >>**].

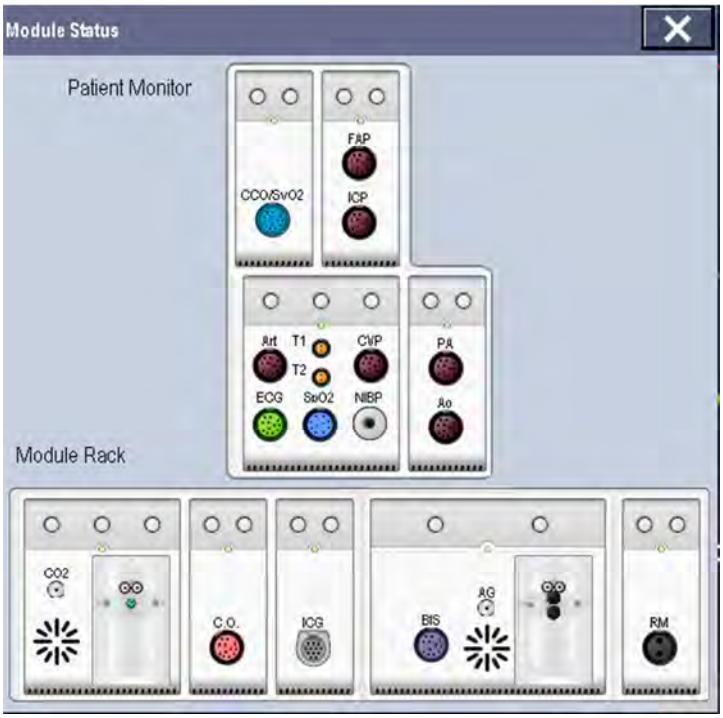
When a parameter is switched off, its corresponding parameter module stops working, and its parameter value and waveform are not shown on the monitor display.

NOTE

- **ECG is always selected, and you can not switch it off.**

3.13.2 Accessing the Parameters Menu

Select [**Parameters >>**] from the main menu or select the [**Parameters**] QuickKey at the bottom of the screen to enter the [**Parameters**] menu where you can get the access of each parameter's setup menu. You can further select [**Module Status >>**] to enter the menu as shown below. Your display may be configured to look slightly different depending on the modules mounted.



This menu displays the measurement modules mounted in the two-slot module rack, three-slot module rack and satellite module rack from top to bottom. Beside each measurement connector is the measurement label. The color in which a measurement connector appears matches the status as follows:

 (colored) indicates that the module is turned on.

 (grey) indicates that the module is turned off.

 indicates a module name conflict.

 indicates a module error.

3.13.3 Removing a Module Conflict

Besides three independent IBP modules and the IBP module on the MPM, the patient monitor supports only one more measurement module simultaneously. Otherwise, the message of module conflict will de prompted.

For example, if a CO_2 module is already loaded and then another CO_2 module is inserted, your patient monitor will then display module conflict. To use one module, just pull out another module.

3.14 Using a CF Storage Card

A CF storage card is used to prevent data loss in case of a sudden power failure. The patient data such as trend data, waveform data, etc., will be automatically saved into the CF storage card during patient monitoring. In case of a sudden power failure, the patient data can be retrieved from the CF storage card after the patient monitor restarts.

To insert a CF storage card, open the compartment and then insert the card until the button flips out.
To remove the CF storage card, follow this procedure:

1. In the main menu, select [**Unload CF Storage Card**], or [**Patient Data**]→[**Unload CF Storage Card**]. You can also click  icon in the lower right corner of the screen.
2. Select [**Ok**] from the popup menu to unload the CF storage card. A status message shown in the prompt message area will report completion of the unloading.
3. Press the button until the CF storage card flips out.

To browse the data saved in the CF storage card, follow this procedure:

1. Select [**Main Menu**]→[**Patient Data >>**]→[**History Data >>**].
2. Select a patient whose data you want to view from the [**Patient Data List**] and then select [**Review**].
3. Select [**Data Review**].

As reviewing the history patient's data is just like reviewing the current patient's data, you can refer to the chapter 32 ***Review*** for details.

NOTE

- **Data may be unable to be saved into the CF storage card when the patient monitor is just turned on.**
- **If no CF stroage card is used, all the data you have saved will get lost in case of monitor shut-down or sudden power interrupt.**

⚠ CAUTION

- **Unload the CF storage card before removing it from the patient monitor. Otherwise it may cause damage to the data in the card.**
- **Use only the CF storage card specified by Mindray.**
- **Please take measures against the static electricity such as Disposable Wrist Strap when you fetch the CF card.**

3.15 Changing General Settings

This chapter covers only general settings such as language, brightness, date and time, etc. Measurement settings and other settings can be referred to in respective sections.

3.15.1 Setting up a Monitor

In situations where you install a patient monitor or change the patient monitor's application site, you need to setup the patient monitor as follows:

1. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password.
2. In the [**User Maintenance**] menu, select, in turn, [**Monitor Name**], [**Department**] and [**Bed No**.], and then change their settings.

3.15.2 Changing Language

1. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password.
2. In the [**User Maintenance**] menu, select [**Language**] and then select the desired language.
3. Restart the patient monitor.

NOTE

- **The changed language is applied only after the patient monitor is restarted.**

3.15.3 Adjusting the Screen Brightness

1. Select the [**Main Menu**]→[**Screen Setup >>**]→[**Brightness**].
2. Select the appropriate setting for the screen brightness. 10 is the brightest, and 1 is the dimmest.

If the patient monitor operates on battery power, you can set a less bright screen to prolong the operating time of the battery. When the patient monitor enters standby mode, the screen automatically changes to the dimmest setting.

3.15.4 Showing/Hiding the Help

The patient monitor provides online help information. The user can display or hide the help as required.

1. Select [**Main Menu**]→[**Screen Setup >>**].
2. Select [**Help**] and toggle between [**On**] and [**Off**].

3.15.5 Setting the Date and Time

1. Select [**Main Menu**] →[**Maintenance >>**]→[**System Time >>**].
2. Set the date and time.
3. Select [**Date Format**] and toggle between [**yyyy-mm-dd**], [**mm-dd-yyyy**] and [**dd-mm-yyyy**].
4. Select [**Time Format**] and toggle between [**24h**] and [**12h**].

If your patient monitor is connected to a central monitoring system (CMS), the date and time are automatically taken from that CMS. In that case, you cannot change the date and time settings on your patient monitor.

⚠ CAUTION

- **Changing date and time affects the storage of trends and events and may cause data missing.**

3.15.6 Adjusting Volume

Alarm Volume

1. Select the [**Volume Setup**] QuickKey, or [**Main Menu**]→[**Alarm Setup >>**]→[**Others**].
2. Select [**Alm Volume**] and then select the appropriate volume: X-10, in which X is the minimum volume, depending on the set minimum alarm volume (refer to section ***8.4.1 Setting the Minimum Alarm Volume***), and 10 the maximum volume.

Key Volume

When you press the navigation knob, the touchscreen, or the hardkeys on the front panel, the patient monitor prompts you by making a sound of the key volume you have set.

1. Select the [**Volume Setup**] QuickKey, or [**Main Menu**]→[**Screen Setup >>**].
2. Select [**Key Volume**] and then select the appropriate volume. 0 means off, and 10 the maximum volume.

QRS Volume

The QRS tone is derived from either the HR or PR, depending on which is currently selected as the alarm source in [**ECG Setup**] or [**SpO_2 Setup**]. When monitoring SpO_2, there is a variable pitch tone which changes as the patient's saturation level changes. The pitch of the tone rises as the saturation level increases and falls as the saturation level decreases. The volume of this tone is user adjustable.

1. Select the [**Volume Setup**] QuickKey, or the ECG parameter window→[**Others >>**], or the SpO_2 parameter window.
2. Select [**QRS Volume**] or [**Beat Vol**] and then select the appropriate volume. 0 means off, and 10 the maximum volume.

FOR YOUR NOTES

4 Managing Patients

4.1 Admitting a Patient

The patient monitor displays physiological data and stores it in the trends as soon as a patient is connected. This allows you to monitor a patient that is not admitted yet. However, it is recommended that you fully admit a patient so that you can clearly identify your patient, on recordings, reports and networking devices. To admit a patient:

1. Select the [**Patient Setup**] QuickKey, or [**Main Menu**]→[**Patient Setup >>**].
2. Select [**Discharge Patient**] to clear any previous patient data. If you do not erase data from the previous patient, the new patient's data will be saved into the data of the previous patient. The monitor makes no distinction between the old and the new patient data.
3. If [**Discharge Patient**] button appears dimmed, directly select [**Admit Patient**] and then select:
   - [**Yes**] to apply the data saved in the patient monitor to the new patient, or
   - [**No**] to clear the data saved in the patient monitor.
4. In the [**Patient Demographics**] menu, enter the demographic details, of which:
   - [**Patient Cat.**] determines the way your patient monitor processes and calculates some measurements, and what safety and alarm limits are applied for your patient.
   - [**Paced**] determines whether to show pace pulse marks on the ECG waveform. When the [**Paced**] is set to [**No**], pace pulse marks are not shown in the ECG waveform.
5. Select [**Ok**].

⚠WARNING

- **[Patient Cat.] and [Paced] will always contain a value, regardless of whether the patient is fully admitted or not. If you do not specify settings for these fields, the patient monitor uses the default settings from the current configuration, which might not be correct for your patient.**
- **For paced patients, you must set [Paced] to [Yes]. If it is incorrectly set to [No], the patient monitor could mistake a pace pulse for a QRS and fail to alarm when the ECG signal is too weak.**
- **For non-paced patients, you must set [Paced] to [No].**

4.2 Quick Admitting a Patient

Use [**Quick Admit**] only if you do not have the time or information to fully admit a patient. Complete the rest of the patient demographic details later. Otherwise, the  symbol will always be displayed in the patient information area.

1. Select the [**Patient Setup**] QuickKey, or [**Main Menu**]→[**Patient Setup >>**].
2. Select [**Quick Admit**]. If a patient has been admitted at present, select [**OK**] to discharge the current patient. If .no patient is admitted, you can choose either:
   - [**Yes**] to apply the data in your patient monitor to the new patient, or
   - [**No**] to clear any previous patient data**.**
3. Enter the patient category and paced status for the new patient, and then select [**Ok**].

4.3 Setting the Monitor Location

To set the monitor location, follow this procedure:

1. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password.
2. Input the following location of the monitor:
   - [**Facility**]: your facility name.
   - [**Department**]: your department name.
   - [**Room No.**]: room number.
   - [**Bed No.**]: bed number.

4.4 Querying and Obtaining Patient Information

The monitor can obtain patient information from HIS through eGateway. To query or obtain patient information from HIS,

1. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password→[**Network Setup >>**]→[**Gateway Comm Setup >>**], and set[**IP Address**] and [**Port**]. Set [**ADT Query**] to [**On**].
2. Click patient information area to enter the [**Patient Demographics**] menu.
3. Select [**Obtain Patient Info. >>**] to enter the [**Obtain Patient Information**] menu.
4. Input query condition and then select [**Query**]. The monitor will display the obtained patient information.
5. Select a patient and then click [**Import**]. Then the monitor will update the information of corresponding patient.
6. Select  to exit the [**Obtain Patient Information**] menu.

NOTE

- **The option [Obtain Patient Information] is available in the [Patient Setup] menu only when [ADT Query] is set to [On].**
- **When obtaining patient information from the HIS, the monitor only updates patient information. The patient's monitoring data is not changed and the patient is not discharged.**

4.5 Querying from Local Facility

You can query the patient information from either the local facility or all networked facilities. To set where to query, follow this procedure:

1. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password→[**Network Setup >>**]→[**Gateway Comm Setup >>**].
2. Set [**Query From Local Facility**].
   - ◆ Select [**Yes**] to query only from local facility.
   - ◆ Select [**No**] to query from all networked facilities.

4.6 Associating Patient Information

After associating patient information with HIS, the monitor will automatically update patient information if corresponding information in HIS has been is changed. The monitor can associate patient's MRN, visit number, first name, last name, date of birth, and gender with HIS.

NOTE

- **A keyword takes effect only when being defined in eGateway. Refer to eGateway Integration Manager Installation Guide for details.**
- **The monitor displays corresponding patient information only when all the keywords have been inputted.**

4.7 Editing Patient Information

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

1. Select the [**Patient Setup**] QuickKey, or [**Main Menu**]→[**Patient Setup >>**].
2. Select [**Patient Demographics**] and then make the required changes.
3. Select [**Ok**].

You can also input the patient's visit number in the [**Patient Demographics**] menu, but the [**Visit Number**] option needs to be enabled.

To display the [**Visit Number**] option in the [**Patient Demographics**] menu:

1. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password.
2. Set [**Visit Number**] to [**On >>**].

4.8 Discharging a Patient

To discharge a patient:

1. Select the [**Patient Setup**] QuickKey, or [**Main Menu**]→[**Patient Setup >>**].
2. Select [**Discharge Patient**]. In the popup menu, you can either:
   - ◆ Directly select [**Ok**] to discharge the current patient, or
   - ◆ Select [**Standby**] then [**Ok**]. The patient monitor enters the standby mode after discharging the current patient, or
   - ◆ Select [**Cancel**] to exit without discharging the patient.

NOTE

- **Discharging a patient clears all history data in the monitor.**

4.9 Transferring Patient Data

You can transfer a patient with an MPM or BeneView T1 (referred to as T1 hereafter) to a new location without re-entering the patient demographic information or changing the settings. Transferring of patient data enables you to understand the patient's history condition. The patient data that can be transferred includes: patient demographics, trend data, alarm events and parameters alarm limits.

Select [**Others >>**] from [**User Maintenance**] menu. In the popup menu, you can set [**Transferred Data Length**]. The default is [**4 h**]. You can also set [**Data Transfer Method**]. The default is [**Off**].

⚠WARNING

- **Do not discharge a patient before the patient is successfully transferred.**
- **After a patient is successfully transferred, check if the patient settings (especially patient category, paced status and alarm limits settings, etc) on the monitor are appropriate for this patient.**
- **Only when you open MPM transfer function and select [Continue Patient in MPM] or [Continue Patient in T1] can the IBP labels be transferred along with the MPM/T1.**

NOTE

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

4.9.1 Transferring Patient Data via MPM/T1

Familiarizing yourself with the data respectively stored in the patient monitor, T1 or MPM helps you understand the effects incurred by transferring patients with an MPM/T1.

Contents stored		In the patient monitor	In the MPM	In the T1
Data	Patient demographics (Name, Bed No., Gender, etc.)	Yes	Yes	Yes
	Trend data	Yes	Yes	Yes
	Calculation data (Dose calculations, oxygenation calculations, etc.)	Yes	No	No
	Event data (Marked events, alarm events, etc.)	Yes	No	Yes
Settings	Monitor settings (Alarm pause, alarm volume, etc.)	Yes	No	No
	Parameter settings (Alarm limits, etc.)	Yes	Yes	Yes

Before transferring a patient with an MPM/T1, set the destination monitor as follows:

1. Select [**Main Menu**]→[**Maintenance**]→[**User Maintenance >>**]→enter the required password.
2. Select [**Others >>**].
3. Set [**Data Transfer Method**] to [**Module**].
4. Set [**Apply Module Settings**] to [**On**]. If your patient monitor does not have this option, the system applies the MPM/T1's settings by default.

Then, follow this procedure to transfer the patient:

1. Disconnect MPM/T1 from the original monitor.
2. Connect MPM/T1 to the destination monitor.
3. If there is a mismatch between the MPM/T1 and monitor, the system will automatically display the [**Select Patient**] menu, from which you can choose the data set you want to continue using for this patient, either:
   - [**Continue Patient in Monitor**]: continue with the patient data and settings in the monitor, deleting all patient data and setting in MPM/T1 and copying all data in the monitor to MPM/T1.
   - [**Continue Patient in MPM**] or [**Continue Patient in T1**]: continue with the patient data and settings in MPM/T1. Discharge the patient in the monitor. The monitor then automatically admits the patient and copies all data from MPM/T1.
   - [**New Patient**]: select this button if none of the information is correct. This deletes all data in the monitor and MPM/T1 and lets you admit a new patient on the monitor. In this case, you need to re-enter the patient demographics. The monitor will restore the settings according to the patient category.
   - [**Same Patient**]: select this button if the patient demographics are different, but it is the same patient. This merges the patient's trend data in the monitor and MPM/T1 and copies the settings in MPM/T1 to the monitor as well.
4. Select [**Yes**].

Operations	Examples of applications
Continue Patient in Monitor	1. Replace MPM/T1 during patient monitoring. 2. After the patient is admitted, connect the MPM/T1.
Continue Patient in MPM/Continue Patient in T1	A patient is monitored using MPM/T1. You need to transfer the patient, e.g. from a ward (original monitor) to the operating room (destination monitor).
New Patient	Connect the MPM/T1 before admitting a new patient. However, the monitor and/or MPM/T1 store the previous patient's data and settings.
Same Patient	A patient monitored with the MPM/T1 is moved to another department and again moved back. However, the patient information stored in the MPM/T1 was altered before connected to the original monitor.

4.9.2 Transferring Patient Data via Storage Medium

4.9.2.1 Transferring Data from the Monitor to Storage Medium

1. Select [**Main Menu**]→[**Patient Setup >>**].
2. Select [**Transfer to Storage Medium**]. In the popup menu, you can:
   - ◆ Select [**Ok**] to transfer the patient data, or
   - ◆ Select [**Cancel**] to exit the menu.
3. Wait until the following message appears: [**Transfer to storage medium successful. Remove the CF storage card.**] or [**Transfer to storage medium successful. Please remove the USB drive.**].
4. Remove the CF storage card or USB drive from patient monitor.

4.9.2.2 Transferring Data from the Storage Medium to the Monitor

1. Connect the storage medium to the destination monitor.
2. In the popup menu, you can:
   - ◆ Select [**Transfer**] to transfer the patient data to the monitor, or
   - ◆ Select [**Cancel Transfer**] to cancel the operation of transferring patient data.
   - ◆ Select [**Unload CF Storage Card**] or [**Unload USB Drive**] to not transfer the patient data and to unload the card or USB drive.
3. After you select [**Transfer**], in the popup menu you can further select the patient data contents that need to be transferred. [**Patient Demographics**] must be selected. After [**Ok**] is selected, the monitor compares the patient information stored in both the storage medium and monitor and deals with the patient data based on the following.
   - ◆ Different Patients: The monitor erases all the current patient data, transfers the patient data from the storage medium, and loads the configuration according to the patient category.
   - ◆ Same Patient: In the popup dialog box, you can:
     - ◆ Select [**Yes**] to merge the patient data in the monitor and storage medium.
     - ◆ Select [**No**] to erase all the current patient data in the monitor and to transfer the patient data from the storage medium.

Wait until the following message appears: [**Transfer from storage medium successful.**].

⚠WARNING

- **The USB drive you use may have write-protect function. In this case, please make sure the USB drive for data transfer is in read/write mode.**
- **Do not remove the storage medium during data transfer process. Otherwise, data files may be damaged.**

4.10 Connecting to a Central Monitoring System

If your patient monitor is connected to a central monitoring system (CMS):

- All patient information, measurement data and settings on the patient monitor can be transferred to the CMS.
- All patient information, measurement data and settings can be displayed simultaneously on the patient monitor and CMS. For some functions such as editing patient information, admitting a patient, discharging a patient, starting/stopping NIBP measurements, etc., bi-directional control can be achieved between your patient monitor and the CMS.

For details, refer to the CMS's instructions for use.

FOR YOUR NOTES

5 Managing Configurations

5.1 Introduction

When performing continuous monitoring on a patient, the clinical professional often needs to adjust the monitor's settings according to the patient's condition. The collection of all these settings is called a configuration. Allowing you to configure the monitor more efficiently, the monitor provides different sets of configurations to accommodate the varying patient categories and departments. You can change some settings from a certain set of configuration and then save the changed configuration as a user configuration.

The default configurations provided for your monitor are department-oriented. You can choose either from:

- General
- OR
- ICU
- NICU
- CCU

Each department has three different sets of configurations tailored for adult, pediatric and neonatal patients.

⚠WARNING

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

The system configuration items can be classified as:

- Parameter configuration items

These items relate to parameters, e.g., waveform gain, alarm switch, alarm limits.

- Conventional configuration items

These items define how the monitor works, e.g., screen layout, record, print and alarm settings.

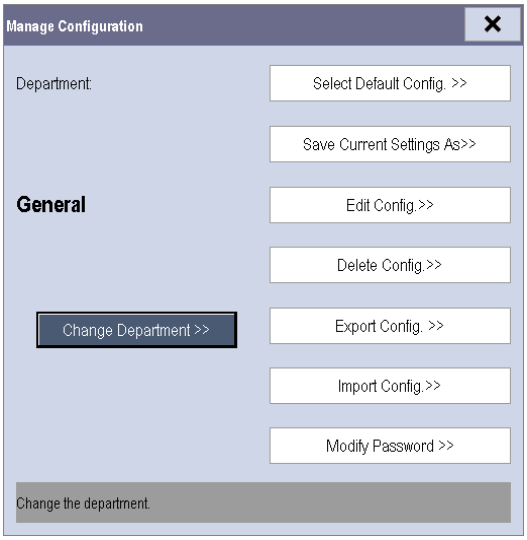
- User maintenance items

These items relate to user maintenance settings, e.g., unit setup, time format and data format.

For the important configuration items and their default values and user maintenance items, see appendix ***Configuration Default Information***.

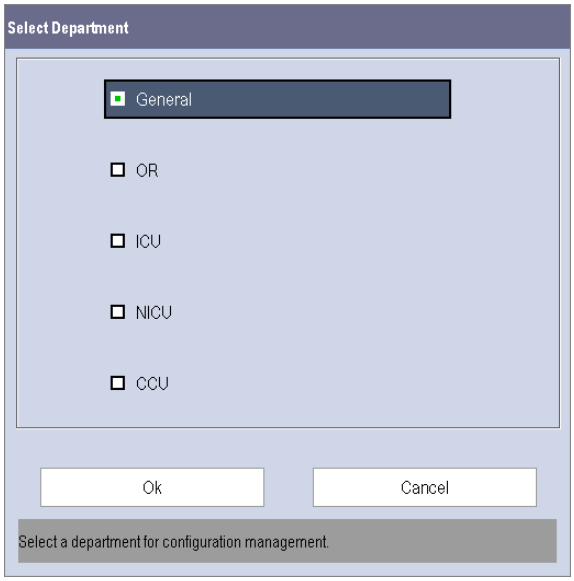
5.2 Entering the [Manage Configuration] Menu

1. Press the hardkey on the monitor's front to enter the main menu.
2. Select [**Maintenance >>**]→[**Manage Configuration >>**]. Enter the required password and then select [**Ok**].



5.3 Changing Department

If the current department configuration is not the one you want to view, you can select [**Change Department >>**] in the [**Manage Configuration**] menu and then choose the one you want for viewing as shown below.



NOTE

- **Changing the department will delete all current user configurations. Please act with caution.**

5.4 Setting Default Configuration

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

- The patient monitor restarts after being switched off for more than 120 seconds. A patient is admitted.
- A patient is discharged.
- Patient data is cleared.
- Patient category is changed.

To set default configuration:

1. Select [**Select Default Config. >>**] in the [**Manage Configuration**] menu.
2. In the [**Select Default Config.**] menu, select [**Load the Latest Config.**] or [**Load Specified Config.**].

When you select [**Load Specified Config.**], the configuration (adult, pediatric or neonate) to be restored is subject to the patient category. This configuration can be either factory configuration or saved user configuration. Take adult as an example, select [**Default Adu Config.**] and toggle between [**Defaults**] or user configuration(s).

NOTE

- **To know what configuration is restored when the patient monitor starts, enter the main screen to check the prompt information at the lower part of the screen (displayed for about 10 seconds).**

5.5 Saving Current Settings

Current settings can be saved as a user configuration. Up to 10 user configurations can be saved.

To save current settings:

1. Select [**Save Current Settings As >>**] in the [**Manage Configuration**] menu.
2. In the popup dialog box, enter the configuration name and then select [**Ok**].

5.6 Editing Configuration

1. Select [**Edit Config. >>**] in the [**Manage Configuration**] menu. The following menu appears.

2. The popup menu shows the existing configurations on the monitor. Selecting [**Config. on USB drive >>**] will show the existing configurations on the USB drive. Select the desired configuration and then select the [**Edit**] button. The following menu appears.

3. Select [**Alarm Setup >>**], [**Screen Setup >>**] or [**Parameter >>**] to enter the corresponding menu in which settings can be changed. The changed items of alarm setup will be marked in red.
4. You can select [**Save**] or [**Save as**] to save the changed configuration. Select [**Save**] to overwrite the original configuration. Select [**Save as**] to save the changed configuration with another name.

5.7 Deleting a Configuration

To delete a configuration:

1. Select [**Delete Config. >>**] in the [**Manage Configuration**] menu.
2. The popup menu shows the existing user configurations on the monitor. Selecting [**Config. on USB drive >>**] will show the existing user configurations on the USB drive. Select the user configurations you want to delete and then select [**Delete**].
3. Select [**Yes**] in the popup.

5.8 Transferring a Configuration

When installing several monitors with identical user configuration it is not necessary to set each unit separately. A USB drive may be used to transfer the configuration from monitor to monitor.

To export the current monitor's configuration:

1. Connect the USB drive to the monitor's USB port.
2. Select [**Export Config. >>**] in the [**Manage Configuration**] menu.
3. In the [**Export Config**.] menu, select the configurations and [**User Maintenance Settings**] to export. Then select the [**Export**] button. A status message will report completion of the transfer.

To import the configuration on the USB drive to the monitor:

1. Connect the USB drive to the monitor's USB port.
2. Select [**Import Config. >>**] in the [**Manage Configuration**] menu.
3. In the [**Import Config.**] menu, select the configurations and [**User Maintenance Settings**] to import. Then select the [**Import**] button. A status message will report completion of the transfer.

5.9 Loading a Configuration

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

To load a configuration,

1. Select [**Load Configuration >>**] from the main menu.
2. The popup menu shows the existing configurations on the monitor. Selecting [**Config. on USB drive >>**] will show the existing configurations on the USB drive.
3. Select a desired configuration.
4. Select [**View**] to view the configuration details. In the popup menu, you can select [**Alarm Setup >>**], [**Screen Setup >>**] or [**Parameter >>**] to view the corresponding contents. The alarm setup items which are different than those currently used are marked in red.
5. Select [**Load**] to load this configuration.

NOTE

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

5.10 Restoring the Latest Configuration Automatically

During operation, you may make changes to some settings. However, these changes may not be saved as user configuration. To prevent the changes from losing in case of a sudden power failure, the patient monitor stores the configuration in real time. The saved configuration is the latest configuration.

The monitor restores the latest configuration if it restarts within 60 seconds after the power failure. And it will restore the default configuration rather than the latest configuration if it restarts 120 seconds after the power failure. The monitor loads either the latest configuration or the default configuration if it restarts from 60-120 seconds after the power failure.

5.11 Modifying Password

To modify the password for accessing the [**Manage Configuration**] menu,

1. Select [**Modify Password >>**] in the [**Manage Configuration**] menu.
2. Input a new password in the popup menu.
3. Select [**Ok**].

6 User Screens

6.1 Configuring Your Screens

You can tailor your patient monitor's screens by setting:

- Waveform sweep mode
- Wave line size
- The color in which each measurement's numerics and waveform are displayed
- The parameter to be monitored.

Changing some settings may be hazardous. Therefore, those settings are password-protected and can be modified by authorized personnel only. Once a change is made, those who use the patient monitor should be notified.

6.1.1 Setting the Waveform Sweep Mode

1. Select [**Main Menu**]→[**Screen Setup >>**].
2. Select [**Sweep Mode**] and toggle between [**Refresh**] and [**Scroll**].
   - [**Refresh**]: The waveforms arerefreshed from left to right.
   - [**Scroll**]: The waveforms move from the right to the left with time passing by.

6.1.2 Changing the Wave Line Size

1. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password.
2. Select [**Others >>**].
3. Select [**Wave Line**] and toggle between [**Thick**], [**Mediate**] and [**Thin**].

6.1.3 Changing Measurement Colors

1. Select [**Main Menu**]→[**Screen Setup >>**]→[**Measurement Color Setup >>**].
2. Select the color box next to your desired measurement and then select a color from the popup menu.

6.1.4 Changing Screen Layout

Select the [**Screens**] QuickKey, or [**Main Menu**]→[**Screen Setup >>**]→[**Screen Layout >>**] to enter the [**Screens**] menu.

- You can choose the desired screen type in the [**Choose Screen**] window.
- You can select the parameters and waveforms you want to view in the [**Screen Setup**] window. For details, please refer to the section ***Setting the Screen***.
- You can select the parameters you want to view on big numerics screen in the [**Big Numerics Screen Setup**] window.
- You can switch on or off the connected parameter modules in the [**Parameters Switch**] window. If a parameter module is switched off, parameter values and waveforms will not display on the screen.

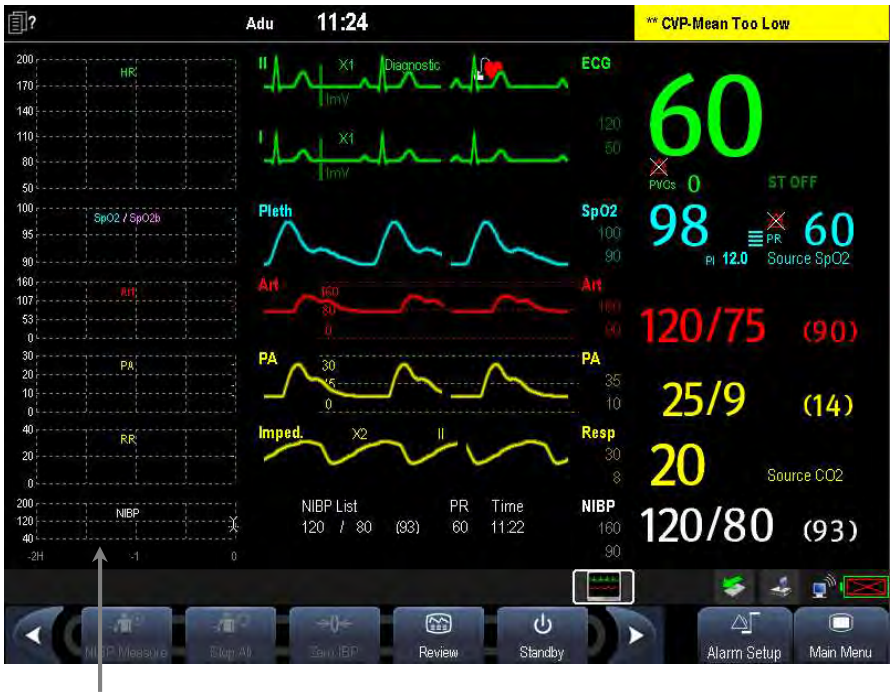
6.2 Viewing Minitrends

6.2.1 Having a Split-Screen View of Minitrends

You can split the normal screen so that one part of the screen, on the left hand side, continuously shows graphic minitrends beside waveforms as shown in the figure below.

To have a split-screen view of minitrends, you can:

- Select [**Minitrends**] QuickKey, or
- Select [**Screens**] QuickKey →[**Choose Screen**]→[**Minitrends Screen**]→, or
- Select [**Main Menu**]→[**Screen Setup >>**]→[**Screen Layout >>**]→[**Choose Screen**]→[**Minitrends Screen**]→.



Minitrend View

The split-screen view provides minitrends for multiple parameters. In each field, the label and scale are respectively displayed at the top and left. The time is displayed at the bottom of the minitrends view.

6.2.2 Setting Minitrends

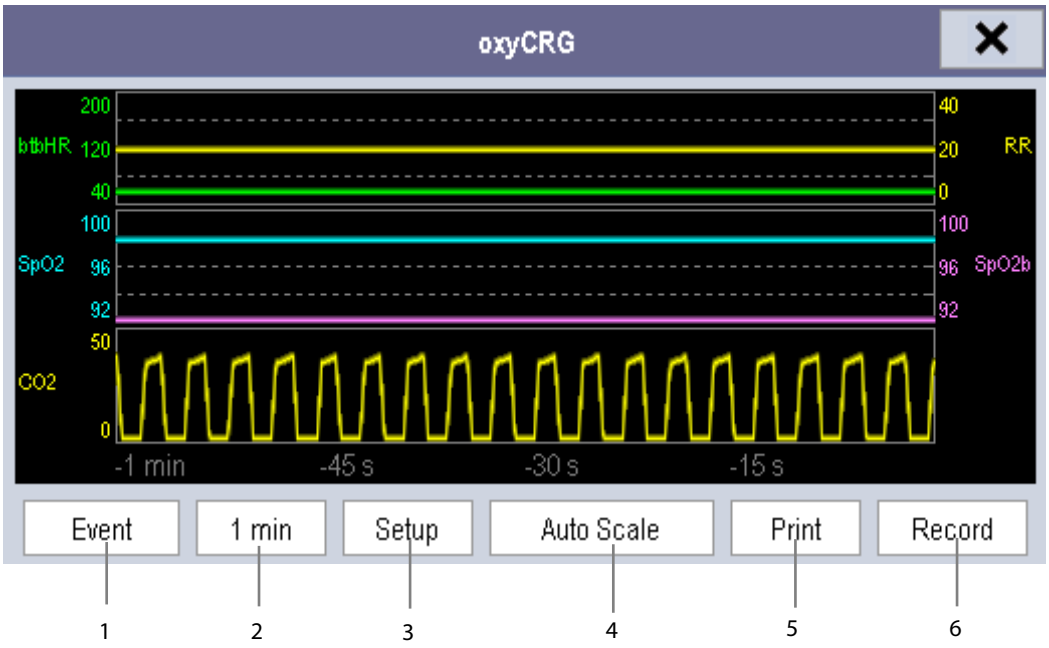
Select the minitrends area. From the pop-up [**Minitrend Setup**] menu, you can:

- Select the parameters to be displayed, or
- Select [**Minitrend Length**] and then select the appropriate setting.

6.3 Viewing OxyCRG

To have a split screen view of OxyCRG, you can:

- Select [**OxyCRG**] QuickKey, or
- Select [**Screens**] QuickKey → [**Choose Screen**] → [**OxyCRG Screen**] → ✕, or
- Select [**Main Menu**] → [**Screen Setup >>**] → [**Screen Layout >>**] → [**Choose Screen**] → [**OxyCRG Screen**] → ✕.



The split-screen view covers the lower part of the waveform area and shows HR trend, btbHR (beat to beat heart rate) trend, SpO_2 trend, SpO_2b trend, RR trend and a compressed wave (CO_2 wave or Resp wave). At the bottom, there are controls:

1. OxyCRG Event

   You can enter the [**Review**] menu by selecting the [**Event**] button.

2. Trend length list box

   In the trend length list box, you can select [**1 min**], [**2 min**], [**4 min**], or [**8 min**].

3. Setup

   Select [**Setup**] button to enter [**Setup**] menu, in which you can select the parameters for display, the time length to be saved before and after an event, and the scale of the graphic trends and waveform.

4. Auto Scale

   Select [**Auto Scale**] button, and the system automatically adjusts the scaling.

5. Print

   Select [**Print**] to print out the realtime OxyCRG.

6. Record

   Select [**Record**] to print the currently displayed OxyCRG trends with the recorder.

6.4 Viewing Other Patients

6.4.1 Care Group

You can select other patient monitors (including telemetry) connected to the same LAN into a Care Group. This lets you:

- View information on the monitor screen from another bed in the same Care Group.
- Be notified of physiological and technical alarm conditions at the other beds in the same Care Group.

You can select up to 10 patient monitors for BeneView T5 and 16 for BeneView T8 and BeneView T9 in a Care Group. To have a Care Group:

1. Open the [**View Other Patient**] window by:
   - Selecting [**Others**] QuickKey, or
   - Selecting [**Screens**] QuickKey  → [**Choose Screen**] → [**View Others Screen**] → ✕, or
   - Selecting [**Main Menu**] → [**Screen Setup >>**] → [**Screen Layout >>**] → [**Choose Screen**] → [**View Others Screen**] → ✕.
2. Select [**Setup**] in the [**View Other Patient**] window.
3. Select the desired patient monitors from the [**Connected Monitor List**], and then select the ✕ button. The selected patient monitors constitute a Care Group.

This monitor can transmit alarms to multiple monitors simultaneously when this monitor is in their Care Groups. However, only four monitors can view simultaneously the waveforms and measurements of this monitor in those monitors' [**View Other Patient**] window. If you want to view the waveforms and measurements of this monitor in the fifth monitor, you need to close the [**View Other Patient**] window in any of the four monitors which are viewing the waveforms and measurements right now.

NOTE

- **Monitors of software version prior to 05.25.00 can not view monitors with [Address Type] configured to [DHCP] and with software version 05.25.00 or later.**

6.4.2 Viewing the Care Group Overview Bar

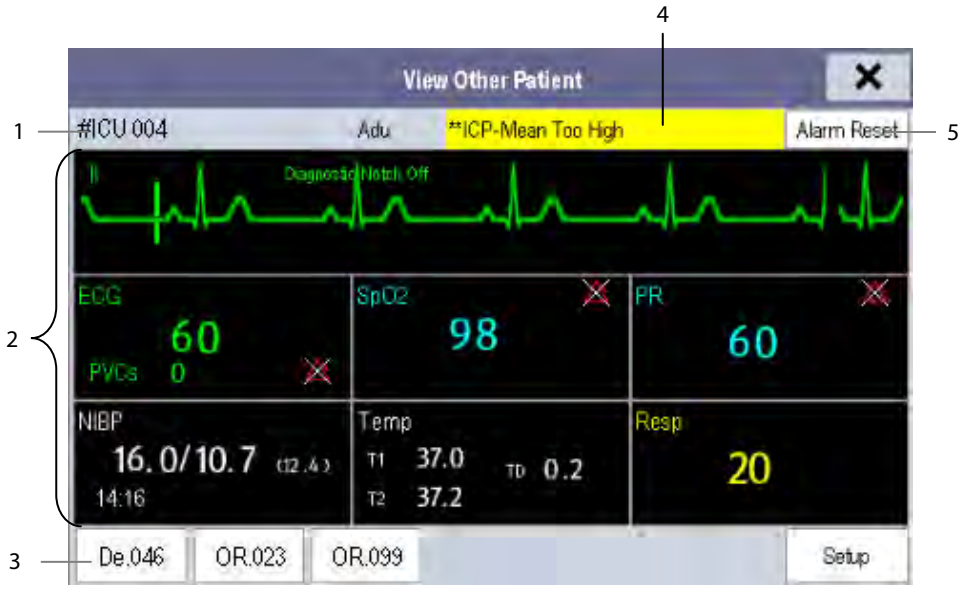
The Care Group overview bar locates at the bottom of the [**View Other Patient**] window. In the overview bar, the department and bed label for any Care Group beds are displayed. For telemetry, # is displayed before the department label. The color in which a Care Group bed appears matches its status:

- Red: indicates the bed is giving high-level physiological alarms or the telemetry is giving alarm, such as nurse call or event.
- Yellow: indicates the bed is giving medium- or low-level physiological alarms, or medium-level technical alarms.
- Blue: indicates the bed is giving low-level technical alarms.
- Grey: indicates the bed fails to be networked or stays in the standby mode.

You can view a Care Group bed's alarms by selecting it from the care group, and as well you can select the [**View This Patient**] button to view this bed in the [**View Other Patient**] window.For more details about Care Group alarms, refer to the ***Alarms*** chapter.

6.4.3 Understanding the View Other Patient Window

When you first open the [**View Other Patient**] window, the patient monitor automatically selects a monitor from the network to display in the [**View Other Patient**] window.



The [**View Other Patient**] window covers the lower part of the waveform area and consists of:

1. Information Area: shows the patient information (including department, bed number, patient name, etc.), and network status symbol.
2. View Area: shows physiological waveforms and parameters. You can switch a waveform area to a parameter area by selecting your desired waveform area and then selecting [**Switch to Parameter Area**], or switch a parameter area to a waveform area by selecting your desired parameter area and then selecting [**Switch to Waveform Area**].
3. Care Group Overview Bar.
4. Message Area: shows physiological, technical and prompt messages from the currently viewed patient monitor. It also shows the alarm given by the telemetry such as nurse call or event. By selecting this area, you can enter the [**Alarm Information List**] to view all physiological, technical and prompt messages coming from the currently viewed patient.
5. [**Alarm Reset**] button

   When [**Reset Other Bed's Alarms**] is set to [**On**] in [**Maintenance**]→[**User Maintenance**]→[**Alarm Setup**], the [**Alarm Reset**] button appears on the [**View Other Patient**] window. You can reset the alarm system for the selected monitor by pressing the button. Refer to ***section 7.12.3 Resetting Care Group Alarms*** for details. When [**Reset Other Bed's Alarms**] is set to [**Off**], there is no button appearing on the [**View Other Patient**] window.

Additionally, you can change a waveform or parameter for viewing

- To change a waveform for viewing, select the waveform segment where you want a new waveform to appear and then select the waveform you want from the popup menu.
- To change a parameter for viewing, select the parameter window where you want a new parameter to appear and then select the parameter you want from the popup menu.

WARNING

- **The data presented in the [View Other Patient] window has a delay. Do not rely on this window for realtime data.**

6.5 Understanding the Big Numerics Screen

To enter the big numerics screen:

1. Select the [**Screens**] QuickKey, or [**Main Menu**]→[**Screen Setup >>**]→[**Screen Layout >>**]→[**Choose Screen**].
2. Select [**Big Numerics**]→.

You can select your desired parameters to display in this screen: select the [**Screens**] QuickKey→[**Big Numerics Screen Setup**] and then select the parameters you want. For parameters having a waveform, the waveform will also be displayed.

7 Balance of Anesthesia (BOA)

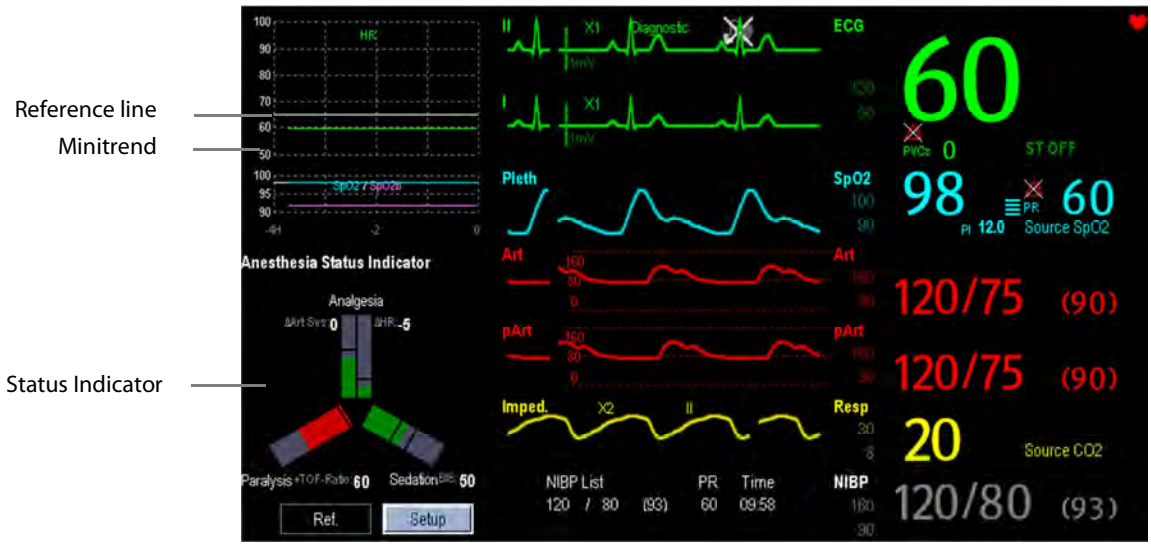
7.1 Introduction

BeneView T5 OR and BeneView T9 OR monitors provide the Balance of Anesthesia (BOA) screen to show parameters required for anesthetic patient. The BOA screen helps the clinicians judge the patient's anesthesia status.

7.2 Accessing the BOA Screen

Access the BOA screen by either of the following methods:

- Select the [**BOA**] QuickKey  .
- Select [**Screens**] QuickKey  →[**Choose Screen**]→[**BOA Screen**]→  .
- Select [**Main Menu**]→[**Screen Setup >>**]→[**Screen Layout >>**]→[**Choose Screen**]→[**BOA Screen**]→  .



7.3 Status Indicators

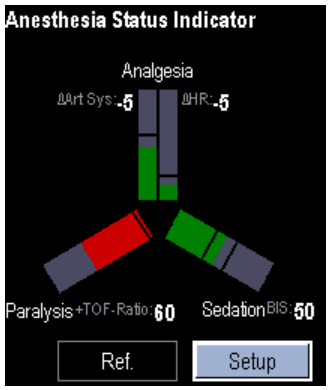
Status indicators include anesthesia status indicator and triple low indicator. Anesthesia status indicator reflects the patient anesthesia status from three dimensions: analgesia, paralysis and sedation. Triple low indicator reflects the duration of the patient's triple low condition. You can adjust the dose of drugs when this patient is in triple low condition, i.e. the BIS, MAC and MAP values are simultaneously below the configured limits.

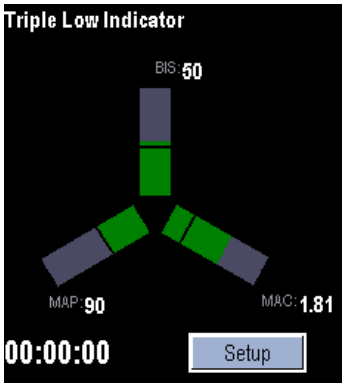
The status indicators provide the following information:

- Each parameter arm represents a parameter.
- The height of the hightlighted part indicates the parameter measurement.
- The color indicates the status of the current parameter:

- The parameter arm is highlighted in green when the parameter measurement is within the normal range.
- The parameter arm is highlighted in red when the parameter measurement is outside the normal range.
- The parameter arm is displayed gray when the system cannot aquire the parameter measurement or the parameter measurement is invalid.

- The black line on the parameter arm represents the threshold of parameter measurement:
  - Two lines are shown if the parameter has both uper and lower limits
  - Only one line is shown if the parameter has only uper limit or lower limit
- The duration of triple low conditon can be viewed in the [**Triple Low Indicator**] area.
- The current HR and Art Sys values can be set as reference values by pressing the [**Ref.**] button in the [**Anesthesia Status Indicator**] area. Refer to section ***7.7Setting the Reference Value***.





7.4 Accessing the BOA Setup Menu

Access the [**BOA Setup**] menu by either of the following methods:

- Select the minitrend area.
- Select the [**Setup**] button in the status indicator area.

7.5 Setting the Minitrend

In the [**Minitrend Setup**] page of the [**BOA Setup**] menu, you can:

- Select the parameters for display.
- Select [**Minitrend Length**] and select a proper length from the dropdown list. If [**Minitrend Length**] is set to [**Auto**], the length can be adjusted automatically.

7.6 Setting the Status Indicators

In the [**Status Indicators**] page of the [**BOA Setup**] menu, you can set the [**Status Indicators**] to:

- [**Anesthesia Status Indicator**]: measurement limits of [**Sedation**], [**Paralysis**], and [**Analgesia**] related parameters can be set.
- [**Triple Low Indicator**]: measurement limits of [**BIS**], [**MAC**], and [**MAP**] can be set.
- [**Off**]: turn the status indicator off.

7.7 Setting the Reference Values

Reference values are used to calculate △HR (difference between HR reference value and the current HR value) and △Art Sys (difference between Art Sys reference value and the current Art Sys value). You can set the reference value of HR and Art Sys by either of the following methods:

- Select [**Ref.**] button in the [**Anesthesia Status Indicator**] area to set current HR and Art sys measurement as reference values.
- In the [**Status Indicator**] page of [**BOA Setup**] menu, set the [**Status Indicators**] to [**Anesthesia Status Indicator**]. Then set the reference value of [**HR**] and [**Art Sys**] in the [**Reference Value**] area.

A horizontal white line is displayed in the minitrend area after the reference value is set.

7.8 Hiding the BOA Screen

For BeneView T5 OR and BeneView T9 OR monitors, the BOA screen is displayed by default when the monitor starts up. You can hide the BOA screen by either of the following methods:

- Select the [**BOA**] QuickKey  to return to the normal screen.
- Select [**Screens**] QuickKey  →[**Choose Screen**], and then select a desired screen.
- Select [**Main Menu**]→[**Screen Setup >>**]→[**Screen Layout >>**]→[**Choose Screen**], and then select a desired screen.

7.9 Reviewing the Trends of Anesthesia Monitoring

You can review the trends of the anesthesia monitoring in the [**Tabular Trends**] page of the [**Review**] menu. Refer to chapter ***32 Review*** for details.

FOR YOUR NOTES

8 Alarms

Alarms, triggered by a vital sign that appears abnormal or by technical problems of the patient monitor, are indicated to the user by visual and audible alarm indications.

⚠WARNING

- **A potential hazard can exist if different alarm presets are used for the same or similar equipment in any single area, e.g. an intensive care unit or cardiac operating room.**
- **If your patient monitor is connected to the central monitoring system (CMS) or other monitors, alarms can be displayed and controlled remotely. Remote suspension, inhibition, or reset of monitor alarms via the CMS or other monitors may cause a potential hazard. For details, refer to the operator's manual of the CMS and the other monitors.**

8.1 Alarm Categories

By nature, the patient monitor's alarms can be classified into three categories: physiological alarms, technical alarms and prompt messages.

1. Physiological alarms

   Physiological alarms, also called patient status alarms, are triggered by a monitored parameter value that violates set alarm limits or an abnormal patient condition. Physiological alarm messages are displayed in the physiological alarm area.

2. Technical alarms

   Technical alarms, also called system status alarms, are triggered by a device malfunction or a patient data distortion due to improper operation or mechanical problems. Technical alarm messages are displayed in the technical alarm area.

Apart from the physiological and technical alarm messages, the patient monitor shows some messages telling the system status or patient status. Messages of this kind are included into the prompt message category and usually displayed in the prompt information area. Some prompt messages that indicate the arrhythmia events are displayed in the physiological alarm area. For some measurements, their related prompt messages are displayed in their respective parameter windows.

8.2 Alarm Levels

By severity, the patient monitor's alarms can be classified into three categories: high level, medium level and low level.

	Physiological alarms	Technical alarms
High level	Indicate that your patient is in a life threatening situation, such as Asystole, Vfib/Vtac and so forth, and an emergency treatment is demanded.	Indicate a severe device malfunction or an improper operation, which could make it possible that the monitor cannot detect critical patient status and thus threaten the patient's life.
Medium level	Indicate that your patient's vital signs appear abnormal and an immediate treatment is required.	Indicate a device malfunction or an improper operation, which may not threaten the patient's life but may compromise the monitoring of vital physiological parameters.
Low level	Indicate that you patient's vital signs appear abnormal and an immediate treatment may be required.	Indicate a device malfunction or an improper operation, which may compromise a certain monitoring function but will not threaten the patient's life.

8.3 Alarm Indicators

When an alarm occurs, the patient monitor will indicate it to the user through visual or audible alarm indications.

- Alarm lamp
- Alarm message
- Flashing numeric
- Audible alarm tones

8.3.1 Alarm Lamp

If a technical alarm occurs, the technical alarm lamp will turn blue. If a technical alarm or physiological alarm occurs, the alarm lamp will flash. The flashing color and frequency match the alarm level as follows:

- High level alarms: the lamp quickly flashes red.
- Medium level alarms: the lamp slowly flashes yellow.
- Low level physiological alarms: the lamp turns yellow without flashing.
- Low level technical alarms: the lamp does not light.

8.3.2 Alarm Message

When an alarm occurs, an alarm message will appear in the technical or physiological alarm area. For physiological alarms, the asterisk symbols (*) before the alarm message match the alarm level as follows:

- High level alarms: ***
- Medium level alarms: **
- Low level alarms: *

Additionally, the alarm message uses different background color to match the alarm level:

- High level alarms: red
- Medium level alarms: yellow
- Low level physiological alarms: yellow
- Low level technical alarms: blue

You can view the alarm messages by selecting the physiological or technical alarm area.

8.3.3 Flashing Numeric

If an alarm triggered by an alarm limit violation occurs, the numeric of the measurement in alarm will flash every second, and the corresponding alarm limit will also flash at the same frequency indicating the high or low alarm limit is violated.

8.3.4 Audible Alarm Tones

The alarm tone is distinct from heart beat tone, keystroke tone and pulse tone in frequency. This monitor has three choices of alarm tones and patterns: ISO, Mode 1 and Mode 2. For each pattern, the alarm tones identify the alarm levels as follows:

- ISO pattern:
  - High level alarms: triple+double+triple+double beep.
  - Medium level alarms: triple beep.
  - Low level alarms: single beep.
- Mode 1:
  - High level alarms: high-pitched single beep.
  - Medium level alarms: double beep.
  - Low level alarms: low-pitched single beep.
- Mode 2:
  - High level alarms: high-pitched triple beep.
  - Medium level alarms: double beep.
  - Low level alarms: low-pitched single beep.

NOTE

- **When multiple alarms of different levels occur simultaneously, the patient monitor will select the alarm of the highest level to light the alarm lamp and give alarm sounds accordingly, while all the alarm messages are displayed circularly on the screen.**
- **Some physiological alarms, such as asystole, are exclusive. They have identical alarm tones and alarm lights with normal high level physiological alarms, but their alarm messages are displayed exclusively. That is to say, when an exclusive physiological alarm and a normal high level physiological alarm are triggered simultaneously, only alarm message of the exclusive physiological alarm is displayed.**

8.3.5 Alarm Status Symbols

Apart from the aforementioned alarm indicators, the patient monitor still uses the following symbols telling the alarm status:

-  indicates alarms are paused.
-  indicates alarms are reset.
-  indicates the alarm sound is turned off.
-  indicates individual measurement alarms are turned off or the system is in alarm off status.

8.4 Alarm Tone Configuration

8.4.1 Setting the Minimum Alarm Volume

1. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password.
2. Select [**Alarm Setup >>**] to enter the [**Alarm Setup**] menu.
3. Select [**Minimum Alarm Volume**] and toggle between 0 and 10.

The minimum alarm volume refers to the minimum value you can set for the alarm volume, which is not affected by user or factory default configurations. The setting of minimum alarm volume remains unchanged when the patient monitor shuts down and restarts.

8.4.2 Changing the Alarm Volume

1. Select the [**Volume Setup**] QuickKey or the [**Alarm Setup**] QuickKey→[**Others**], or [**Main Menu**]→[**Alarm Setup >>**]→[**Others**].
2. Select the appropriate volume from [**Alm Volume**]: X-10, in which X is the minimum volume, depending on the set minimum alarm volume, and 10 the maximum volume.
3. Select [**High Alarm Volume**] to set the volume of the high priority alarm as [**Alm Volume+0**], [**Alm Volume+1**] or [**Alm Volume+2**].
4. Select [**Reminder Vol**] to set the volume of the reminder tone as **[High**], [**Med**] or [**Low**].

When alarm volume is set to 0, the alarm sound is turned off and a  symbol appears on the screen.

8.4.3 Setting the Interval between Alarm Sounds

You cannot change the interval between alarm tones if you choose mode 1 or 2 as your desired alarm tone pattern. For these two patterns, the interval between alarm tones identifies the alarm levels as follows:

- Mode 1:
  - Interval between high level alarm tones: continuously.
  - Interval between medium level alarm tones: 5 s.
  - Interval between low level alarm tones: 20 s.
- Mode 2:
  - Interval between high level alarm tones: 1 s.
  - Interval between medium level alarm tones: 5 s.
  - Interval between low level alarm tones: 20 s.

If you choose the ISO pattern, you can change the interval between alarm tones. To change the interval between alarm tones:

1. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password.
2. Select [**Alarm Setup >>**] to enter the [**Alarm Setup**] menu.
3. Select [**High Alarm Interval (s)**], [**Med Alarm Interval (s)**] and [**Low Alarm Interval (s)**] in turn and then select the appropriate settings.

⚠ WARNING

- **When the alarm sound is switched off, the patient monitor will give no audible alarm tones even if a new alarm occurs. Therefore the user should be very careful about whether to switch off the alarm sound or not.**
- **Do not rely exclusively on the audible alarm system for patient monitoring. Adjustment of alarm volume to a low level may result in a hazard to the patient. Always keep the patient under close surveillance.**

8.4.4 Changing the Alarm Tone Pattern

To change the alarm tone pattern:

1. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password.
2. Select [**Alarm Setup >>**] to enter the [**Alarm Setup**] menu.
3. Select [**Alarm Sound**] and toggle between [**ISO**], [**Mode 1**] and [**Mode 2**].

User or factory default configurations exert no impact on the setup of alarm tone pattern. The alarm tone pattern remains unchanged after the monitor restarts.

8.4.5 Setting the Reminder Tones

When the alarm volume is set to zero, or the alarm is reset or switched off, the patient monitor issues a periodical reminder tone.

1. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password.
2. Select [**Alarm Setup >>**] to enter the [**Alarm Setup**] menu.
3. Set the [**Reminder Tones**] to [**On**], [**Off**] or [**Re-alarm**]. When [**Re-alarm**] is selected, the acknowledged physiological alarms and technical alarms marked with " √ " will be re-generated after the [**Reminder Interval**] if the alarm condition persists.

To set the interval between reminder tones, select [**Reminder Interval**] and toggle between [**1min**], [**2min**] and [**3min**].

In addition, you can set the volume of alarm reminder tones. To set the volume of alarm reminder tones, select [**Main Menu**]→[**Alarm Setup >>**]→[**Others**] or the [**Alarm Setup**] QuickKey→[**Others**]. Then, select [**Reminder Vol**] and toggle between [**High**], [**Medium**] and [**Low**].

8.5 Understanding the Alarm Setup Menu

Select the [**Alarm Setup**] QuickKey or [**Main Menu**]→[**Alarm Setup >>**] to enter the [**Alarm Setup**], where you can:

- Set alarm properties for all parameters.
- Change ST alarm settings.
- Change arrhythmia alarm settings.
- Set the threshold for some arrhythmia alarms.
- Change other settings.

Please refer to the ***ECG*** section for how to change ST alarm settings, how to change arrhythmia alarm settings and how to set the threshold for some arrhythmia alarms.

8.5.1 Setting Alarm Properties for All Parameters

In the main menu, select [**Alarm Setup >>**]→[**Parameters**]. You can review and set alarm limits, alarm switches, alarm level and alarm recordings for all parameters.

When a measurement alarm occurs, automatic recording of all the measurement numerics and related waveforms is possible when the measurement's [**On/Off**] and [**Record**] are set to on.

⚠WARNING

- **Make sure that the alarm limits settings are appropriate for your patient before monitoring.**
- **Setting alarm limits to extreme values may cause the alarm system to become ineffective. For example, High oxygen levels may predispose a premature infant to retrolental fibroplasia. If this is a consideration do NOT set the high alarm limit to 100%, which is equivalent to switching the alarm off.**
- **When monitoring patients that are not continuously attended by a clinical operator, properly configure the alarm system and adjust alarm settings as per the patient's condition.**

8.5.2 Adjusting Alarm Limits Automatically

The monitor can automatically adjust alarm limits according to the measured vital signs, using the auto limits function. When auto limits are selected, the monitor calculates safe auto limits based on the latest measured values.

To get accurate auto alarm limits, you need to collect a set of measured vital signs as a baseline. Then, in the main menu, select [**Alarm Setup >>**]→[**Parameters**]→[**Auto Limits**] →[**Ok**]. The monitor will create new alarm limits based on the measured values.

Before applying these automatically created alarm limits, confirm if they are appropriate for your patient in the mass alarm setup menu. If not, you can adjust them manually. These alarm limits will remain unchanged until you select auto limits again or adjust them manually.

The monitor calculates the auto limits based on the following rules.

Module	Parameter	Low alarm limit		High alarm limit		Auto alarm limits range
		Adult/ pediatric	Neonate	Adult/ pediatric	Neonate	
ECG	HR/PR	HR × 0.8 or 40bpm (whichever is greater)	(HR – 30) or 90bpm (whichever is greater)	HR × 1.25 or 240bpm (whichever is smalle)	(HR + 40) or 200bpm (whichever is smaller)	Adult/pediatric: 35 to 240 Neonate: 55 to 225
Resp	RR	RR × 0.5 or 6 rpm (whichever is greater)	(RR – 10) or 30 rpm (whichever is greater)	RR × 1.5 or 30 rpm (whichever is smaller)	(RR + 25) or 85 rpm (whichever is smaller)	Adult/pediatric: 6 to 55 Neonate: 10 to 90
SpO_2	SpO_2	Same as the default alarm limit	Same as the default alarm limit	Same as the default alarm limit	Same as the default alarm limit	Same as the measurement range

Module	Parameter	Low alarm limit		High alarm limit		Auto alarm limits range
		Adult/ pediatric	Neonate	Adult/ pediatric	Neonate	
NIBP	NIBP-S	(SYS × 0.68 + 10) mmHg	(SYS – 15) or 45mmHg (whichever is greater)	(SYS × 0.86 + 38) mmHg	(SYS + 15) or 105mmHg (whichever is smaller)	Adult: 45 to 270 Pediatric: 45 to 185 Neonate: 40 to 115
	NIBP-D	(Dia × 0.68 + 6) mmHg	(Dia – 15) or 20mmHg (whichever is greater)	(Dia × 0.86 + 32) mmHg	(Dia + 15) or 80mmHg (whichever is smaller)	Adult: 25 to 210 Pediatric: 25 to 150 Neonate: 20 to 90
	NIBP-M	(Mean × 0.68 + 8) mmHg	(Mean – 15) or 35mmHg (whichever is greater)	(Mean × 0.86 + 35) mmHg	(Mean + 15) or 95mmHg (whichever is smaller)	Adult: 30 to 230 Pediatric: 30 to 165 Neonate: 25 to 105
Temp	T1	(T1 – 0.5)℃	(T1 – 0.5) ℃	(T1 + 0.5)℃	(T1 + 0.5)℃	1 to 49 ℃
	T2	(T2 – 0.5)℃	(T2 – 0.5) ℃	(T2 + 0.5)℃	(T2 + 0.5)℃	1 to 49 ℃
	TD	Same as the default alarm limit	Same as the default alarm limit	Same as the default alarm limit	Same as the default alarm limit	Same as the measurement range
IBP：ART/ Ao/ UAP/ BAP/ FAP/ LV/ P1-P4 (Arterial pressure)	IBP-S	(SYS × 0.68＋10) mmHg	(SYS – 15) or 45mmHg (whichever is greater)	(SYS × 0.86＋38) mmHg	(SYS + 15) or 105mmHg (whichever is smaller)	Adult: 45 to 270 Pediatric: 45 to 185 Neonate: 35 to 115
	IBP-D	(Dia × 0.68＋ 6)mmHg	(Dia – 15) or 20mmHg (whichever is greater)	(Dia × 0.86＋ 32)mmHg	(Dia + 15) or 80mmHg (whichever is smaller)	Adult: 25 to 225 Pediatric: 25 to 150 Neonate: 20 to 90
	IBP-M	(Mean × 0.68 + 8)mmHg	(Mean – 15) or 35mmHg (whichever is greater)	(Mean × 0.86 + 35)mmHg	(Mean + 15) or 95mmHg (whichever is smaller)	Adult: 30 to 245 Pediatric: 30 to 180 Neonate: 25 to 105
IBP: PA	IBP-S	SYS × 0.75	SYS × 0.75	SYS × 1.25	SYS × 1.25	3 to 120mmHg
	IBP-D	Dia × 0.75	Dia × 0.75	Dia × 1.25	Dia × 1.25	
	IBP-M	Mean × 0.75	Mean × 0.75	Mean × 1.25	Mean × 1.25	
IBP: CVP/ ICP/ LAP/ RAP/ UVP/ P1-P4 (Venous pressure)	IBP-M	Mean × 0.75	Mean × 0.75	Mean × 1.25	Mean × 1.25	3 to 40mmHg

Module	Parameter	Low alarm limit		High alarm limit		Auto alarm limits range
		Adult/ pediatric	Neonate	Adult/ pediatric	Neonate	
IBP: CPP	CPP	CPP × 0.68 + 8mmHg	(CPP – 15) or 35mmHg (whichever is greater)	CPP × 0.86＋ 35mmHg	(CPP＋15) or 95mmHg (whichever is smaller)	Adult: 20 to 235 mmHg Pediatric: 25 to 175 mmHg Neonate: 25 to 100 mmHg
CO_2	$EtCO_2$	0 to 32mmHg: remains the same	0 to 32mmHg: remains the same	0 to 32mmHg: remains the same	0 to 32mmHg: remains the same	Same as the measurement range
		32 to 35mmHg: 29mmHg	32 to 35mmHg: 29mmHg	32 to 35mmHg: 41mmHg	32 to 35mmHg: 41mmHg	
		35 to 45mmHg: (etCO2-6) mmHg	35 to 45mmHg: (etCO2-6) mmHg	35 to 45mmHg: (etCO2+6) mmHg	35 to 45mmHg: (etCO2+6) mmHg	
		45 to 48mmHg:39 mmHg	45 to 48mmHg:39 mmHg	45 to 48mmHg:51 mmHg	45 to 48mmHg:51 mmHg	
		>48mmHg: remains the same	>48mmHg: remains the same	>48mmHg: remains the same	>48mmHg: remains the same	
	$FiCO_2$	N/A	N/A	Same as the default alarm limit	Same as the default alarm limit	Same as the measurement range
	awRR	awRR × 0.5 or 6 rpm (whichever is greater)	(awRR – 10) or 30 rpm (whichever is greater)	awRR × 1.5 or 30 rpm (whichever is smaller)	(awRR+25) or 85 rpm (whichever is smaller)	Adult/pediatric: 6 to 55 Neonate: 10 to 90
AG	$EtCO_2$ (AG)	Same as CO_2 module				
	$FiCO_2$ (AG)					
	awRR	awRR × 0.5 or 6 rpm (whichever is greater)	awRR – 10 or 30 rpm (whichever is greater)	awRR × 1.5 or 30 rpm (whichever is smaller)	awRR+25 or 85 rpm (whichever is smaller)	Adult/pediatric: 6 to 55 Neonate: 10 to 90

Module	Parameter	Low alarm limit		High alarm limit		Auto alarm limits range
		Adult/ pediatric	Neonate	Adult/ pediatric	Neonate	
	FiAA/ EtAA	Same as the default alarm limit	Same as the default alarm limit	Same as the default alarm limit	Same as the default alarm limit	Same as the measurement range
	FiO_2/ $EtCO_2$	Same as the default alarm limit	Same as the default alarm limit	Same as the default alarm limit	Same as the default alarm limit	Same as the measurement range
	FiN_2O/ EtN_2O	Same as the default alarm limit	Same as the default alarm limit	Same as the default alarm limit	Same as the default alarm limit	Same as the measurement range
C.O.	BT	Adult: (BT – 1)℃	N/A	Adult: (BT – 1)℃	N/A	Same as the measurement range
ICG	C.I. TFC	N/A				
RM	RR(RM)	awRR × 0.5 or 6 rpm (whichever is greater)	N/A	awRR × 1.5 or 30 rpm (whichever is smaller)	N/A	Adult/pediatric: 6 to 55 Neonate: 10 to 90
	PEEP	(PEEP – 5) cmH_2O	N/A	(PEEP＋5) cmH_2O	N/A	Same as the measurement range
	PIP	(PIP – 10) cmH_2O	N/A	(PIP＋10) cmH_2O	N/A	Same as the measurement range
	MVe	(MVe – 2) L/min	N/A	(MVe＋2) L/min	N/A	Same as the measurement range
BIS	BIS	N/A				
CCO	CCO/ CCI, EDV/ EDVI, SVR/ SVRI, SV/SVI, RVEF	N/A				
SvO_2	SvO_2	(SvO_2 – 5)%	N/A	(SvO_2 + 5)%	N/A	Same as the measurement range
	$ScvO_2$	($ScvO_2$ – 5)%	N/A	($ScvO_2$ + 5)%	N/A	Same as the measurement range

8.5.3 Setting Alarm Delay Time

You can set the alarm delay time for over-limit alarms of continuously measured parameters. If the alarm-triggered condition disappears within the delay time, the patient monitor will not give the alarm.

To set the alarm delay time,

1. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]. Enter the required password and then select [**Ok**].
2. Select [**Alarm Setup >>**]→[**Alarm Delay**].

Alarm delay is not applied to the following physiological alarms:

- Appnea
- ST alarms
- Arrhythmia alarms
- ECG Weak Signal
- Resp Artifact
- No Pulse
- Nellcor SpO_2 over alarm limits
- FiO_2 Shortage
- Measurements of noncontinuous parameters over alarm limits
- HR over alarm limits
- Anesthetic Mixture's MAC >3

You can set [**Apnea Delay**] and [**ST Alarm Delay**] separately.

8.5.4 Setting SpO_2 Technical Alarm Delay

You can set [**Tech. Alarm Delay**] in the [**Others**] tab of the [**Alarm Setup**] menu. The options are [**Off**], [**5s**], [**10s**] and [**15s**]. The delay is effective to the following technical alarms: SpO_2 Sensor Off, SpO_2 Too Much Light, SpO_2 Low Signal and SpO_2 Interference.

8.5.5 Setting Recording Length

You can change the length of the recorded waveforms. In the [**Others**] window of the [**Alarm Setup**] menu, select [**Recording Length**] and toggle between [**8 s**], [**16 s**] and [**32 s**]:

- [**8 s**]: 4 seconds respectively before and after the alarm or manual event trigger moment.
- [**16 s**]: 8 seconds respectively before and after the alarm or manual event trigger moment.
- [**32 s**]: 16 seconds respectively before and after the alarm or manual event trigger moment.

8.5.6 Entering CPB Mode

When performing Cardiopulmonary bypass (CPB), you can set the patient monitor to enter CPB mode in order to reduce unnecessary alarms. The CPB mode is activated only if you select [**OR**]. To select [**OR**],

1. Press the hardkey on the monitor's front panel to enter [**Main Menu**].
2. Select [**Maintenance >>**]→[**Manage Configuration >>**]. Enter the required password and then select [**Ok**].
3. Select [**Change Department >>**]→[**OR**].

In the CPB mode, all the physiological alarms, technical alarms and prompt messages are switched off except for BIS, tcGas and NMT related alarms. In CPB mode, [**CPB Mode**] is displayed in the physiological alarm area with red background color.

To enter CPB mode, select the [**CPB Mode**] Quickkey or select [**Enter CPB Mode**] in the [**Others**] window of the [**Alarm Setup**] menu. Then select [**Ok**] in the popup dialog box.

8.6 Intubation Mode

When performing intubation during general anesthesia, you can set the patient monitor to enter intubation mode in order to reduce unnecessary alarms. Intubation mode is available for Resp, CO_2, AG and RM parameters. In the setup menu of these parameters, you can choose [**Intubation Mode**] button to disable respective physiological alarms.

The default intubation time is 2 minutes. You can also change the time by following this procedure:

1. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password.
2. Select [**Alarm Setup >>**], and set the [**Intubation Mode Period**] to [**1 min**], [**2 min**], [**3 min**], or [**5 min**].

8.7 Pausing Alarms

If you want to temporarily prevent alarms from sounding, you can pause alarms by pressing the hardkey on the monitor's front. When alarms are paused:

- No alarm lamps flash and no alarms are sounded.
- No numeric and alarm limit flash.
- No alarm messages are shown.
- The remaining pause time is displayed in the physiological alarm area.
- The  alarms paused symbol is displayed in the alarm symbol area.

The patient monitor enters into the alarm paused status as soon as it is turned on. The alarm pause time is fixed to be 2 minutes.

When the alarm pause time expires, the alarm paused status is automatically cancelled and the alarm tone will sound. You can also cancel the alarm paused status by pressing the hardkey.

The alarm pause time can be set to [**1 min**], [**2 min**], [**3 min**], [**5 min**], [**10 min**], [**15 min**] or [**Permanent**]. The default alarm pause time is 2 minutes.

1. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password.
2. Select [**Alarm Setup >>**]→[**Alarm Pause Time**] and then select the appropriate setting from the popup list.

You can also temporarily prolong the alarm pause time after the monitor enters the alarm paused status:

1. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password→[**Alarm Setup >>**].
2. In the [**Alarm Setup**] menu, set the [**Max. Alarm Pause 15min**] to [**Enable**].
3. In the physiological alarm area, select a proper time in the [**Alarm Pause Time**] menu.

NOTE

- **[Max. Alarm Pause 15min] is configured to [Disable] by default. In this case, you cannot prolong the pause time.The prolonged pause time is only effective to the current paused alarms.**

8.8 Switching Off All Alarms

If [**Alarm Pause Time**] is set to [**Permanent**], the patient monitor will enter into the alarm off status after the hardkey is pressed. During the alarm off status,

- As for physiological alarms, no alarm lamps flash and no alarms are sounded.
- As for physiological alarms, no numeric and alarm limit flash.
- No physiological alarm messages are shown.
- [**Alarm Off**] is displayed in the physiological alarm area with red background.
- As for technical alarms, no alarms are sounded.
- The alarm off symbol is displayed in the sound symbol area.

You can cancel the alarm off status by pressing the hardkey.

WARNING

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

8.9 Resetting Alarms

By selecting the  QuickKey, you can reset the alarm system to acknowledging the on-going alarms and enable the alarm system to respond to a subsequent alarm condition.

For physiological alarms, except the NIBP-related alarms, when the alarm system is reset:

- The alarm sound is silenced.
- A √ appears before the alarm message, indicating that the alarm is acknowledged.
- The icon  appears in the alarm symbol area.
- The parameter numeric and alarm limits still flash.

The indication of alarm lamp for the physiological alarm depends on the alarm light setting.

- When [**Alarm Light on Alarm Reset**] is set to [**On**], the alarm lamp remains flashing.
- When [**Alarm Light on Alarm Reset**] is set to [**Off**], the alarm lamp stops flashing.

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

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

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

To set [**Alarm Light on Alarm Reset**]:

1. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password.
2. Select [**Alarm Setup >>**] to enter the [**Alarm Setup**] menu.
3. Select [**Alarm Light on Alarm Reset**], and toggle between [**On**] and [**Off**].

The default setting for [**Alarm Light on Alarm Reset**] is [**On**].

8.10 Latching Alarms

The alarm latching setting for your patient monitor defines how the indicators of the physiological alarms behave when you do not acknowledge them:

- If you do not "latch" the physiological alarms, their alarm indications disappear when the alarm condition ends.
- If you "latch" the physiological alarms, all visual and audible alarm indications last until you acknowledge the alarms, except that the measurement numeric and violated alarm limit stop flashing as soon as the initial alarm condition goes away.

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

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

To latch a physiological alarm:

1. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password.
2. Select [**Alarm Setup** >>]→[**Latching Alarms>>**].
3. In the [**Latching Alarms**] menu, select how you want to latch the alarms.

The rules for latching the alarms are:

- You can separately select [**Latching Visual Signal**].
- Selecting [**Latching Audible Signal**] simultaneously latches the visual signal.
- Selecting alarms of lower priority simultaneously latches the alarms of higher priority.

NOTE

- **Changing of alarm priority may affect the latching status of corresponding alarm. Please determine if you need to reset the latching status for the specific alarm when you have changed its alarm priority.**
- **When the alarm system is reset, the latched physiological alarms are cleared.**

8.11 Testing Alarms

When the monitor starts up, a selftest is performed. In the meantime, the start-up screens are displayed, and the technical alarm lamp and alarm lamp are lit in blue and yellow respectively. Then, the alarm lamp turns into red, and turns off together with the technical alarm lamp after the system gives a beep. This indicates that the visible and audible alarm indicators are functioning correctly.

For further testing of individual measurement alarms, perform the measurement on yourself (for example SpO_2 or CO_2) or use a simulator. Adjust alarm limits and check that appropriate alarm behaviour is observed.

8.12 Using Care Group Alarms

8.12.1 Care Group Auto Alarms

When a Care Group is set up on your monitor, a flashing symbol will appear beside the QuickKeys area if any monitor in your Care Group, which is not currently viewed by your monitor, is alarming. The alarm symbol is shown as below.

The background colors of the alarm symbols indicate alarm levels, and are the same as those of corresponding alarm messages. If multiple alarms are active in the Care Group, the background color is the same as that of the highest-level alarm message. If low level physiological alarm and technical alarm are active simultaneously, the background color of the alarm symbol is yellow. For more information about the alarm message and background color, see 8.3.2 ***Alarm Message***.

When a patient monitor in the Care Group is disconnected, the flashing symbol is shown as below.

The department and bed label of the alarming monitor appear on the symbols. You can enter the view other patient window by pressing the symbol.

8.12.2 Resetting Care Group Alarms

You can reset the alarms presented on the viewed bed by pressing the [**Alarm Reset**] from the current monitor's [**View Other Patient**] window. To enable this function:

1. Select [**Main Menu**]→[**Maintenance>>**]→[**User Maintenance>>**]→enter the required password→[**Alarm Setup>>**]→[**Other Bed Alarm Setup>>**].
2. Set [**Reset Other Bed's Alarms**] to [**On**].

The alarms presented on the current monitor can also be reset from another monitor viewing this monitor. To do so, proceed as follows:

1. In the current monitor, select [**Main Menu**]→[**Maintenance>>**]→[**User Maintenance>>**]→enter the required password→[**Alarm Setup>>**]→[**Other Bed Alarm Setup>>**].
2. Set [**Alarm Reset By Other Bed**] to [**On**].
3. In the other monitor, select the [**Alarm Reset**] button from the [**View Other Patient**] window.

WARNING

- **Resetting care group alarms may cause a potential hazard. Please act with caution.**

8.12.3 Switching Off the Remote Device Disconnection Alarm

The monitor can provide an alarm if a viewed bed device is disconnected. By default, the function is enabled. To disable the alarm, follow this procedure:

1. In the current monitor, select [**Main Menu**]→[**Maintenance>>**]→[**User Maintenance>>**]→enter the required password→[**Alarm Setup>>**]→[**Other Bed Alarm Setup>>**].
2. Set [**Other Bed Disconnection Alm**] to [**Off**].

8.12.4 Setting Care Group Alert Tone

8.12.4.1 Setting the Alarm Reminder

When a monitor in the Care Group issues an alarm, your patient monitor prompts you by giving alert tone. To set the alert tone, follow this procedure:

1. In the current monitor, select [**Main Menu**]→[**Maintenance>>**]→[**User Maintenance>>**]→enter the required password→[**Alarm Setup>>**]→[**Other Bed Alarm Setup>>**].
2. Set the [**Alarm Reminder**].
   - [**Repeat**]: The monitor gives continuous alert tone when the alarm occurs at the viewed bed is the same level as the setup level in the monitor. To set which alarm level applies to continuous alert tone, see section ***8.12.4.2Setting the Alarm Level***.
   - [**Once**]: The monitor gives a single alert tone when an alarm occurs at the viewed bed.
   - [**Off**]: The monitor do not give any alert tone when an alarm occurs at the viewed bed.

8.12.4.2 Setting the Alarm Level

When [**Alarm Reminder**] is set to [**Repeat**], you can set which alarm level of the viewed bed alarm applies to the continuous alert tone. To set the alarm level of the viewed bed alarm, follow this procedure:

1. In the current monitor, select [**Main Menu**]→[**Maintenance>>**]→[**User Maintenance>>**]→enter the required password→[**Alarm Setup>>**]→[**Other Bed Alarm Setup>>**].
2. Set the [**Alarm Lev**].
   - [**All**]: This monitor gives continous alert tone to all the alarms of the viewed bed when [**Alarm Reminder**] is set to [**Repeat**].
   - [**High Only**]: This monitor gives continous alert tone only to high level alarms of the viewed bed when [**Alarm Reminder**] is set to [**Repeat**].
   - [**High&Med**]: This monitor gives continous alert tone to high level and mediate level alarms of the viewed bed when [**Alarm Reminder**] is set to [**Repeat**].

NOTE

- **The setting of the [Alarm Lev] is valid only when [Alarm Reminder] is set to [Repeat].**

8.13 When an Alarm Occurs

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

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

For troubleshooting specific alarms, see appendix ***D Alarm Messages***.

9 Monitoring ECG

9.1 Introduction

The electrocardiogram (ECG) measures the electrical activity of the heart and displays it on the patient monitor as a waveform and a numeric. This patient monitor measures ECG using the MPM module or the BeneView T1. ECG monitoring provides the following algorithms:

- Mindray algorithm

  The Mindray algorithm enables 3-, 5- and 12-lead ECG monitoring, ST-segment analysis, arrhythmia analysis and interpretation of resting 12-lead ECG.

- Mortara algorithm

  The Mortara algorithm enables 3-, 5- and 12-lead ECG monitoring, ST-segment analysis and arrhythmia analysis.

- Glasgow algorithm

Glasgow algorithm provides resting 12-lead ECG analysis.

You can select algorithms as required. The MPM module or the BeneView T1 incorporating Mortara algorithm is labelled with the logo of Mortara. The MPM module or the BeneView T1 incorporating Glasgow algorithm is labelled with the logo of Glasgow.

9.2 Safety

⚠ WARNING

- **Use only ECG electrodes and cables specified by the manufacturer.**
- **Make sure the conductive parts of electrodes and associated connectors for applied parts, including the neutral electrode, should not contact any other conductive parts including earth.**
- **Periodically inspect the electrode application site to ensure skin quality. If the skin quality changes, replace the electrodes or change the application site.**
- **Use defibrillation-proof ECG cables during defibrillation.**
- **Do not touch the patient, or table, or instruments during defibrillation.**
- **This equipment is not suitable for direct cardiac application.**
- **To reduce the hazard of burns during high-frequency surgical procedure, ensure that the monitor's cables and transducers never come into contact with the electro-surgery unit (ESU).**
- **The neutral electrode of the electro-surgery unit (ESU) shall properly contact the patient. Otherwise, burns may result.**

⚠CAUTION

- **Interference from a non-grounded instrument near the patient and electrosurgery interference can cause problems with the waveform.**

NOTE

- **After defibrillation, the screen display recovers within 10 seconds if the correct electrodes are used and applied in accordance with the manufacturer's instructions for use.**

9.3 Preparing to Monitor ECG

9.3.1 Preparing the Patient and Placing the Electrodes

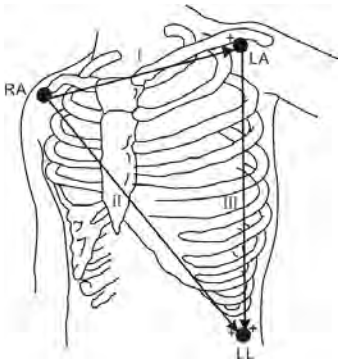
1. Prepare the patient's skin. Proper skin preparation is necessary for good signal quality at the electrode site, as the skin is a poor conductor of electricity. To properly prepare the skin, choose flat areas and then follow this procedure:
   - ◆ Shave hair from skin at chosen sites.
   - ◆ Gently rub skin surface at sites to remove dead skin cells.
   - ◆ Thoroughly cleanse the site with a mild soap and water solution. We do not recommend using ether or pure alcohol, because this dries the skin and increases the resistance.
   - ◆ Dry the skin completely before applying the electrodes.
2. Attach the clips or snaps to the electrodes before placing them.
3. Place the electrodes on the patient.
4. Attach the electrode cable to the patient cable and then plug the patient cable into the ECG connector on the MPM or the BeneView T1.

9.3.2 Choosing AHA or IEC Lead Placement

1. Select the ECG parameter window or waveform area to enter the [**ECG Setup**] menu.
2. Select [**Others >>**]→[**Lead Set**] and then select [**3-lead**], [**5-lead**], [**12-lead**] or [**Auto**] according to the applied electrodes.
3. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password.
4. Select [**Others >>**]→[**ECG Standard**] and then select [**AHA**] or [**IEC**] according to the standard that is applied for your hospital.

9.3.3 ECG Lead Placements

The electrode placement illustrations in this chapter adopt the AHA standard.



3-Leadwire Electrode Placement

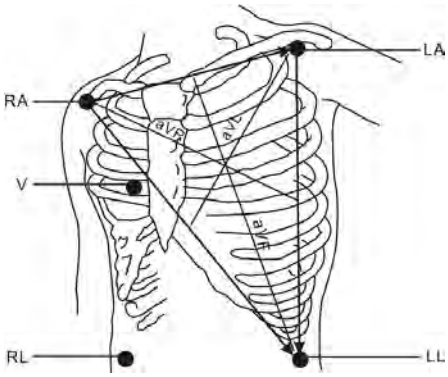
Following is an electrode configuration when using 3 leadwires:

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

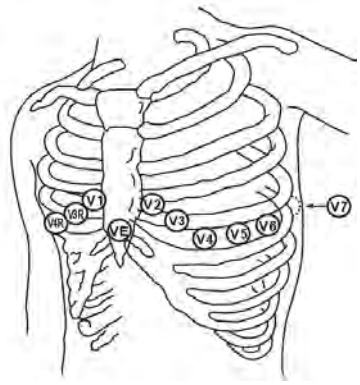
5-Leadwire Electrode Placement

Following is an electrode configuration when using 5 leadwires:

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



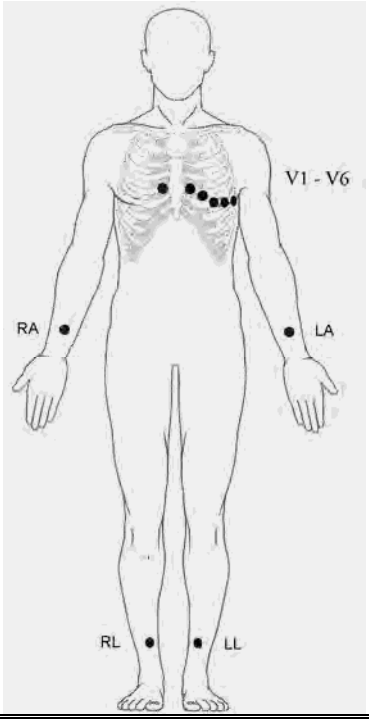
The chest (V) electrode can be placed on one of the following positions:



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

12-Leadwire Electrode Placement

12-lead ECG uses 10 electrodes, which are placed on the patient's four limbs and chest. The limb electrodes should be placed on the soft skin and the chest electrodes placed according to the physician's preference.



Lead Placement for Surgical Patients

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

WARNING

- **When using an electrosurgery unit (ESU), ensure proper contact of the ESU's return electrode to the patient to avoid burns at the monitor measurement site. Never entangle the ESU cable and the ECG cable together.**
- **When using electrosurgical units (ESU), never place ECG electrodes near to the return electrode of the ESU, as this can cause a lot of interference on the ECG signal.**

9.3.4 Checking Paced Status

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

To change the paced status, you can select either:

- the patient information area, or
- [**Main Menu**]→[**Patient Setup**]→[**Patient Demographics**], or,
- the ECG parameter window or waveform area→[**Others >>**], and then, select [**Paced**] from the popup menu and toggle between [**Yes**] and [**No**].

If you do not set the paced status, the patient monitor issues a prompt tone when pace pulse is detected. At the same time, the paced symbol flashes and the message "Please confirm the pace of patient" appears in the ECG waveform area. Then, please check and set the paced status of the patient.

⚠WARNING

- **For paced patients, you must set [Paced] to [Yes]. If it is incorrectly set to [No], the patient monitor could mistake a pace pulse for a QRS and fail to alarm when the ECG signal is too weak. Do not rely entirely on rate meter alarms when monitoring patients with pacemakers. Always keep these patients under close surveillance.**
- **For non-paced patients, you must set [Paced] to [No].**
- **The auto pacer recognition is not applicable to pediatric and neonatal patients.**
- **False low heart rate indicators or false Asystole calls may result with certain pacemakers because of pacemaker artifact such as electrical overshoot of the pacemaker overlapping the true QRS complexes.**

9.4 Understanding the ECG Display

Your display may be configured to look slightly different.

1. Lead label of the displayed wave
2. ECG gain
3. ECG filter label
4. Notch filter status

When a paced signal has been detected, the pace pulse marks "|" are shown on the ECG wave if the [**Paced**] has been set to [**Yes**].

1. Current heart rate alarm limits
2. Current heart rate
3. Heart beat symbol

NOTE

- **When an electro-surgery unit is in use, a question mark (?) may display on the right of the HR value. This indicates that there is high frequency interference**

For 12-lead ECG display screen, refer to the section ***12-Lead ECG Monitoring***.

9.5 Changing ECG Settings

9.5.1 Accessing ECG Menus

By selecting the ECG parameter window or waveform area, you can access the [**ECG Setup**] menu.

9.5.2 Setting Pacemaker Rate (For Mortara algorithm only)

Some pacemaker pulses can be difficult to reject. When this happens, the pulses are counted as a QRS complex and could result in an incorrect HR and failure to detect some arrhythmias. You can set [**Pacemaker Rate**] to the pacemaker's rate in the [**ECG Setup**] menu. In this way, the patient monitor can calculate HR and detect arrhythmias more accurately. When [**Paced**] is set to [**No**], the pacemaker rate cannot be set.

9.5.3 Choosing the Alarm Source

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

- [**HR**]: if you want the HR to be the alarm source for HR/PR.
- [**PR**]: if you want the PR to be the alarm source for HR/PR.
- [**Auto**]: If the [**Alm Source**] is set to [**Auto**], the patient monitor will use the heart rate from the ECG measurements as the alarm source whenever a valid heart rate is available. If the heart rate becomes unavailable, for example the ECG module is turned off or becomes disconnected, the patient monitor will automatically switch to PR as the alarm source.

9.5.4 Setting the ECG Lead Set

You can set the [**Lead Set**] by selecting [**ECG Setup**]→[**Others>>**]. You can set the [**Lead Set**] as [**Auto**] if the auto lead detection function is available.

9.5.5 Choosing an ECG Display Screen

When monitoring with a 5-lead or 12-lead set, you can select the [**Screens**] Quickkey. In the [**Choose Screen**] window, choose the screen type as:

- [**Normal Screen**]: The ECG waveform area shows 2 ECG waveforms.
- [**ECG 7-Lead Full-Screen**]: The whole waveform area shows 7 ECG waveforms only.
- [**ECG 7-Lead Half-Screen**]: The upper half part of the whole waveform area displays 7 ECG waveforms.

When monitoring with a 12-lead set, you can also choose the screen type as [**ECG 12-Lead Full-Screen**].

When the screen type is set to [**Normal Screen**] and [**Sweep Mode**] is set to [**Refresh**], cascaded ECG waveforms can be displayed. To cascade ECG waveforms:

1. Select the [**Screens**] Quickkey→[**Screen Setup**].
2. Select [**ECG1 Casc**.] in the second row. A cascaded waveform is displayed in two waveform positions.

9.5.6 Changing the ECG Filter Settings

The ECG filter setting defines how ECG waves are smoothed. To change the filter setting, select [**Filter**] from [**ECG Setup**] and then select the appropriate setting.

- [**Monitor**]: Use under normal measurement conditions.
- [**Diagnostic**]: Use when diagnostic quality is required. The unfiltered ECG wave is displayed so that changes such as R-wave notching or discrete elevation or depression of the ST segment are visible.
- [**Surgery**]: Use when the signal is distorted by high frequency or low frequency interference. High frequency interference usually results in large amplitude spikes making the ECG signal look irregular. Low frequency interference usually leads to wandering or rough baseline. In the operating room, the surgery filter reduces artifacts and interference from electrosurgical units. Under normal measurement conditions, selecting [**Surgery**] may suppress the QRS complexes too much and then interfere with ECG analysis.
- [**ST**]: Use when ST monitoring is applied.

⚠WARNING

- **The [Diagnostic] filter is recommended when monitoring a patient in an environment with slight interference only.**

9.5.7 Setting the Notch Filter

The notch filter removes the line frequency interference. Only when [**Filter**] is set to [**Diagnostic**], the [**Notch Filter**] is adjustable.

1. Select the ECG parameter window or waveform area to enter its setup menu. Then select [**Others >>**].
2. Set [**Notch Filter**] to

- [**Strong**] when interference is strong (such as spikes).
- [**Weak**] when interference is weak.
- [**Off**] to turn the notch filter off

Set notch frequency according to the electric power frequency of your country. To set notch filter frequency:

1. When [**Notch Filter**] is turned on, select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password.
2. Select [**Others >>**]→[**Notch Freq.**] and then select [**50Hz**] or [**60Hz**] according to the power line frequency.

9.5.8 Changing the Pacer Reject Settings

Select [**ECG Setup**]→[**Others>>**]→[**Pacer Reject**], and toggle between [**On**] and [**Off**].

- When [**Pacer Reject**] is switched on, the pace pulses are not displayed.
- When [**Pacer Reject**] is switched off, pace pulses are displayed.

NOTE

- **When pace pulses are detected, pace pulse marks "|" are shown on the ECG waveforms. Pacer Rejection setting has no impact on the display of pace pulse marks "|"**
- **When [Paced] is set to [No], the pace markers are not shown on the ECG wave, and the options of [Pacer Reject] are inactivated.**

9.5.9 About the Defibrillator Synchronization

If a defibrillator is connected, a defibrillator synchronization pulse (100 ms, +5V) is outputted through the Defib. Sync Connector every time when the patient monitor detects an R-wave.

⚠WARNING

- **Improper use of a defibrillator may cause injury to the patient. The user should determine whether to perform defibrillation or not according to the patient's condition.**
- **Before defibrillation, the user must ensure both defibrillator and monitor has passed the system test and can be safely used jointly.**

9.5.10 Adjusting the Minimum QRS Detection Threshold (For Mindray ECG Algorithm)

To avoid false asystole alarms when the R wave amplitude is low and missed asystole alarms during ventricular standstill (tall P waves, but no QRS), a means to manually adjust the minimum QRS detection threshold is provided.

To adjust the QRS detection threshold,

1. In the [**ECG Setup**] menu, set [**Filter**] to [**Monitor**].
2. Select [**Others >>**]→[**Minimum QRS Threshold >>**] to enter the [**Minimum QRS Threshold**] menu.
3. Select the up or down arrow to adjust the QRS threshold. Selecting [**Defaults**] resets the QRS threshold to the default value (0.16 mV).
4. Select [**Confirm**] to make the changes effective.

⚠ CAUTION

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

NOTE

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

9.5.11 Changing ECG Wave Settings

In the [**ECG Setup**] menu:

- You can select [**ECG**], [**ECG1**], or [**ECG2**] to select a lead to view. The waveform of selected lead should have the following characteristics:
  - The QRS should be either completely above or below the baseline and it should not be biphasic.
  - The QRS should be tall and narrow.
  - The P-waves and T-waves should be less than 0.2mV.
- If the wave is too small or clipped, you can change its size by selecting an appropriate [**Gain**] setting. If you select [**Auto**] from [**Gain**], the patient monitor will automatically adjust the size of the ECG waves. In normal screen, only the selected ECG wave's size is adjusted. In other screens, all ECG waves' size is adjusted simultaneously.
- You can change the wave sweep speed by selecting [**Sweep**] and then selecting the appropriate setting.

9.5.12 Enabling Smart Lead Off

When the smart lead off function is set on and there is a "lead off" in the lead that has an ECG waveform in filter mode and notch status, if another lead is available, this available lead automatically becomes that lead. The system will re-calculate HR and analyze and detect arrhythmia. When the "lead off" condition is corrected, the leads are automatically switched back.

To switch on/off the smart lead off function, select [**Others >>**] from the [**ECG Setup**] menu; select [**Smart Lead Off**] and toggle between [**On**] and [**Off**] from the popup menu.

9.5.13 Setting the Alarm Level for ECG Lead Off Alarms

Select [**Alarm Setup >>**] from the [**User Maintenance**] menu. You can set [**ECGLeadOff Lev**.] from the popup menu.

9.5.14 Adjusting QRS Volume

QRS sounds are produced based on the alarm source. To adjust the QRS volume, select [**Others >>**] from the [**ECG Setup**] menu; select [**QRS Volume**] from the popup menu and select the appropriate setting. When valid SpO_2 measured value is available, the system adjusts the pitch tone of QRS sound based on the SpO_2 value.

9.6 About ST Monitoring

- Mortara ST segment analysis is not intended for neonatal patients.
- ST segment analysis calculates ST segment elevations and depressions for individual leads and then displays them as numerics in the ST1 and ST2 areas.
- A positive value indicates ST segment elevation; a negative value indicates ST segment depression.
- Measurement unit of the ST segment: mV or mm. You can set the unit in the [**Unit Setup**] menu from the [**User Maintenance**] menu.
- Measurement range of the ST segment: -2.0 mV to +2.0 mV.

⚠ WARNING

- **The ST algorithm has been tested for accuracy of the ST segment data. The significance of the ST segment changes need to be determined by a clinician.**

9.6.1 Switching ST On and Off

To switch ST monitoring on or off:

1. In the [**ECG Setup**] menu, select [**ST Analysis >>**].
2. Select [**ST Analysis**] to toggle between [**On**] and [**Off**].

Reliable ST monitoring can hardly be ensured if:

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

In these cases, you may consider switching ST monitoring off.

9.6.2 Changing ST Filter Settings

ST-segment analysis can be carried out only when the filter mode is set to [**Diagnostic**] or [**ST**]. When ST-segment analysis is switched on, [**Filter**] will automatically switch to [**ST**] if it is not [**Diagnostic**] or [**ST**]. When ST-segment analysis is switched off, the filter mode automatically switches to previous manual setting.

However, if you switch [**Filter**] to [**Monitor**] or [**Surgery**], ST-segment analysis will turn off automatically. If you change [**Monitor**] or [**Surgery**] to [**Diagnostic**] or [**ST**], ST-segment analysis remains off, you can turn it on manually.

9.6.3 Understanding the ST Display

9.6.3.1 ST Numerics

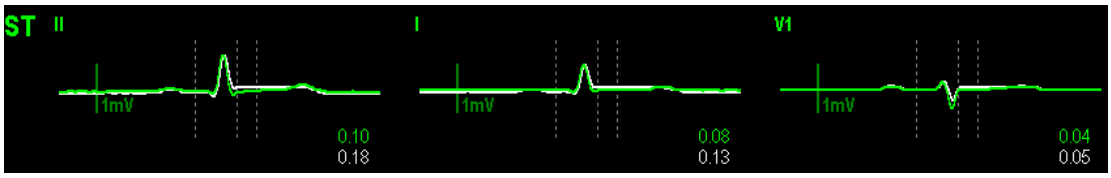
This example shows ST numerics with 5-lead ECG. Your monitor screen may look slightly different from the illustration.

9.6.3.2 ST Segment

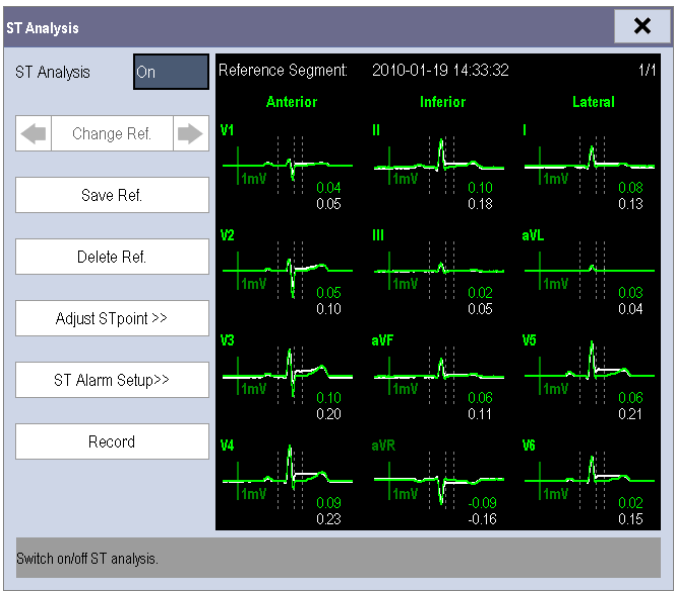
ST segment shows a QRS complex segment for each measured ST lead. The current ST segment is drawn in the same color as the ECG wave, usually green, superimposed over the stored reference segment, drawn in a different color. The information is updated once every ten seconds.

To display the ST segment on normal screen:

1. Enter the [**ST Analysis**] menu. Set [**ST Analysis**] to [**On**].
2. Enter the [**Screen Setup**] window of [**Screens**] menu. Set [**ST Segment**] to be displayed.



Select the ST parameter window or ST segment area and you can enter the [**ST Analysis**] menu.



9.6.4 Saving the Current ST Segment as Reference

Select [**Save Ref.**] in the [**ST Analysis**] menu to save the current segment as reference. Up to 20 reference segment groups can be saved.

NOTE

- **If the memory is full and you do not delete a group before saving a new one, the oldest saved group is deleted automatically.**

9.6.5 Changing the Reference Segment

Select the ◀ and ▶ arrow keys beside the [**Change Ref.**] to switch between different reference segment groups.

9.6.6 Deleting a Reference Segment

To delete the current ST reference segment, select [**Delete Ref.**] in the [**ST Analysis**] menu and then select [**Ok**] in the popup.

9.6.7 Recording the ST Segment

To record the current ST segment and reference segment, select [**Record**] in the [**ST Analysis**] menu.

9.6.8 Changing the ST Alarm Limits

High and low ST alarm limits can be set individually for each ECG lead. Alarm limits can also be set separately for single-lead and multi-lead ST monitoring. You can select [**ST Alarm Setup >>**] from [**ST Analysis**] menu and then change ST alarm settings for each lead.

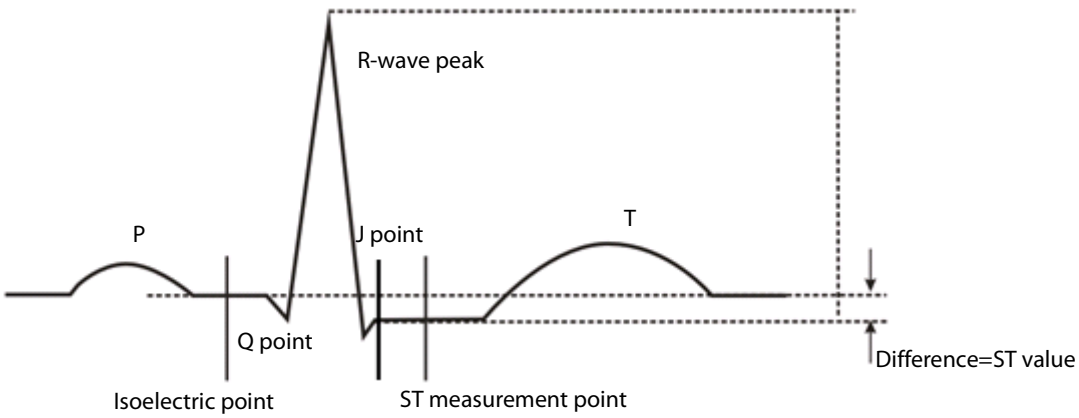
9.6.9 Setting the ST Alarm Delay Time

To set the ST alarm delay time,

1. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]. Enter the required password and then select [**OK**].
2. Select [**Alarm Setup >>**]→[**ST Alarm Delay**].

9.6.10 Adjusting ST Measurement Points

As shown in the figure below, the ST measured for each beat complex is the vertical difference between two measurement points with the R-wave peak as the baseline for the measurement.



The ISO and ST points need to be adjusted when you start monitoring and if the patient's heart rate or ECG morphology changes significantly. Exceptional QRS complexes are not considered for ST-segment analysis.

⚠ WARNING

- **Always make sure that the positions of ST measurement points are appropriate for your patient.**

To adjust the ST measurement points:

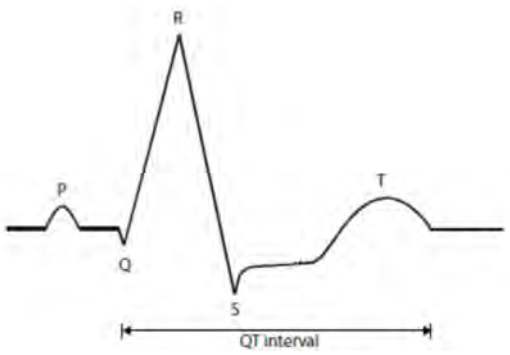
1. In the [**ST Analysis**] menu, select [**Adjust ST Point >>**]. In the [**Adjust ST Point**] window, three vertical lines represent the ISO, J and ST point positions respectively.
2. Select [**View Leads**] and use the Knob to select an ECG lead with obvious J point and R wave.
3. Select [**ISO**], [**J**] or [**ST Point**] and then use the Knob to adjust the position of each point.
   - The ISO-point (isoelectric) position is given relative to the R-wave peak. Position the ISO-point in the middle of the flattest part of the baseline (between the P and Q waves).
   - The J-point position is given relative to the R-wave peak and helps locating the ST-point. Position the J-point at the end of the QRS complex and the beginning of the ST segment.
   - The ST-point is positioned a fixed distance from the J-point. Move the J-point to position the ST-point at the midpoint of the ST segment. Position the ST-point relative to the J-point at either [**J+60/80ms**], [**J+40ms**], [**J+60ms**] or [**J+80ms**]. When [**J+60/80ms**] is selected, the ST-point will be positioned 80 ms (heart rate 120 bpm or less) or 60 ms (heart rate more than 120 bpm) from the J-point.

9.7 QT/QTc Interval Monitoring (For Mindray ECG Algorithm)

The QT interval is defined as the time between the beginning of the Q-wave and the end of the T-wave. It measures the total duration of the depolarization (QRS duration) and repolarization (ST-T) phases of the the ventricles. QT interval monitoring can assist in the detection of long QT syndrome.

The QT interval has an inverse relationship to heart rate. As heart rate increases, the QT interval shortens, while at lower heart rates QT interval gets longer. Several formulas are available to correct QT interval for heart rate. The heart rate corrected QT interval is abbreviated as QTc.

QT/QTc Interval Monitoring is intended for adult, pediatric, and neonate patients.



9.7.1 QT/QTc Monitoring Limitations

Some conditions may make it difficult to achieve reliable QT monitoring, for example:

R-wave amplitudes are too low

- The presence of frequent ventricular ectopic beats
- Unstable RR intervals
- P-waves tending to encroach on the end of the previous T-wave at high heart rates
- T-waves are very flat or not well defined
- The end of the T-wave is difficult to delineate because of the presence of U-waves
- QTc measurements are not stable
- In the presence of noise, asystole, ventricular fibrillation, and ECG lead off

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

Some conditions such as left or right bundle branch block or hypertrophy can lead to a widened QRS complex. If a long QTc is observed you should verify it to ensure that it is not caused by QRS widening.

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

If the heart rate is extremely high (over 150bpm for adults and over 180bpm for pediatrics and neonates), QT will not be measured. When the heart rate changes, it can take several minutes for the QT interval to stabilize. For reliable QTc calculation it is important to avoid the region where the heart rate is changing.

9.7.2 Enabling QT/QTc Monitoring

The QT monitoring function is disabled by default. Before you start QT monitoring, enable the QT function. To enable QT/QTc monitoring:

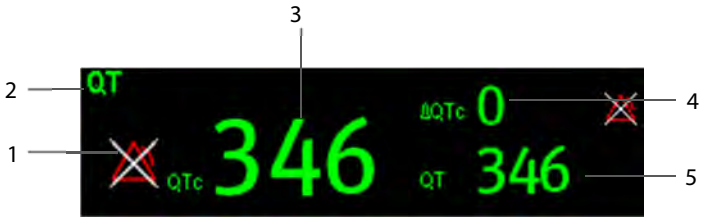
1. In the [**ECG Setup**] menu, select [**QT Analysis>>**] to enter the [**QT Analysis**] menu.
2. Set [**QT Analysis**] to [**On**].

9.7.3 Displaying QT/QTc Parameters and Waveform

To display QT/QTc parameters and waveform:

1. Select the [**Screens**] QuickKey or select [**Main Menu**] →[**Screen Setup>>**]→[**Screen Layout>>**], and then select [**Screen Setup**] to enter the [**Screen Setup**] window.
2 Select the parameter area where you want to display the QT parameters, and then select [**QT**].

The following picture shows the QT numeric area. Your monitor screen may look slightly different:



1. QTc alarm limit (if QTc alarm is off, the alarm off symbol is displayed)
2. Parameter label
3. QTc value
4. ΔQTc value (the difference between the current and reference QTc values. If ΔQTc alarm is off, the alarm off symbol is displayed on the right.)
5. QT value

NOTE

- **QTc values are calculated based on the QT-HR, not the ECG HR. To view the QT-HR, open the QT View window. For more information. see *9.7.4Entering the QT View*.**

9.7.4 Entering the QT View

QT View shows the current and reference QT parameter values and waveforms. To enter the QT View:

1. Select the QT parameter area or waveform area to enter the [**QT Analysis**] menu.
2. Select [**QT View>>**].

The following picture shows the QT view.

- The current waveform is shown in the upper half in green.
- The reference waveform is shown below in yellow.
- The start of QRS complex and the end of the T wave are marked with vertical lines.

- In some conditions, no QT measurement can be calculated. Then the cause of failed QT measurement is shown at the bottom of the QT numerics area. Additionally the message "Cannot Analyze QT" is shown in the technical alarm area.

Select the arrows beside [**View Leads**] to switch leads. Corresponding waveform will be highlighted.

9.7.5 Saving the Current QTc as Reference

In order to quantify changes in the QTc value, you can set a QTc reference. If no reference has been set for this patient within the first five minutes after getting valid QT values, the monitor will automatically set a reference.

To set QT reference, select [**Save Ref.**] at the bottom of the QT View.

If you set a new reference, the previous reference is discarded.

CAUTION

- **Updating QTc reference affects ΔQTc value and alarm.**

9.7.6 Changing QT Settings

9.7.6.1 Setting QT Alarm Properties

To set QT alarm properties,

1. Select the [**Alarm Setup**] QuickKey, or select [**Alarm Setup>>**] from the [**QT Analysis]** menu.
2. Set QTc and ΔQTc alarm properties.

9.7.6.2 Selecting Leads for QT Calculation

You can select one lead or all leads for QT calculation. To do so, select [**Analysis Lead**] from the [**QT Analysis**] menu. [**All**] is selected by default. This means all leads are used for QT calculation.

9.7.6.3 Changing the QTc Formula

The monitor uses as a default the Hodges correction formula to correct the QT interval for heart rate. To change the QTc formula, select [**QTc Formula**] from the [**QT Analysis**] menu.

- Hodges: $QTc = QT + 1.75 \times (HeartRate - 60)$
- Bazett: $QTc = QT \times \left(\frac{HeartRate}{60} \right)^{\frac{1}{2}}$
- Fridericia: $QTc = QT \times \left(\frac{HeartRate}{60} \right)^{\frac{1}{3}}$
- Framingham: $QTc = QT + 154 \times \left(1 - \frac{60}{HeartRate} \right)$

9.8 About Arrhythmia Monitoring

Arrhythmia analysis provides information about your patient's condition, including heart rate, PVC rate, rhythm and ectopics.

⚠ WARNING

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

9.8.1 Understanding the Arrhythmia Events

Mindray algorithm

Arrhythmia message	Description	Category
Asystole	No QRS detected within the set time threshold in absence of ventricular fibrillation or chaotic signal.	Lethal arrhythmia
Vfib/Vtac	A fibrillatory wave for 6 consecutive seconds. A dominant rhythm of adjacent Vs and a HR > the V-Tac HR limit.	
Vtac	The consecutive PVCs ≥ Vtac PVCs limit, and the HR ≥ the Vtac rate limit.	
Vent. Brady	The consecutive PVCs ≥ the Vbrd threshold and the ventricular HR < the Vbrd Rate threshold.	
Extreme Tachy	The heart rate is no less than the extreme tachycardia limit.	
Extreme Brady	The heart rate is no greater than the extreme bradycardia limit.	
PVCs	PVCs/min exceeds high limit	Nonlethal arrhythmia
PNP	No pace pulse detected for 1.75 x average R-to-R intervals following a QRS complex (for paced patients only).	
PNC	No QRS complex detected for 300 milliseconds following a pace pulse (for paced patients only).	
PVC	One PVC detected in normal heartbeats.	
Couplet	Paired PVCs detected in normal heartbeats.	
Run PVCs	More than 2 consecutive PVCs.	
Bigeminy	A dominant rhythm of N, V, N, V, N, V.	
Trigeminy	A dominant rhythm of N, N, V,N, N, V, N, N, V.	
R on T	R on T detected in normal heartbeats.	
Missed Beats	No beat detected for 1.75 x average R-R interval for HR <120, or No beat for 1 second with HR > 120 (for non-paced patients only), or No beat detected for more than the set pause threshold.	
Brady	The average heart rate is no greater than the bradycardia limit.	
Tachy	The average heart rate is no less than the tachycardia limit.	
Vent. Rhythm	The consecutive PVCs ≥ the Vbrd PVCs limit, and the HR ≥ Vbrd Rate limit but < the Vtac Rate limit.	
Multif. PVC	Multiform PVCs detected in Multif. PVC's Window (which is adjustable).	
Nonsus. Vtac	The consecutive PVCs < the Vtac PVCs limit but > 2, and HR ≥ the Vtac Rate limit.	
Pause	No QRS detected within the set time threshold of pause.	
Irr. Rhythm	Consistently irregular rhythm.	
Afib	P wave is absent and normal beat RR intervals are irregular.	

Mortara algorithm

Arrhythmia Message	Description	Category
Asystole	No QRS complex detected within the set time threshold (in absence of ventricular fibrillation or chaotic signals).	Lethal arrhythmia
Vfib	Ventricular fibrillation occurs and persists for 6 seconds.	
Vtac	Ventricular HR is greater or equal to the preset threshold and the number of consecutive PVCs is greater than the preset threshold.	
PVCs	PVCs/min exceeds high limit	Nonlethal arrhythmia
PNP	No pace pulse detected for (60*1000/pace rate +90) milliseconds following a QRS complex or a pacer pulse (for paced patients only).	
PNC	No QRS complex detected for 300 milliseconds following a pace pulse (for paced patients only).	
Multif. PVC	More than 2 PVCs of different forms occur in the predefined search window (3-31).	
Couplet	Paired PVCs are detected.	
Run PVCs	Ventricular HR is greater than or equal to the preset threshold and the number of PVCs is greater than or equal to 3 but less than the preset threshold.	
Vent. Rhythm	Ventricular HR is less than the preset threshold and the number of PVCs is greater than or equal to 3.	
Bigeminy	A dominant rhythm of N, V,N, V, N, V.	
Trigeminy	A dominant rhythm of N, N, V,N, N, V, N, N, V.	
R on T	R on T is detected.	
Irr. Rhythm	Consistently irregular rhythm	
Missed Beats	No beat detected for 1.75x average R-R interval for HR <120, or No beat for 1 second with HR >120 (for non-paced patients only), or No beat detected for more than the set pause threshold.	
Brady	The HR is less than the set bradycardia low limit.	
Tachy	The HR is greater than the set tachycardia high limit.	

9.8.2 Changing Arrhythmia Alarm Settings

To change arrhythmia alarm settings, select the ECG parameter area or waveform area →[**ECG Setup**]→ [**Arrh. Analysis >>**]. In the pop-up menu, you can set the [**Alm Lev**] to [**High**], [**Med**], [**Low**] or [**Message**], or switch on lethal arrhythmia analysis alarms only or switch on/off all arrhythmia analysis alarms. In the [**Alarm Setup**] menu from the [**User Maintenance**] menu, you can enable/disable turning off lethal arrhythmia analysis alarms.

⚠ WARNING

- **If you switch off all arrhythmia analysis alarms, the monitor cannot give any arrhythmia analysis alarm. Always keep the patient under close surveillance.**
- **The priority of lethal arrhythmia alarms is always high. It is unchangeable.**

9.8.3 Changing Arrhythmia Threshold Settings

Select the ECG parameter window or waveform area→[**Arrh. Analysis >>**]→[**Arrh. Threshold**], and you can then change threshold settings for some arrhythmia alarms. In case an arrhythmia violates its threshold, an alarm will be triggered. The asystole delay time relates to ECG relearning. When HR is less than 30 bpm, it is recommended to set the asystole delay time to 10 seconds.

Mindray algorithm

Arrh. event	Range	Default	Step	Unit
PVCs High	1 to 100	10	1	/min
Asys. Delay	3 to 10	5	1	s
Tachy High	60 to 300	Adult: 120 Pediatric: 160 Neonate: 180	5	bpm
Brady Low	15 to 120	Adult: 50 Pediatric: 75 Neonate: 90	5	bpm
Extreme Tachy	120 to 300	Adult: 160 Pediatric: 180 Neonate: 200	5	bpm
Extreme Brady	15 to 60	Adult: 35 Pediatric: 50 Neonate: 60	5	bpm
Multif. PVC's Window	3 to 31	15	1	/min
Vtac Rate	100 to 200	Adult, pediatric: 130 Neonate: 160	5	bpm
Vtac PVCs	3 to 99	6	1	/min
Pause Time	1.5, 2.0,2.5	2	/	s
Vbrd PVCs	3 to 99	5	1	/min
Vbrd Rate	15 to 60	40	5	bpm

Mortara algorithm

Arrh. event	Range	Default	Step	Unit
PVCs High	1 to 100	10	1	/min
Asys. Delay	2 to 10	5	1	s
Vtac Rate	100 to 200	130	5	bpm
Vtac PVC	3 to 12	6	1	beats
Multif. PVC	3 to 31	15	1	beats
Tachy High	Adult: 100 to 300 Pediatric: 160 to 300	Adult: 100 Pediatric: 160	5	bpm
Brady Low	Adult: 15 to 60 Pediatric: 15 to 80	Adult: 60 Pediatric: 80	5	bpm

9.8.4 Setting the Extended Arrh. (For Mindray Algorithm Only)

The following arrhythmia events are defined as extended arrhythmia:

- Extreme Tachy
- Extreme Brady
- Vent. Brady
- Nonsus. Vtac
- Multif. PVC
- Irr. Rhythm
- Pause
- Afib

You can select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password→select [**Alarm Setup >>**], and set [**Extended Arrh**.] to [**Enable**] or [**Disable**]. When [**Extended Arrh**.] is set to [**Disable**], the patient monitor does not analysis the extended arrhythmia events and corresponding alarms are not given.

⚠CAUTION

- **Set [Extended Arrh.] to [Disable] when the patient monitor is connected to the Central Monitoring System of version prior to 06.01.00. Failure to do so may cause the Central Monitoring System unable to display extended arrhythmia related alarms normally when extended arrhythmia occurs.**

9.8.5 Reviewing Arrhythmia Events

Please refer to the ***Review*** chapter.

9.9 ECG Relearning

9.9.1 Initiating an ECG Relearning Manually

During ECG monitoring, you may need to initiate an ECG relearning when the patient's ECG template changes dramatically. A change in the ECG template could result in:

- incorrect arrhythmia alarms
- loss of ST measurement, and/or
- inaccurate heart rate

ECG relearning allows the monitor to learn the new ECG template so as to correct arrhythmia alarms and HR value, and restore ST measurements. To initiate relearning manually, select the ECG parameter window or waveform area→ [**Relearn**]. When the patient monitor is learning, the message [**ECG Learning**] is displayed in the technical alarm area.

⚠CAUTION

- **Initiate ECG relearning only during periods of normal rhythm and when the ECG signal is relatively noise-free. If ECG learning takes place during ventricular rhythm, the ectopics may be incorrectly learned as the normal QRS complex. This may result in missed detection of subsequent events of V-Tach and V-Fib.**

9.9.2 Automatic ECG Relearning

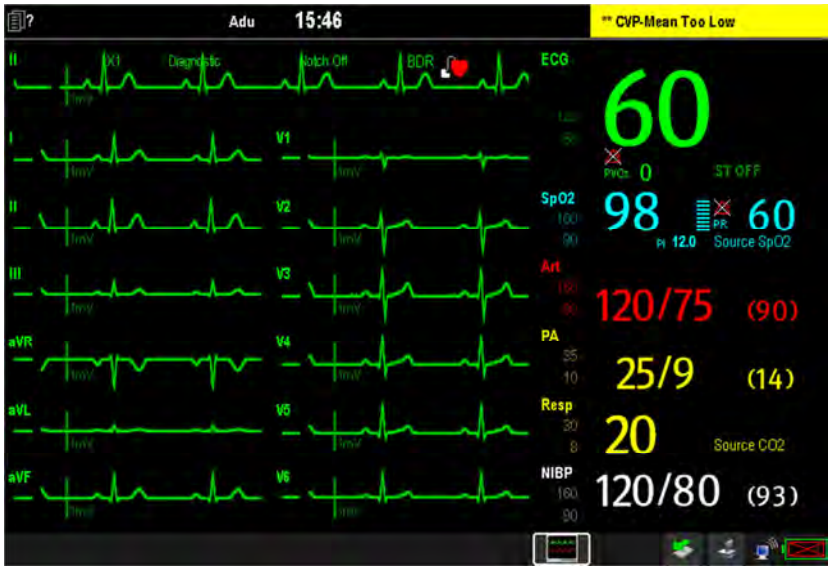
ECG relearning is initiated automatically whenever:

- The ECG lead or lead label is changed
- The ECG lead is re-connected
- A new patient is admitted
- After ECG calibration is completed, and [**Stop Calibrating ECG**] is selected.
- A switch happens between the options of screen type during 5/12-lead ECG monitoring.
- The paced status of the patient is changed.

9.10 12-Lead ECG Monitoring

9.10.1 Entering the 12-lead ECG Monitoring Screen

1. Refer to the section ***9.3.3 ECG Lead Placements*** to place the electrodes.
2. In the [**ECG Setup**] menu, select [**Others>>**] to enter the [**Other Setup Menu**].
3. Set [**Lead Set**] to [**12-Lead**], and set [**ECG Display**] to [**12-Lead**].



There are a total of 12 ECG waves and 1 rhythm wave displayed on the screen. The rhythm lead is ECG Ⅰ before entering the 12-lead ECG screen.

Additionally, the 12-lead ECG monitoring has the following features:

- The [**Filter**] mode is automatically switched to [**Diagnostic**] when the patient monitor accesses the 12-lead full-screen; the [**Filter**] mode resumes to the configuration before accessing the 12-lead full screen when the patient monitor exits the 12-lead full screen.
- In the adult mode, the ⋈ hardkey on the monitor's front is disabled.

9.10.2 Setting ECG Waveform Sequence

You can select the sequence of ECG waveforms on the 12-lead ECG screen and 12-lead ECG report.

To select the sequence of the ECG waveforms,

1. In the [**ECG Setup**] menu, select [**Others>>**] to enter the [**Others Setup Menu**].
2. Set [**Waveform Layout**] to [**Standard**] or [**Cabrera**].
   - [**Standard**]: the sequence is I, II, III, aVR, aVL, aVF, V1, V2, V3, V4, V5, V6.
   - [**Cabrera**]: the sequence is aVL, I, -aVR, II, aVF, III, V1, V2, V3, V4, V5, V6.

9.10.3 Extending the rhythm lead waveform area

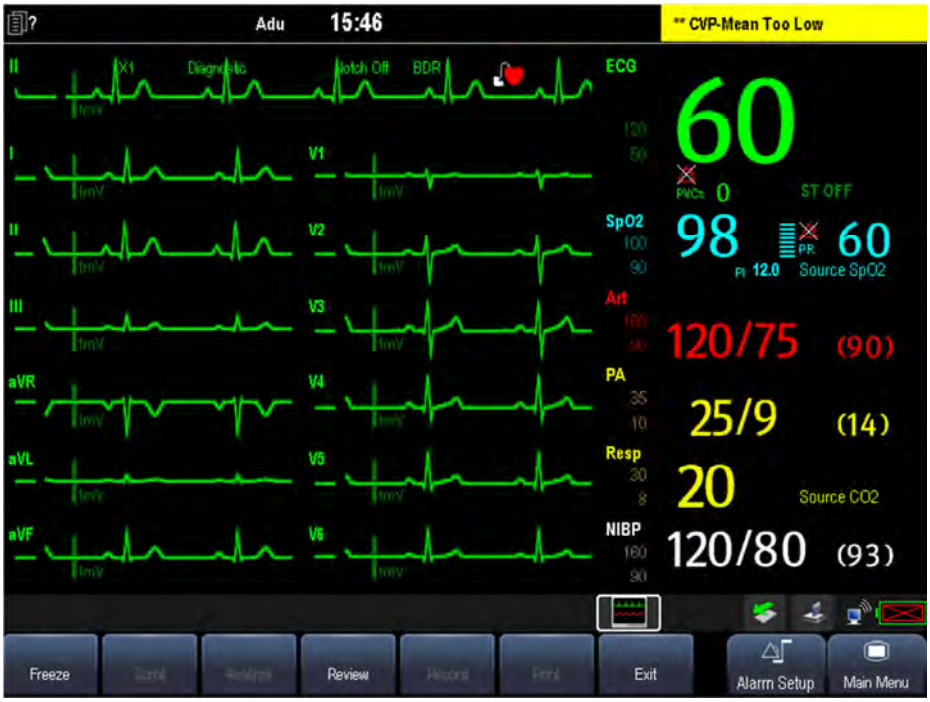
You can extend the height of rhythm lead waveform area. To do so,

1. In the [**ECG Setup**] menu, select [**Others>>**] to enter the [**Others Setup Menu**].
2. Set **[ECG Display Area**] to [**Extended**].

9.11 Mindray Resting 12-lead ECG Analysis

9.11.1 Entering the 12-lead Screen

1. In the [**ECG Setup**] menu, select [**Others>>**] to enter the [**Other Setup Menu**].
2. Set [**Lead Set**] to [**12-Lead**].
3. Set [**ECG Display**] to [**12-Lead**].



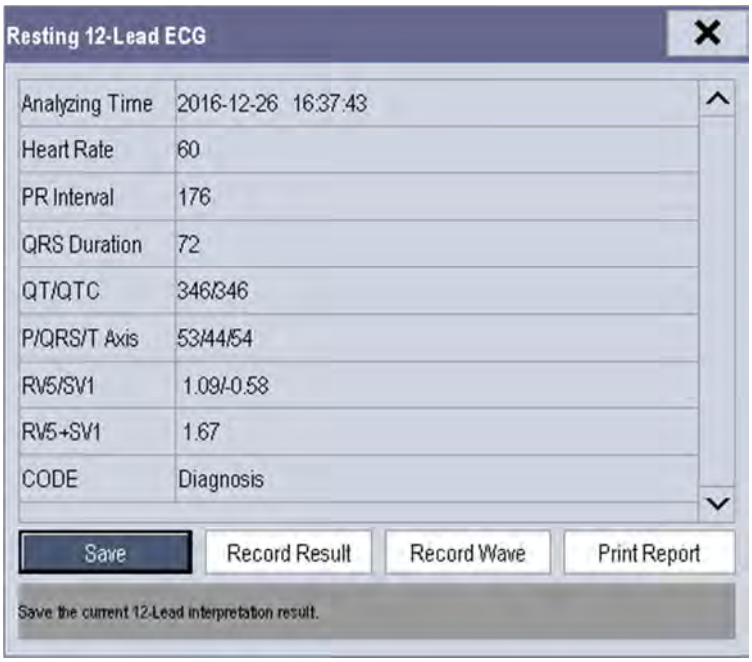
9.11.2 Resting 12-lead ECG Analysis

⚠ WARNING

- **Interpretation of resting 12-lead ECG is restricted to adult patients only.**

You can only start a interpretation of resting 12-lead ECG 11 seconds after entering the 12-lead ECG monitoring screen. Otherwise, the prompt message [**Not enough data. Cannot analyze**.] will be displayed. To start a interpretation of resting 12-lead ECG, select [**Freeze**] and then [**Analyze**]. The following screen will be displayed. In this screen, you can:

- Select [**Save**] to save current 12-lead ECG report. You can review the saved 12-lead ECG report in the [**Review**] window.
- Select [**Record Result**] to print out the interpretation of resting 12-lead ECG results by the recorder.
- Select [**Record Wave**] to print out the interpretation of resting 12-lead ECG results and waves by the recorder.
- Select [**Print Report**] to print out the interpretation of resting 12-lead ECG report by the printer.



Besides, after selecting [**Freeze**], you can:

- Browse the frozen ECG waves by selecting [**Scroll**] and rotating the Knob, or selecting the ◀ or ▶ button beside [**Scroll**].
- Print out the currently frozen waves by selecting [**Record**].

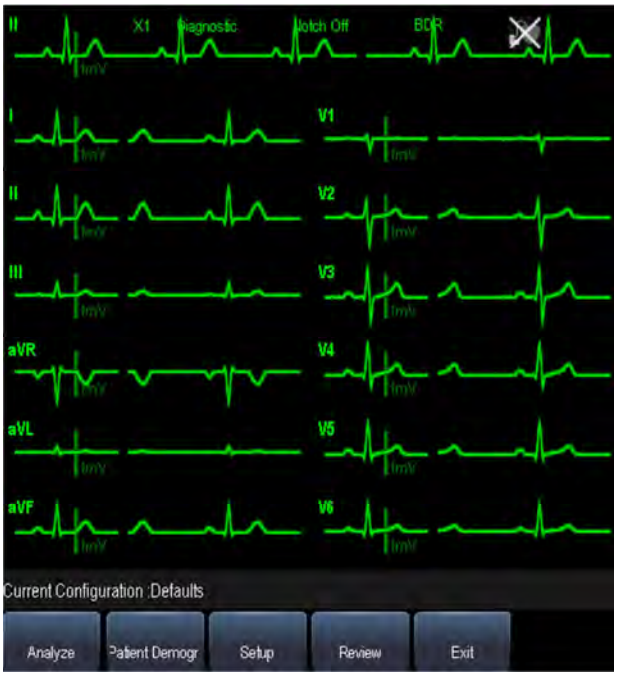
9.11.3 Reviewing Interpretation of resting 12-lead ECG Results

In the 12-lead ECG monitoring screen, you can review previous 12-lead ECG analyses by selecting [**Review**].

Glasgow Resting 12-lead ECG Analysis

9.12.1 Entering the 12-lead Screen

1. In the [**ECG Setup**] menu, select [**Others>>**] to enter the [**Other Setup Menu**].
2. Set [**Lead Set**] to [**12-Lead**].
3. Set [**ECG Display**] to [**12-Lead**].



The functions of the keys at the bottom of the 12-lead screen are as follows:

- [**Analyze**]: starts resting 12-lead analysis.
- [**Patient demogr.**]: enters the patient information.
- [**Setup**]: enters the 12-lead setup menu.
- [**Review**]:enters the [**Review**] window. .
- [**Exit**]: exits the 12-lead screen.

9.12.2 Entering Patient Information

Some patient information may directly affect ECG analysis. Complete and correct patient information is helpful for accurate diagnosis and treatment of the patient. Enter patient information before taking an ECG measurement.

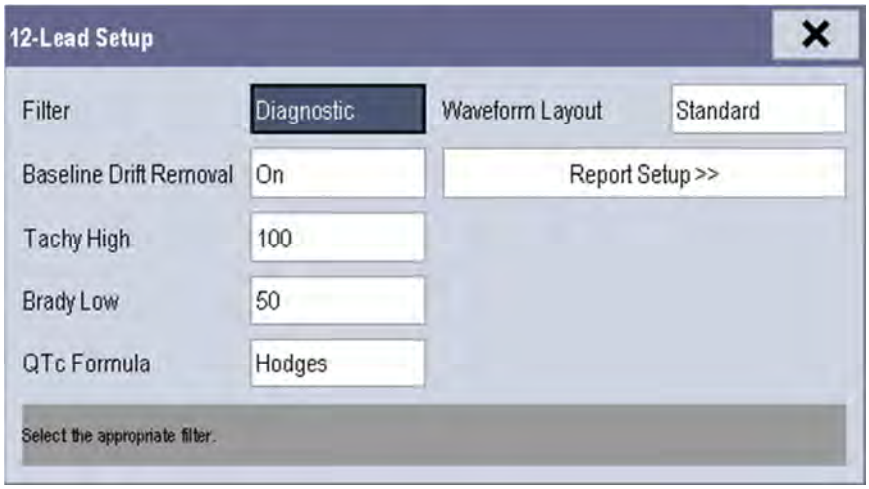
To enter the patient information, select [**Patient Demogr.**] from the 12-lead screen.

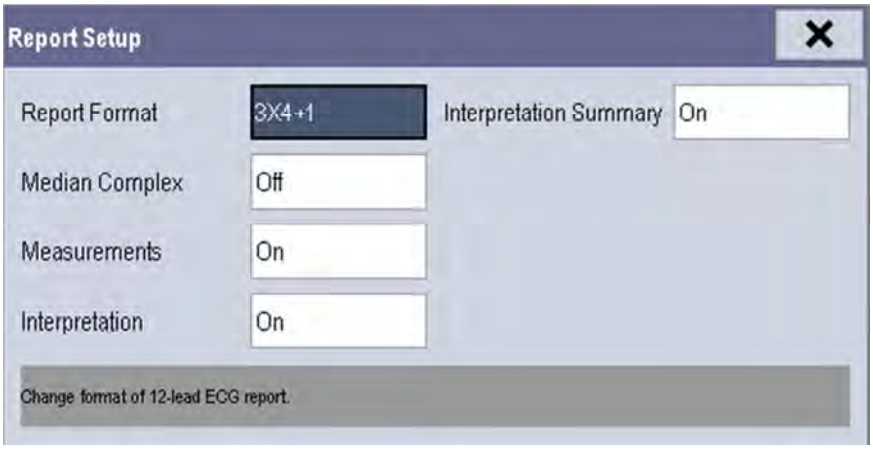
NOTE

- **Check that patient information is correct beform resting 12-lead analysis.**
- **We recommend using pediatric lead placement V4R, V1, V2, V4 - V6 if the patient is under 16 years of age. Please record V4R using the V3 electrode. Also set [V3 Electrode Placement] to [V4R]. This is a normal practice for a patient of this age.**

9.12.3 12-Lead Setup

In the 12-lead screen, select [**Setup**] to enter the [**12-Lead Setup**] menu to change the settings related to 12-lead ECG analysis. In the [**12-Lead Setup**] menu, you can also select [**Report Setup>>**] to set the format and contents of the ECG reports.





12-lead Setup			
Menu item	**Option**	**Default**	**Description**
Filter	Diagnostic, ST	Diagnostic	Set filter mode. **Note:** The filter mode automatically switches to [**Diagnostic**] when the patient monitor accesses the 12-lead -screen and resumes to the original setting when the patient monitor exits the 12-lead screen.
Baseline Drift Removal	On, Off	On	Select whether the baseline drift removal (BDR) process or 0.05-Hz filter is used. [**On**]: BDR is enabled. This process suppresses most baseline drift interference and also is able to preserve the fidelity of the ST-segment level. [**Off**]: BDR is disabled and the 0.05-Hz filter is used. **NOTE:** BDR or 0.05-Hz selection applies to the displayed ECG, printed report, analyzed and stored data.

			BDR introduces around 1-second delay. We recommend use of BDR except when the delay is unacceptable. Both BDR and 0.05-Hz selections meet requirements of the 1990 American Heart Association Recommendations for Standardization and Specifications in Automated Electrocardiography: Bandwidth and Signal Processing pertaining to lower-frequency response in electrocardiography.
Tachy High	80 - 130	100	Adjusts tachycardia threshold. Heart rates above the setting are labelled Tachycardia. Only applies to patients whose age exceeds 180 days.
Brady Low	40 - 60	50	Adjusts bradycardia threshold. Heart rates below the setting are labelled Bradycardia. Only applies to patients whose age exceeds 2191 days.
QTc Formula	Hodges, Bazett, Fridericia, Framingham	Hodges	Selects QTc formula. Hodges: $QTc = QT + 1.75 \times (HeartRate - 60)$ Bazett: $QTc = QT \times \left(\frac{HeartRate}{60} \right)^{\frac{1}{2}}$ Fridericia: $QTc = QT \times \left(\frac{HeartRate}{60} \right)^{\frac{1}{3}}$ Framingham: $QTc = QT + 154 \times \left(1 - \frac{60}{HeartRate} \right)$
Waveform Layout	Standard, Cabrera	Standard	Select ECG lead sequence for displaying and printing. [**Standard**]: the sequence is I, II, III, aVR, aVL, aVF, V1, V2, V3, V4, V5, V6; [**Cabrera**]: the sequence is aVL, I, -aVR, II, aVF, III, V1, V2, V3, V4, V5, V6.
Report setup			
Menu item	**Option**	**Default**	**Description**
Report Format	12×1, 6×2, 3×4+1	3×4+1	Selects the format of the 12-lead ECG report. [**12×1**]: ECG waveforms are displayed in 12 lines. [**6×2**]: ECG waveforms are displayed in 6 lines and 2 columns. [**3×4+1**]: ECG waveforms are displayed in 3 lines and 4 columns followed by the rhythm lead waveform.
Median Complex	On, Off	Off	Selects whether Median Complex is included on the

			12-lead ECG report. Median Complex displays a median complex waveform for each lead and a rhythm lead waveform of 10 seconds in 3x4+1 format. For each waveform, short vertical lines are used to mark the start of the P-wave and QRS complex, and the end of the P-wave, QRS complex, and T-wave.
Measurements	On, Off	On	Selects whether the measurement result is included on the 12-lead ECG report. Measurement result includes Vent. Rate, PR Interval, QRS Duration, QT/QTc Interval, and P/QRS/T Axes.
Interpretation	On, Off	On	Selects whether diagnoses are included on the 12-lead ECG report.
Interpretation Summary	On, Off	On	Selects whether interpretation summary is included on the 12-lead ECG report. Note: If the [**Interpretation**] option is not enabled, interpretation summary is not included on the report even if [**Interpretation Summary**] is enabled.

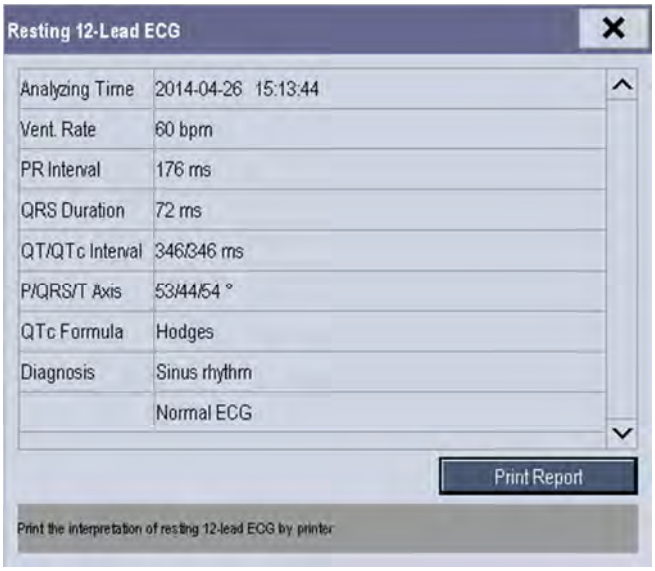
9.12.4 Resting 12-lead ECG Analysis

The Glasgow algorithm provides an interpretation of the resting 12-lead ECG in all situations.

Before 12-lead ECG interpretation, check that all electrodes are correctly connected to the lead wires and the ECG trunk cable is properly connected. Check that patient information is correct.

To start analyzing, select the [**Analyze**] key. The resting 12-lead analysis takes about 10 seconds. During this period, keep the patient still.

After analysis finishes, the following dialog-box pops out.



Select [**Print Report**] to pint the resting 12-lead ECG report from the external printer.

You can also print the latest 12-lead ECG report by selecting [**Report**] from the 12-lead screen.

Refer to***12-Lead ECG Interpretive Program Physician's Guide*** (PN: ***046-006360-00***) for details.

⚠CAUTION

- **During the resting 12-lead ECG analysis, keep the patient still. Patient movement may cause misdiagnosis.**

NOTE

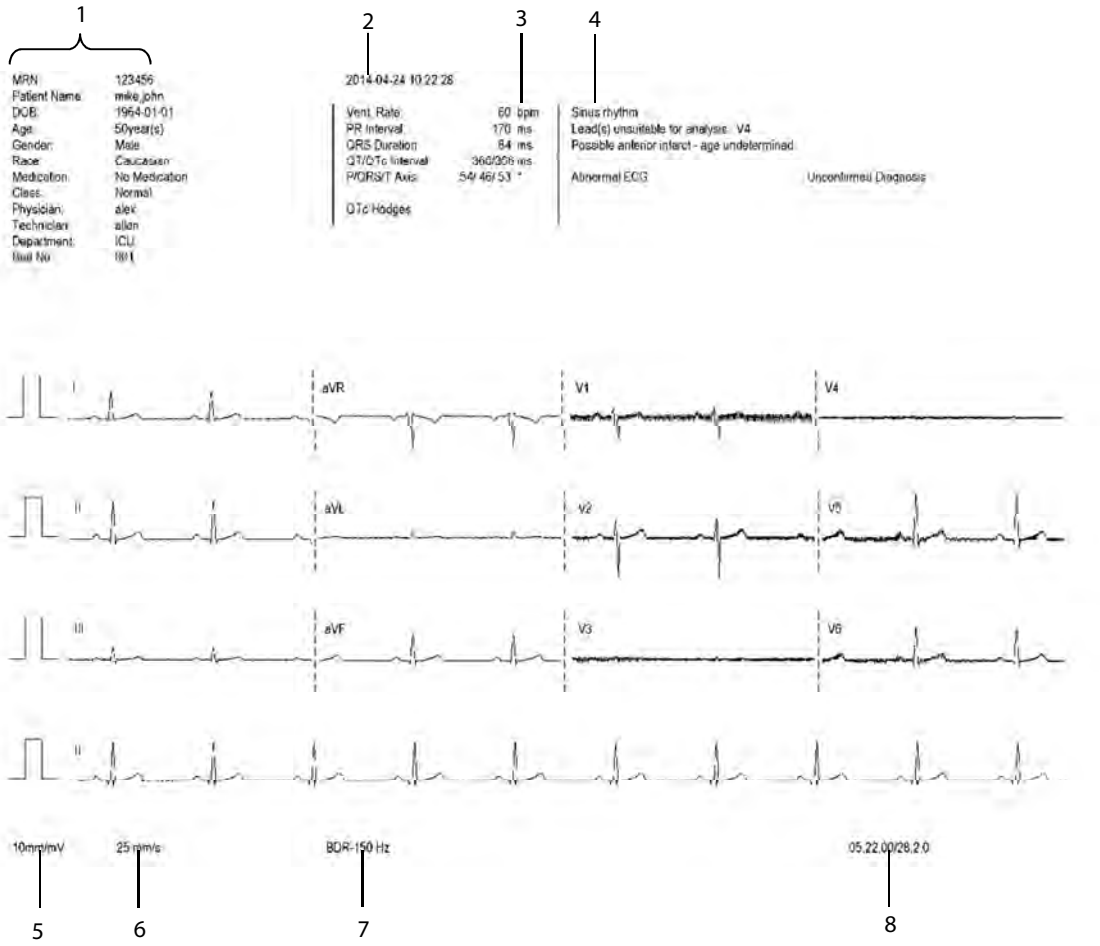
- **Glasgow resting 12-lead ECG intepretation is applied to adult, pediatric and neonate.**
- **During 12-lead ECG analaysis, 12-lead related settings are disabled.**
- **Changing patient information, including the patient's age, date of birth, gender, race, medication, class, or V3 placement setting,may change diagnosis statement. You shall select the [Analyze] key to reanalyze the patient's ECG before you print the latest 12-lead ECG report.**

9.12.5 Reviewing 12-lead ECG Results

You can review the 12-lead ECG results in the [**Review**] window.

9.12.5 12-lead ECG Report

The following is a sample of the12-lead ECG report with default configuration.



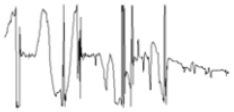
1. Patient information
2. Time of resting 12-lead ECG analysis
3. Measurements
4. Diagnosis statement
5. Gain
6. Paper speed
7. Frequency range
8. System software version/algorithm version

9.13 Troubleshooting

This section lists the problems that might occur. If you encounter the problems when using the equipment or accessories, check the table below before requesting for services. If the problem persists, contact your service personnel.

CAUTION

- **Never try to disassemble the equipment or supplied accessories. There are no internal user-serviceable parts.**

Symptoms	Possible Cause	Correction Action
Noisy ECG traces 	Loose or dry electrodes	Apply fresh and moist electrodes.
	Defective electrode wires	Replace wires if necessary.
	Patient cable or leads are routed too close to other electrical devices	Move the patient cable or leads away from the electrical device.
Excessive Electro-surgical Interference	Wrong ECG cable used	Use ESU-proof ECG cables. For details, refer to ***40. 1 ECG Accessories***.
Muscle Noise	Inadequate skin preparation prior to application of electrode, tremors, tense subject, and/or poor electrode placement	Repeat skin preparation as described in ***9.3.1 Preparing the Patient and Placing the Electrodes*** Apply fresh, moist electrodes. Avoid muscular areas.
Intermittent Signal	Connections not tight and/or properly secured	Check that the cables are properly connected.
	Electrodes dry or loose	Repeat skin preparation as described in ***9.3.1 Preparing the Patient and Placing the Electrodes*** and apply fresh and moist electrodes.
	Cable or lead wires damaged	Change cable and lead wires.
Excessive alarms: heart rate, lead fault	Electrodes dry	Repeat skin preparation as described in ***9.3.1 Preparing the Patient and Placing the Electrodes*** and apply fresh, moist electrodes.
	Excessive patient movement or muscle tremor	Reposition the electrodes. Replace fresh and moist electrodes if necessary.
Low Amplitude ECG Signal	Gain set too low	Set the gain as required. For details, refer to ***9.5.11 Changing ECG Wave Settings.***
	Electrodes dry / old	Apply fresh and moist electrodes.
	Skin improperly prepared	Repeat skin preparation as described in ***9.3.1 Preparing the Patient and Placing the Electrodes***
	This could be the patient's normal QRS complex	Verify with another well-functioning monitor.
	Electrode could be positioned over a bone or muscle mass	Move ECG patches away from the bone or muscle mass.
No ECG Waveform	Gain set too low	Set the gain as required. For details, refer to***9.5.11 Changing ECG Wave Settings.***
	Lead wires and patient cable not fully or properly inserted	Check that the leadwires and patient cables are properly connected.
	Cable or lead wires damaged	Change cable and lead wires.
Base Line Wander	Patient moving excessively	Secure leadwires and cable to patient.
	Electrodes dry or loose	Repeat skin preparation as described in ***9.3.1 Preparing the Patient and Placing the Electrodes*** and apply fresh and moist electrodes.
	ECG Filter set to ST or Diagnostic mode	Set ECG Filter to "Monitor" mode.

FOR YOUR NOTES

10 Monitoring Respiration (Resp)

10.1 Introduction

Impedance respiration is measured across the thorax. When the patient is breathing or ventilated, the volume of air changes in the lungs, resulting in impedance changes between the electrodes. Respiration rate (RR) is calculated from these impedance changes, and a respiration waveform appears on the patient monitor screen.

10.2 Safety Information

⚠WARNING

- **When monitoring the patient's respiration, do not use ESU-proof ECG cables.**
- **If you do not set the detection level for the respiration correctly in manual detection mode, it may not be possible for the monitor to detect apnea. If you set the detection level too low, the monitor is more likely to detect cardiac activity, and to falsely interpret cardiac activity as respiratory activity in the case of apnea.**
- **The respiration measurement does not recognize the cause of apneas. It only indicates an alarm if no breath is detected when a pre-adjusted time has elapsed since the last detected breath. Therefore, it cannot be used for diagnostic purpose.**
- **If operating under conditions according to the EMC Standard IEC 60601-1-2 (Radiated Immunity 3V/m), field strengths above 1V/m may cause erroneous measurements at various frequencies. Therefore it is recommended to avoid the use of electrically radiating equipment in close proximity to the respiration measurement unit.**

10.3 Understanding the Resp Display

By selecting the waveform area or parameter area, you can enter the [**Resp Setup**] menu.

NOTE

- **Respiration monitoring is not for use on the patients who are very active, as this will cause false alarms.**

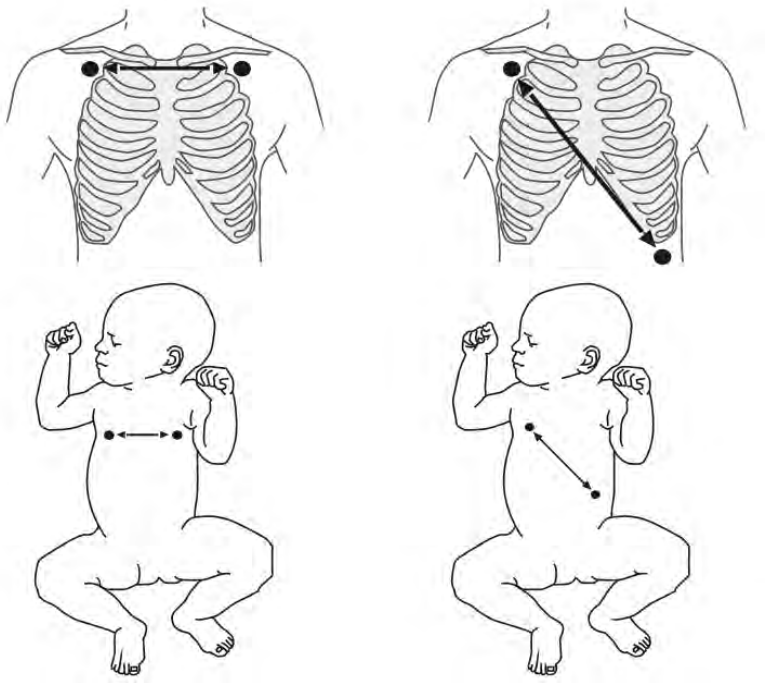
10.4 Placing Resp Electrodes

As the skin is a poor conductor of electricity, preparing the skin is necessary for a good Respiration signal. You can refer to the ECG section for how to prepare the skin.

As the Respiration measurement adopts the standard ECG electrode placement, you can use different ECG cables (3-lead, 5-lead or 12-lead). Since the respiration signal is measured between two ECG electrodes, if a standard ECG electrode placement is applied, the two electrodes should be RA and LA of ECG Lead I, or RA and LL of ECG Lead II.

NOTE

- **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.**



Lead I Lead II

10.4.1 Optimizing Lead Placement for Resp

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

10.4.2 Cardiac Overlay

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

10.4.3 Abdominal Breathing

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

10.4.4 Lateral Chest Expansion

In clinical applications, some patients (especially neonates) expand their chests laterally, causing a negative intrathoracic pressure. In these cases, it is better to place the two respiration electrodes in the right midaxillary and the left lateral chest areas at the patient's maximum point of the breathing movement to optimise the respiratory waveform.

10.5 Choosing the Respiration Lead

In the [**Resp Setup**] menu, set [**Resp Lead**] to [**I**], [**II**] or [**Auto**].

10.6 Changing the Apnea Alarm Delay

The apnea alarm is a high-level alarm used to detect apneas. You can set the apnea alarm delay time after which the patient monitor alarms if the patient stops breathing. In the [**Resp Setup**] menu, select [**Apnea Delay**] and then select the appropriate setting. The [**Apnea Delay**] of Resp, CO_2, AG, and RM module keeps consistent with each other.

10.7 Changing Resp Detection Mode

In the [**Resp Setup**] menu, select [**Detection Mode**] and toggle between [**Auto**] and [**Manual**].

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

  Use auto detection mode for situations where:

  - The respiration rate is not close to the heart rate.
  - Breathing is spontaneous, with or without continuous positive airway pressure (CPAP).
  - Patients are ventilated, except patients with intermittent mandatory ventilation (IMV).

- In manual detection mode, you adjust the dotted detection level line to the desired level by selecting [**Upper Line**] or [**Lower Line**] and then selecting or beside them. Once set, the detection level will not adapt automatically to different respiration depths. It is important to remember that if the depth of breathing changes, you may need to change the detection level.

  Use manual detection mode for situations where:

  - The respiration rate and the heart rate are close.
  - Patients have intermittent mandatory ventilation.
  - Respiration is weak. Try repositioning the electrodes to improve the signal.

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

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

10.8 Changing Resp Wave Settings

⚠WARNING

- **When monitoring in manual detection mode, make sure to check the respiration detection level after you have increased or decreased the size of the respiration wave.**

In the [**Resp Setup**] menu, you can:

- Select [**Gain**] and then select an appropriate setting. The bigger the gain is, the larger the wave amplitude is.
- Select [**Sweep**] and then select an appropriate setting. The faster the wave sweeps, the wider the wave is.

10.9 Setting RR Source

To set RR source:

1. Enter the [**Resp Setup**] menu.
2. Select [**RR Source**] and then select a source or [**Auto**] from the dropdown list.

The dropdown list displays the currently available RR source. When you select [**Auto**], the system will automatically select the RR source according to the priority. When the current RR source does not have valid measurement, the system will automatically switch the [**RR Source**] to [**Auto**]. RR source switches back to impedance respiration if you press the  hardkey on the monitor's front during an apnea alarm.

The priority of RR source is (from high to low): CO_2 measurement, RM measurement and impedance respiration measurement.

The [**RR Source**] settings of Resp, CO_2, AG and RM module are linked.
The RR source options and description are shown in the table below.

Option	Description
Auto	RR source is automatically selected according to the priority.
CO_2	RR source is from CO_2 measurement.
RM	RR source is from RM measurement.
ECG	RR source is from impedance respiration measurement.

10.10 Setting alarm properties

Select [**Alarm Setup >>**] from the [**Resp Setup**] menu. In the popup menu, you can set alarm properties for this parameter.

FOR YOUR NOTES

11 Monitoring PR

11.1 Introduction

The pulse numeric counts the arterial pulsations that result from the mechanical activity of the heart. You can display a pulse from any measured SpO_2 or any arterial pressure (see the IBP section). The displayed pulse numeric is color-coded to match its source.

1. PR: detected beats per minute.
2. PR Source

11.2 Setting the PR Source

The current pulse source is displayed in the PR parameter area. The pulse rate chosen as pulse source:

- is monitored as system pulse and generates alarms when you select PR as the active alarm source;
- is stored in the monitor's database and reviewed in the graphic/tabular trends; in trend graphs, as the PR curve is in the same color with the PR source , it is unlikely to distinguish the PR source ;
- is sent via the network to the central monitoring system, if available.

To set which pulse rate as PR source:

1. Enter the [**SpO_2 Setup**] menu.
2. Select [**PR Source**] and then select a label or [**Auto**] from the popup menu.

The popup menu displays the currently available PR sources from top to bottom by priority. When you select [**Auto**], the system will automatically select the first option as the PR source from the popup menu. When the current PR source is unavailable, the system will automatically switch [**PR Source**] to [**Auto**]. When you select [**IBP**], the system will automatically select the first pressure label as the PR source from the popup menu.

11.3 Selecting the Active Alarm Source

In most cases the HR and pulse numerics are identical. In order to avoid simultaneous alarms on HR and Pulse, the monitor uses either HR or Pulse as its active alarm source. To change the alarm source, select [**Alm Source**] in the [**ECG Setup**] or [**SpO_2 Setup**] menu and then select either:

- [**HR**]: The monitor will use the HR as the alarm source for HR/pulse.
- [**PR**]: The monitor will use the PR as the alarm source for HR/pulse.
- [**Auto**]: If the [**Alm Source**] is set to [**Auto**], the monitor will use the heart rate from the ECG measurement as the alarm source whenever the ECG measurement is switched on and a valid heart rate is available. If the heart rate becomes unavailable, for example if leads becomes disconnected, and a pulse source is switch on and available, the monitor will automatically switch to Pulse as the alarm source. When the Leads Off condition is corrected, the monitor will automatically switch back to the heart rate as the alarm source.

11.4 QRS Tone

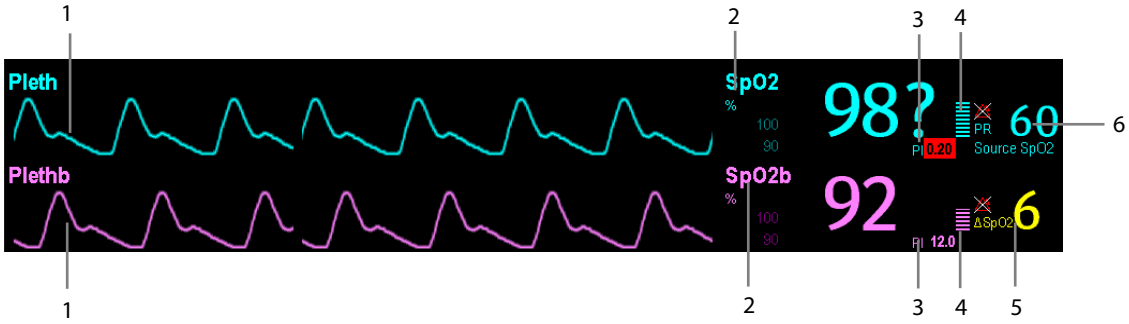
When PR is used as the alarm source, the PR source will be used as a source for the QRS tone. You can change the QRS volume by adjusting [**Beat Vol**] in the [**SpO_2 Setup**] menu. When a valid SpO_2 value exists, the system will adjust the pitch tone of QRS volume according to the SpO_2 value.

12 Monitoring SpO_2

12.1 Introduction

SpO_2 monitoring is a non-invasive technique used to measure the amount of oxygenated haemoglobin and pulse rate by measuring the absorption of selected wavelengths of light. The light generated in the probe passes through the tissue and is converted into electrical signals by the photodetector in the probe. The SpO_2 module processes the electrical signal and displays a waveform and digital values for SpO_2 and pulse rate.

This device is calibrated to display functional oxygen saturation.



1. Pleth waveform (Pleth/Plethb): visual indication of patient's pulse. The waveform is not normalized.
2. Oxygen saturation of arterial blood (SpO_2/SpO_2b): percentage of oxygenated hemoglobin in relation to the sum of oxyhemoglobin and deoxyhemoglobin. SpO_2 measurement is obtained through the MPM module, and SpO_2b measurement is obtained through the SpO_2 module.
3. Perfusion index (PI): gives the numerical value for the pulsatile portion of the measured signal caused by arterial pulsation. PI is an indicator of the pulsatile strength. You can also use it to assess the quality of SpO_2 measurement.
   - ◆ Above 1 is optimal
   - ◆ Between 0.3 and 1 is acceptable
   - ◆ Below 0.3 indicates low perfusion; When PI is below 0.3, a question mark (?) is displayed to the right of the SpO_2 value, indicating that the SpO_2 value may be inaccurate. Reposition the SpO_2 sensor or find a better site. If low perfusion persists, choose another method to measure oxygen saturation if possible.

   PI is available for Mindray SpO_2 module and Masimo SpO_2 module. For Mindray SpO_2 module, PI value can be displayed under the PR value in larger characters if [**PI Zoom**] is enabled.
4. Perfusion indicator: the pulsatile portion of the measured signal caused by arterial pulsation.
5. SpO_2 difference (ΔSpO_2): $\Delta SpO_2 = | SpO_2 - SpO_2b |$.
6. Pulse rate (derived from pleth wave): detected pulsations per minute.

In the case that you need to measure SpO_2 and spO_2b, select the same type of modules. Otherwise, the SpO_2 module for SpO2b is closed automatically. For example, if MPM module configuring Mindray SpO_2 and Masimo SpO_2 module are applied simultaneously, Masimo SpO_2 module is closed automatically.

NOTE

- **A functional tester or SpO2 simulator cannot be used to assess the accuracy of a SpO2 module or a SpO2 sensor.**
- **A functional tester or SpO_2 simulator can be used to determine the pulse rate accuracy.**

12.2 Safety

⚠ WARNING

- **Use only SpO_2 sensors specified in this manual. Follow the SpO_2 sensor's instructions for use and adhere to all warnings and cautions.**
- **When a trend toward patient deoxygenation is indicated, blood samples should be analyzed by a laboratory co-oximeter to completely understand the patient's condition.**
- **Do not use SpO_2 sensors during magnetic resonance imaging (MRI). Induced current could potentially cause burns. The sensor may affect the MRI image, and the MRI unit may affect the accuracy of the oximetry measurements.**
- **Prolonged continuous monitoring may increase the risk of undesirable changes in skin characteristics, such as irritation, reddening, blistering or burns. Inspect the sensor site every two hours and move the sensor if the skin quality changes. Change the application site every four hours. For neonates, or patients with poor peripheral blood circulation or sensitive skin, inspect the sensor site more frequently.**

12.3 Identifying SpO_2 Connectors

To identify which SpO_2 connector is incorporated into your MPM, BeneView T1, or SpO2 module, see the company logo located at the right upper corner. The color of the cable connector matches the company as shown below:

- Mindray SpO_2 connector: a blue connector without logo.
- Masimo SpO_2 connector: a purple connector with a logo of Masimo SET.
- Nellcor SpO_2 connector: a grey connector with a logo of Nellcor.

The connectors for these three SpO_2 sensors are mutually exclusive.

12.4 Applying the Sensor

1. Select an appropriate sensor according to the module type, patient category and weight.
2. Remove colored nail polish from the application site.
3. Apply the sensor to the patient.
4. Select an appropriate adapter cable according to the connector type and plug this cable into the SpO_2 connector.
5. Connect the sensor cable to the adapter cable.

⚠ WARNING

- **If the sensor is too tight because the application site is too large or becomes too large due to edema, excessive pressure for prolonged periods may result in venous congestion distal from the application site, leading to interstitial edema and tissue ischemia.**

12.5 Changing SpO_2 Settings

12.5.1 Accessing SpO_2 Menus

By selecting the SpO_2 parameter window or waveform area, you can access the [**SpO_2 Setup**] or [**SpO_2b Setup**] menu.

12.5.2 Adjusting the Desat Alarm

The desat alarm is a high level alarm notifying you of potentially life threatening drops in oxygen saturation. Select [**Alarm Setup >>**] from the [**SpO_2 Setup**] or [**SpO_2b Setup**] menu. From the popup menu, you can set low alarm limit, alarm switch, and alarm recording for [**Desat**] or [**Desatb**]. When the SpO_2 value is below the desat alarm limit and desat alarm switch is set on, the message [**SpO_2 Desat] or** [**SpO_2b Desat]** is displayed.

12.5.3 Setting SpO_2 Sensitivity

For Masimo SpO_2 module, you can set [**Sensitivity**] to [**Normal**] or [**Maximum**] in the [**SpO_2 Setup**] or [**SpO_2b Setup**] menu. When the [**Sensitivity**] is set to [**Maximum**], the patient monitor is more sensitive to minor signals. When monitoring critically ill patients whose pulsations are very weak, it is strongly recommended that the sensitivity is set to [**Maximum**]. When monitoring neonatal or non-critically ill patients who tend to move a lot, noise or invalid signals may be caused. In this case, it is recommended that the sensitivity is set to [**Normal**] so that the interference caused by motion can be filtered and therefore the measurement stability can be ensured. The settings of sensitivity in the [**SpO_2 Setup**] and [**SpO_2b Setup**] menus are linked.

12.5.4 Changing Averaging Time

The SpO_2 value displayed on the monitor screen is the average of data collected within a specific time. The shorter the averaging time is, the quicker the patient monitor responds to changes in the patient's oxygen saturation level. Contrarily, the longer the averaging time is, the slower the patient monitor responds to changes in the patient's oxygen saturation level, but the measurement accuracy will be improved. For critically ill patients, selecting shorter averaging time will help understanding the patient's state.

To set the averaging time:

- For Mindray SpO_2 module, select [**Sensitivity**] in the [**SpO_2 Setup**] or [**SpO_2b Setup**] menu and then toggle between [**High**], [**Med**] and [**Low**], which respectively correspond to 7 s, 9 s and 11 s.
- For Masimo SpO_2 module, select [**Averaging**] in the [**SpO_2 Setup**] or [**SpO_2b Setup**] menu and then toggle between [**2-4 s**], [**4-6 s**], [**8 s**], [**10 s**], [**12 s**], [**14 s**] and [**16 s**].

12.5.5 Monitoring SpO_2 and NIBP Simultaneously

When monitoring SpO_2 and NIBP on the same limb simultaneously, you can switch [**NIBP Simul**] on in the [**SpO_2 Setup**] or [**SpO_2b Setup**] menu to lock the SpO_2 alarm status until the NIBP measurement ends. If you switch [**NIBP Simul**] off, low perfusion caused by NIBP measurement may lead to inaccurate SpO_2 readings and therefore cause false physiological alarms.

12.5.6 Sat-Seconds Alarm Management

With traditional alarm management, high and low alarm limits are set for monitoring oxygen saturation. During monitoring, as soon as an alarm limit is violated, an audible alarm immediately sounds. When the patient % SpO_2 fluctuates near an alarm limit, the alarm sounds each time the limit is violated. Such frequent alarm can be distracting. Nellcor's Sat-Seconds alarm management technique is used to reduce these nuisance alarms.

The Sat-Seconds feature is available with the Nellcor SpO_2 module to decrease the likelihood of false alarms caused by motion artifacts. To set the Sat-Seconds limit, select [**Sat-Seconds**] in the [**SpO_2 Setup**] menu and then select the appropriate setting.

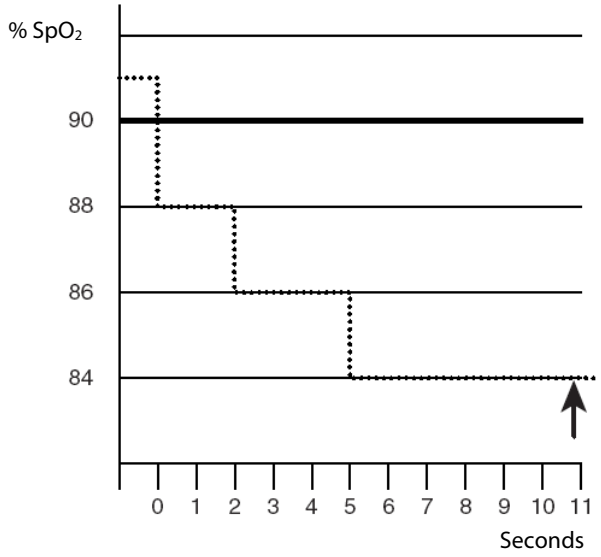
With Sat-Seconds alarm management, high and low alarm limits are set in the same way as traditional alarm management. A Sat-Seconds limit is also set. The Sat-Seconds limit controls the amount of time that SpO_2 saturation may be outside the set limits before an alarm sounds. The method of calculation is as follows: the number of percentage points that the SpO_2 saturation falls outside the alarm limit is multiplied by the number of seconds that it remains outside the limit. This can be stated as the equation:

Sat-Seconds= Points × Seconds

Only when the Sat-Seconds limit is reached, the monitor gives a Sat-Seconds alarm. For example, the figure below demonstrates the alarm response time with a Sat-Seconds limit set at 50 and a low SpO_2 limit set at 90%. In this example, the patient % SpO_2 drops to 88% (2 points) and remains there for 2 seconds. Then it drops to 86% (4 points) for 3 seconds, and then to 84% (6 points) for 6 seconds. The resulting Sat-Seconds are:

% SpO_2	Seconds	Sat-Seconds
2×	2=	4
4×	3=	12
6×	6=	36
Total Sat-Seconds=		52

After approximately 10.9 seconds, a Sat-Second alarm would sound, because the limit of 50 Sat-Seconds would have been exceeded.



Saturation levels may fluctuate rather than remaining steady for a period of several seconds. Often, the patient % SpO_2 may fluctuate above and below an alarm limit, re-entering the non-alarm range several times. During such fluctuation, the monitor integrates the number of %SpO_2 points, both positive and negative, until either the Sat-Seconds limit is reached, or the patient%SpO_2 re-enters the non-alarm range and remains there.

12.5.7 Changing the Speed of the Pleth/Plethb Wave

In the [**SpO_2 Setup**] or [**SpO_2b Setup**] menu, select [**Sweep**] and then select the appropriate setting. The faster the waveform sweeps, the wider the waveform is.

12.5.8 Zooming PI Value

For Mindray SpO_2 module, you can display PI value in larger characters for better view. To zoom in the display of PI value, set [**PI Zoom**] to [**Yes**] from the [**SpO_2 Setup**] menu or [**SpO_2b Setup**] menu.

12.5.9 Setting the Alarm Level for SpO_2 Sensor Off Alarm

Select [**Alarm Setup >>**] from the [**User Maintenance**] menu. You can set the [**SpO_2 SensorOff Lev.**] in the popup menu.

12.5.10 Setting the SpO_2 Tone Mode

Select [**Others >>**] from the [**User Maintenance**] menu. In the popup menu, you can set [**SpO_2 Tone**] as [**Mode 1**] or [**Mode 2**].

⚠WARNING

- **The same SpO_2 tone mode shall be used for the same patient monitors in a single area.**

12.6 Measurement Limitations

If you doubt the measured SpO_2, check patient vital signs first. Then check the patient monitor and SpO_2 sensor. The following factors may influence the accuracy of measurement:

- Ambient light
- Physical movement (patient and imposed motion)
- Diagnostic testing
- Low perfusion
- Electromagnetic interference, such as MRI environment
- Electrosurgical units
- Dysfunctional haemoglobin, such as carboxyhemoglobin (COHb)and methemoglobin (MetHb)
- Presence of certain dyes, such as methylene and indigo carmine
- Inappropriate positioning of the SpO_2 sensor, or use of incorrect SpO_2 sensor
- Drop of arterial blood flow to immeaurable level caused by shock, anemia, low temperature or vasoconstrictor.

12.7 Masimo Information

- Masimo Patents

This device is covered under one or more the following U.S.A. patents: 5,758,644, 6,011,986, 6,699,194, 7,215,986, 7,254,433, 7,530,955 and other applicable patents listed at: www.masimo.com/patents.htm.

- No Implied License

Possession or purchase of this device does not convey any express or implied license to use the device with unauthorized sensors or cables which would, alone, or in combination with this device, fall within the scope of one or more of the patents relating to this device.

12.8 Nellcor Information

- Nellcor Patents

This device may be covered by one or more of the following US patents and foreign equivalents: 5,485,847, 5,676,141, 5,743,263, 6,035,223, 6,226,539, 6,411,833, 6,463,310, 6,591,123, 6,708,049, 7,016,715, 7,039,538, 7,120,479, 7,120,480, 7,142,142, 7,162,288, 7,190,985, 7,194,293, 7,209,774, 7,212,847, 7,400,919.

- No Implied License

Possession or purchase of this device does not convey any express or implied license to use the device with unauthorized replacement parts which would, alone, or in combination with this device, fall within the scope of one or more of the patents relating to this device.

12.9 Troubleshooting

This section lists the problems that might occur. If you encounter the problems when using the equipment or accessories, check the table below before requesting for services. If the problem persists, contact your service personnel.

⚠ CAUTION

- **Never try to disassemble the equipment or supplied accessories. There are no internal user-serviceable parts.**

Symptoms	Possible Cause	Correction Action
Dashes "- -" display in place of numerics.	Measurement is invalid.	Check that the sensor is properly applied. Change the application site if necessary.
Do not see SpO_2 parameter tiles in display.	Parameter not configured to display.	Switch the SpO_2 monitoring function on as described in ***3.13.1 Switching the Parameters On/Off***.
Unable to obtain SpO_2 reading	Patient has poor perfusion	Change the application site or notify the physician
	Sensor not on patient	Check if the "SPO_2 Sensor Off" alarm is reported. If so, reapply the sensor. If not, contact the service personnel.
	Cables loose/not connected	Check the cable connections. Switch the cable if necessary.
	Ambient light	Check if the "SpO_2 Too Much Light" alarm is reported. If so, move the sensor to a place with lower level of ambient light or cover the sensor to minimize the ambient light.

No SpO2 waveform	Waveform not selected to display	Switch the SpO_2 monitoring function on as described in ***3.13.1 Switching the Parameters On/Off***.
	Cable or sensor not plugged in	Check that the cable is properly connected and sensor securely applied.
Low amplitude SpO_2 signal	SpO_2 sensor on same limb as cuff	Check that the sensor is properly applied. Change the application site if necessary.
	Patient has poor perfusion	Change the application site.

13 Monitoring NIBP

13.1 Introduction

The MPM and BeneView T1 use the oscillometric method for measuring the non-invasive blood pressure (NIBP). This measurement can be used for adults, pediatrics and neonates.

Automatic non-invasive blood pressure monitoring uses the oscillometric method of measurement. To understand how this method works, we'll compare it to the auscultative method. With auscultation, the clinician listens to the blood pressure and determines the systolic and diastolic pressures. The mean pressure can then be calculated with reference to these pressures as long as the arterial pressure curve is normal.

Since the monitor cannot hear the blood pressure, it measures cuff pressure oscillation amplitudes. Oscillations are caused by blood pressure pulses against the cuff. The oscillation with the greatest amplitude is the mean pressure. This is the most accurate parameter measured by the oscillometric method. Once the mean pressure is determined, the systolic and diastolic pressures are calculated with reference to the mean.

Simply stated, auscultation measures systolic and diastolic pressures and the mean pressure is calculated. The oscillometric method measures the mean pressure and determines the systolic and diastolic pressures.

As specified by IEC 60601-2-30, NIBP measurement can be performed during electro-surgery and discharge of defibrillator.

NIBP diagnostic significance must be decided by the doctor who performs the measurement.

NOTE

- **Blood pressure measurements determined with this device are equivalent to those obtained by a trained observer using the cuff/stethoscope auscultatory method or an intra-arterial blood pressure measurement device, within the limits prescribed by the American National Standard, Manual, electronic, or automated sphygmomanometers.**

13.2 Safety

⚠ WARNING

- **Be sure to select the correct patient category setting for your patient before measurement. Do not apply the higher adult settings for pediatric or neonatal patients. Otherwise it may present a safety hazard.**
- **Do not measure NIBP on patients with sickle-cell disease or on the limb where skin damage has occurred or is expected.**
- **Use clinical judgement to determine whether to perform frequent unattended blood pressure measurements on patients with severe blood clotting disorders because of the risk of hematoma in the limb fitted with the cuff.**
- **Do not use the NIBP cuff on a limb with an intravenous infusion or arterial catheter in place. This could cause tissue damage around the catheter when the infusion is slowed or blocked during cuff inflation.**
- **NIBP reading can be affected by the measurement site, the position of the PATIENT, exercise, or the patient's physiologic condition. If you doubt the NIBP readings, determines the patient's vital signs by alternative means and then verify that the monitor is working correctly.**
- **Do not use the NIBP cuff on the arm on the side of a mastectomy.**
- **Continuous CUFF pressure due to connection tubing kinking may cause blood flow interference and resulting harmful injury to the patient.**

13.3 Measurement Limitations

Measurements are impossible with heart rate extremes of less than 40bpm or greater than 240bpm, or if the patient is on a heart-lung machine.

The measurement may be inaccurate or impossible:

- If a regular arterial pressure pulse is hard to detect
- With excessive and continuous patient movement such as shivering or convulsions
- With cardiac arrhythmias
- Rapid blood pressure changes
- Severe shock or hypothermia that reduces blood flow to the peripheries
- Obesity, where a thick layer of fat surrounding a limb dampens the oscillations coming from the artery

13.4 Measurement Methods

There are four methods of measuring NIBP:

- Manual: measurement on demand.
- Auto: continually repeated measurements at set intervals.
- STAT: continually rapid series of measurements over a five minute period, then return to the previous mode.
- Sequence: continually automatic measurement at set durations and intervals.

13.5 Setting Up the NIBP Measurement

13.5.1 Preparing the Patient

In normal use, perform NIBP measurement on a patient who is in the following position:

- Comfortably seated
- Legs uncrossed
- Feet flat on the floor
- Back and arm supported
- Middle of the cuff at the level of the right atrium of the heart

NOTE

- **It is recommended that the patient relaxes as much as possible before performing measurement and that the patient does not talk during NIBP measurement.**
- **It is recommended that 5 min should elapse before the first reading is taken.**
- **The operator should not touch the cuff or tubing during NIBP measurement.**

13.5.2 Preparing to Measure NIBP

1. Power on the monitor.
2. Verify that the patient category is correct. If not, select the [**Patient Setup**] QuickKey → [**Patient Demographics**] → [**Patient Cat.**] and set the patient category to [**Adu**], [**Ped**] or [**Neo**].
3. Plug the air tubing into the NIBP connector on the MPM module or BeneView T1.
4. Select a correct sized cuff and then apply it as follows:
   - Determine the patient's limb circumference.
   - Select an appropriate cuff by referring to the limb circumference marked on the cuff. The width of the cuff should be 40% (50% for neonates) of the limb circumference, or 2/3 of the upper arm's length. The inflatable part of the cuff should be long enough to encircle at least 50% to 80% of the limb.
   - Apply the cuff to an upper arm or leg of the patient and make sure the Φ marking on the cuff matches the artery location. Do not wrap the cuff too tightly around the limb. It may cause discoloration, and ischemia of the extremities. Make sure that the cuff edge falls within the marked range. If it does not, use a larger or smaller cuff that will fit better.
5. Connect the cuff to the air tubing and make sure that the air tubing is not compressed or twisted. Air must pass unrestricted through the tubing.

NOTE

- **The use of the equipment is restricted to one patient at a time.**

13.5.3 Starting and Stopping Measurements

Select the [**NIBP Measure**] QuickKey and you can start the desired measurement from the popup menu. You can select [**Stop All**] QuickKey to stop all NIBP measurements. You can also start and stop measurements by using the hardkey on either the monitor's front panel or the MPM module.

13.5.4 Correcting the Measurement if Limb is not at Heart Level

The cuff should be applied to a limb at the same level as the patient's heart. If the limb is not at the heart level, to the displayed value:

- Add 0.75 mmHg (0.10 kPa) for each centimetre higher, or
- Deduct 0.75 mmHg (0.10 kPa) for each centimeter lower.

13.5.5 Enabling NIBP Auto Cycling and Setting the Interval

1. Select the NIBP parameter window to enter the [**NIBP Setup**] menu.
2. Select [**Interval**] and then select a desired time interval. Selecting [**Manual**] switches to manual mode.
3. Start a measurement manually. The monitor will then automatically repeat NIBP measurements at the set time interval.

Or

1. Select [**NIBP Measure**] QuickKey .
2. Select a proper interval.
3. Start a measurement manually. The monitor will then automatically repeat NIBP measurements at the set time interval.

In auto mode, you can enable the clock function to synchronize the NIBP automatic measurements with the real time clock.

For example, when the clock is enabled, if Interval is [**20min**], and then you start NIBP auto measurement at 14: 03, the next measurement will be taken at 14: 20, and the following measurement time will be 14:40, 15:00, and so on.

To enable the clock, in the [**NIBP Setup**] menu, set [**Clock**] to [**On**].

NOTE

- **The clock function is available only when the auto measurement interval is 5 minutes or more.**

13.5.6 Starting a STAT Measurement

1. Select the NIBP parameter window to enter the [**NIBP Setup**] menu.
2. Select [**NIBP STAT**].

Or

1. Select [**NIBP Measure**] QuickKey .
2. Select [**STAT**].

The STAT mode initiates 5 minutes of continuous, sequential, automatic NIBP measurements.

⚠WARNING

- **Continuous non-invasive blood pressure measurements may cause purpura, ischemia and neuropathy in the limb with the cuff. Inspect the application site regularly to ensure skin quality and inspect the extremity of the cuffed limb for normal color, warmth and sensitivity. If any abnormity occurs, move the cuff to another site or stop the blood pressure measurements immediately.**

13.5.7 Sequence Measurement

NIBP sequence measurement can include up to five cycles: A, B, C, D and E. You can individually set the duration and interval for each cycle.

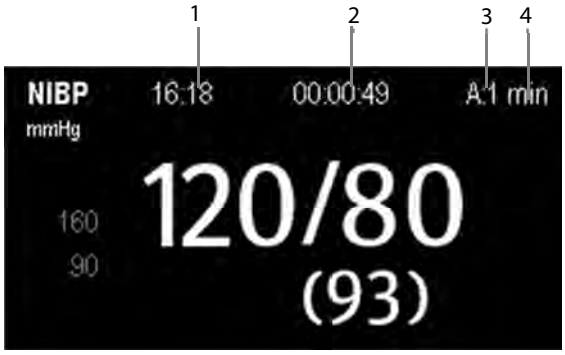
To set the sequence measurement, follow this procedure:

1. Select the NIBP parameter window to enter the [**NIBP Setup**] menu.
2. Select [**Sequence Setup>>**]
3. Set up [**Duration**] and [**Interval**] for each cycle.

To start the sequence measurement, follow this procedure:

1. Select the NIBP parameter window to enter the [**NIBP Setup**] menu.
2. Set [**Interval**] to [**Sequence**]
3. Select [**Start NIBP**], or select [**NIBP Measure**] Quickkey in the main screen.

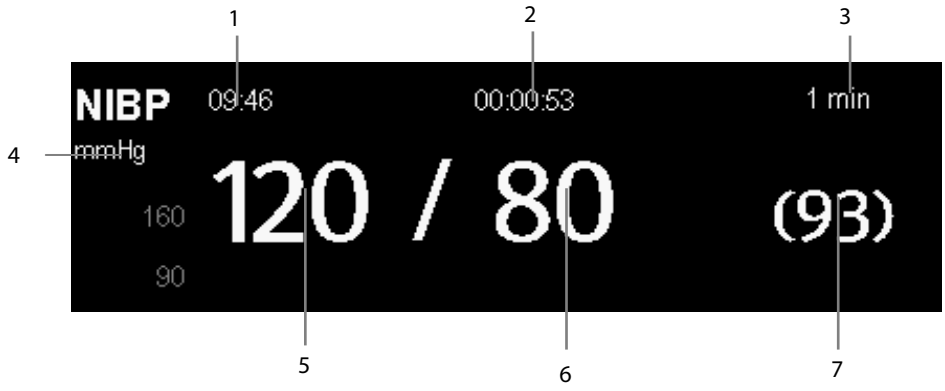
When the NIBP sequence measurement is in use, the NIBP parameter area displays as follows:



1. Time of last measurement
2. Time remaining to next measurement
3. Cycle name
4. NIBP measurement Interval

13.6 Understanding the NIBP Numerics

The NIBP display shows numerics only as below. Your display may be configured to look slightly different.



1. Time of last measurement
2. Time remaining to next measurement
3. Measurement mode
4. Unit of pressure: mmHg or kPa
5. Systolic pressure
6. Diastolic pressure
7. Mean pressure obtained after the measurement and cuff pressure obtained during the measurement

If the NIBP measurement exceeds the measurement range or the measurement fails, "---" will be displayed. If you manually stop the measurement, the last measured value will be displayed.

13.7 Changing NIBP Settings

By selecting the NIBP parameter window, you can enter the [**NIBP Setup**] menu.

13.7.1 Setting the Initial Cuff Inflation Pressure

You can set the initial cuff inflation pressure manually. In the [**NIBP Setup**] menu, select [**Initial Pressure**] and then select the appropriate setting.

NOTE

- **For known hypertensive patients, you need to set initial cuff pressure to a higher value to reduce the measurement time.**

13.7.2 Setting NIBP Alarm Properties

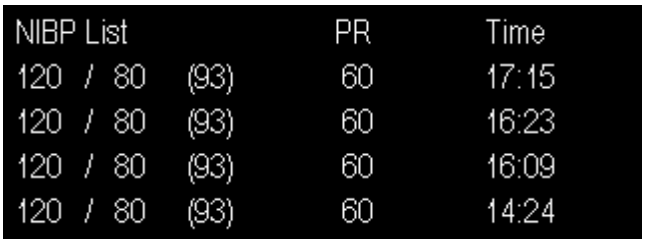
Select [**Alarm Setup >>**] from the [**NIBP Setup**] menu. You can set the alarm properties for this parameter in the popup menu.

13.7.3 Switching On NIBP End Tone

The monitor can issue a reminder tone at the completion of NIBP measurement. The NIBP end tone is off by default. You can switch it on by accessing the [**NIBP Setup**] menu.

13.7.4 Displaying NIBP List

Select [**Screens**] QuickKey→[**Screen Setup**]. You can set [**NIBP List**] to be displayed at the bottom area of the screen. Then, multiple sets of most recent NIBP measurements will be displayed. And PR displayed is derived from NIBP.



You can not display NIBP list in some screens such as the big numerics screen and the interpretation of resting 12-lead ECG screen.

13.7.5 Setting the Pressure Unit

Select [**Unit Setup >>**] from the [**User Maintenance**] menu. In the popup menu, select [**Press. Unit**] and toggle between [**mmHg**] and [**kPa**].

13.8 Assisting Venous Puncture

You can use the NIBP cuff to cause sub-diastolic pressure to block the venous blood vessel and therefore help venous puncture.

1. Select [**VeniPuncture >>**] from the [**NIBP Setup**] menu. In the popup menu, verify that the [**Cuff Press**.] value is appropriate. Change it if necessary.
2. Select [**VeniPuncture**].
3. Puncture vein and draw blood sample.
4. Select the hardkey on the monitor's front, or the [**Stop All**] QuickKey to deflate the cuff. The cuff deflates automatically after a set time if you do not deflate it.

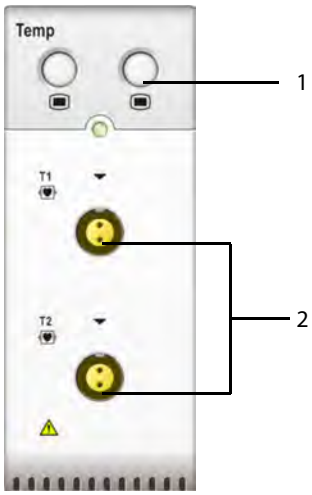
During measurement, the NIBP display shows the inflation pressure of the cuff and the remaining time in venous puncture mode.

FOR YOUR NOTES

14 Monitoring Temp

14.1 Introduction

The equipment is used to monitor skin temperature and core temperature. It can simultaneously monitor four temperature sites using the MPM, Temp module or the BeneView T1.



1. Temp Setup key
2. Temperature probe connector

14.2 Safety

⚠ WARNING

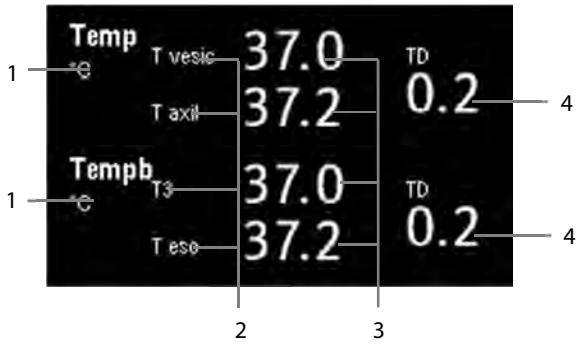
- **Verify that the probe detection program works correctly before monitoring. Plug out the temperature probe cable from the T1 or T2 connector, and the monitor can display the message [**T1 Sensor Off**] or [T2 Sensor Off] and give alarm tones correctly.**

14.3 Making a Temp Measurement

1. Select an appropriate probe for your patient according to the patient type and measuring site.
2. If you are using a disposable probe, connect the probe to the temperature cable.
3 Plug the probe or temperature cable to the temperature connector.
4. Attach the probe to the patient correctly.
5. Check that the alarm settings are appropriate for this patient.

14.4 Understanding the Temperature Display

The following figure shows the Temp numeric area for temperature monitoring with the MPM/T1 and Temp module. Temp measurement is obtained through the MPM or T1, and Tempb measurement is obtained through the Temp module.



1. Temperature unit
2. Temperature label
3. Temperature measurements
4. Temperature difference

14.5 Changing Temperature Settings

14.5.1 Setting the Temperature Unit

Select [**Unit Setup >>**] from the [**User Maintenance**] menu. In the popup menu, select [**Temp Unit]** and toggle between [**ºC**] and [**ºF**].

14.5.2 Setting the Temperature Label

The default temperature label is T1 and T2 when you measure temperature with MPM or T1. To change the Temp label, follow this procedure:

1. Select the Temp parameter area to enter [**Temp Setup**] menu.
2. Select [**Temp-1 Label**] or [**Temp-2 Label**], and in the drop-down list, select a proper label.

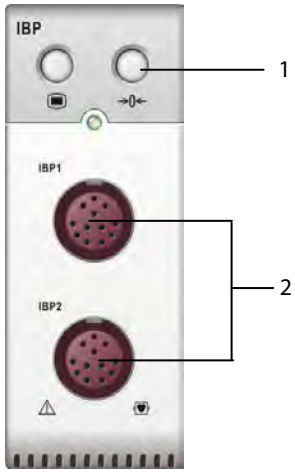
The default temperature label is T3 and T4 when you measure temperature with Temp module. To change the Tempb label, follow this procedure:

1. Select the Tempb parameter area to enter [**Tempb Setup**] menu.
2. Select [**Temp-3 Label**] or [**Temp-4 Label**], and in the drop-down list, select a proper label.

15 Monitoring IBP

15.1 Introduction

You can measure invasive blood pressure using the MPM, BeneView T1, PiCCO module, or the pressure plug-in module. The monitor can monitor up to 8 invasive blood pressures and displays the systolic, diastolic and mean pressures and a waveform for each pressure.



1. Zero key 2. Connector for IBP cable

15.2 Safety

⚠ WARNING

- **Use only pressure transducers specified in this manual. Never reuse disposable pressure transducers.**
- **Make sure that the applied parts never contact other conductive parts.**
- **To reduce the hazard of burns during high-frequency surgical procedure, ensure that the monitor's cables and transducers never come into contact with the high-frequency surgical units.**
- **When using accessories, their operating temperature should be taken into consideration. For details, refer to instructions for use of accessories.**
- **The neutral electrode of the electro-surgery unit (ESU) shall properly contact the patient. Otherwise, burns may result.**

15.3 Measuring an Invasive Blood Pressure

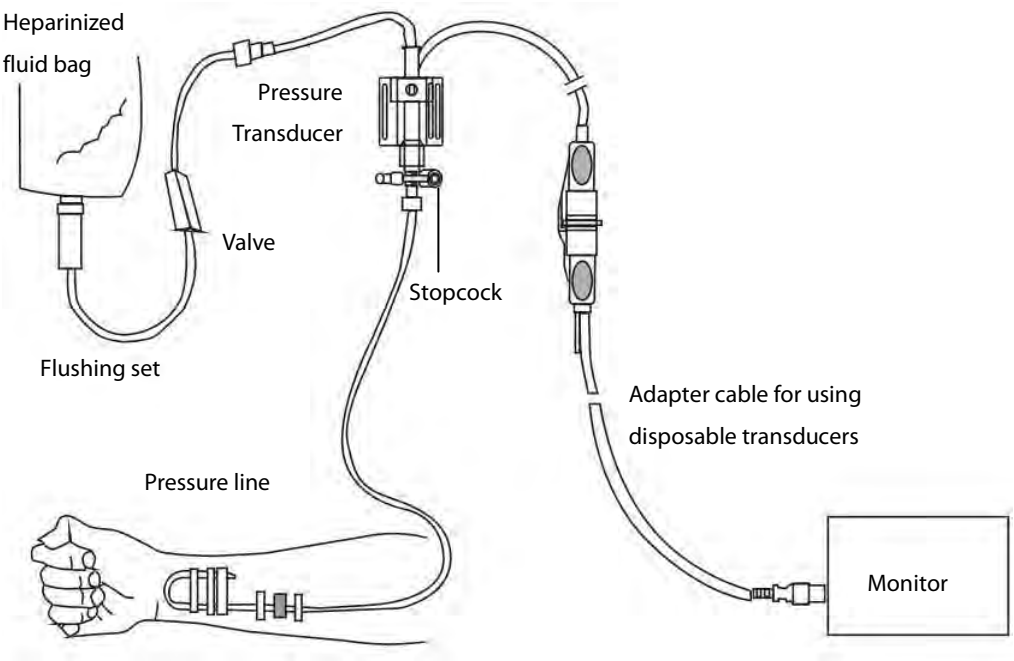
15.3.1 Setting Up the Pressure Measurement

1. Plug the pressure cable into the IBP connector.
2. Prepare the flush solution.
3. Flush the system to exhaust all air from the tubing. Ensure that the transducer and stopcocks are free of air bubbles.

⚠ WARNING

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

4. Connect the pressure line to the patient catheter.
5. Position the transducer so that it is level with the heart, approximately at the level of the midaxillary line.
6. Select the appropriate label.
7. Zero the transducer. After a successful zeroing, turn off the stopcock to the atmosphere and turn on the stopcock to the patient.



⚠ WARNING

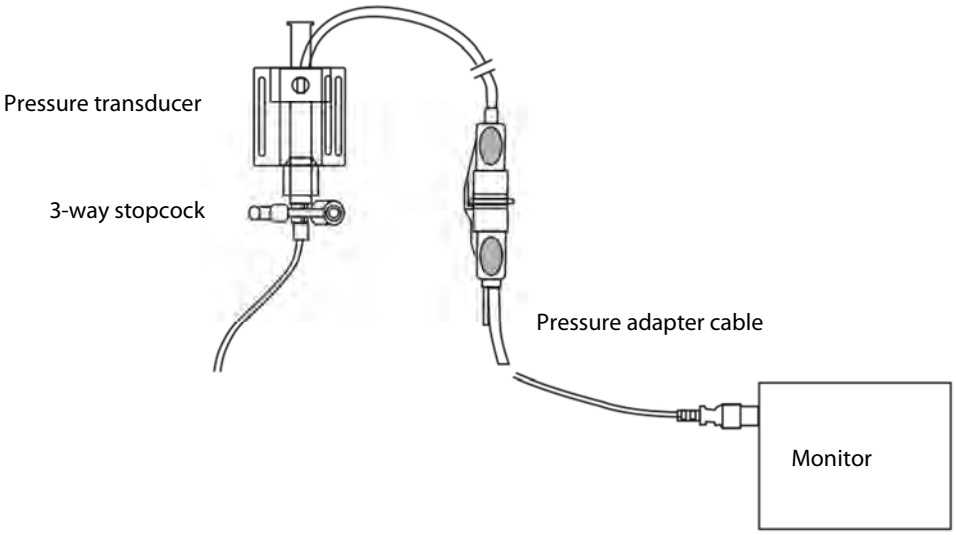
- **If measuring intracranial pressure (ICP) with a sitting patient, level the transducer with the top of the patient's ear. Incorrect leveling may give incorrect values (not applicable if measursing ICP with the Codman ICP transducer).**

15.3.2 Zeroing the Transducer

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

- A new transducer or adapter cable is used.
- You reconnect the transducer cable to the monitor.
- The monitor restarts.
- You doubt the readings.

1. Turn off the stopcock to the patient.



2. Vent the transducer to the atmospheric pressure by turning on the stopcock to the air.
3. Press the →0← hardkey on the module, or, in the setup menu for the pressure (e.g. Art), select [**Art Zero >>**]→ [**Zero**]. During zero calibration, the [**Zero**] button appears dimmed. It recovers after the zero calibration is completed. To zero all IBP channels, select [**Zero IBP**] hotkey, and then select [**Zero All Channels**] in the popup menu.
4. After the zero calibration is completed, close the stopcock to the air and open the stopcock to the patient.

Zero calibration may fail in case of pressure fluctuation or pressure exceeding the calibration range. If zero calibration fails, follow this procedure:

1. Check that the three-way valve (the one near the transducer) is open to the air.
2. Perform zero calibration again. Do not sway the IBP transducer and tubing during zero calibration.

NOTE

- **Your hospital policy may recommend that the ICP transducer is zeroed less frequently than other transducers.**

15.4 Measuring ICP Using the Codman ICP Transducer

15.4.1 Zeroing the Codman ICP transducer

You shall zero the Codman ICP transducer (PN: 040-002336-00) before use. To zero the ICP transducer, follow this procedure:

1. Before unpacking the ICP transducer, check that the monitor supports the Codman ICP transducer.

   a. Select [**Main Menu**]→[**Parameters>>**]→[**ICP Setup>>**] (if you cannot find [**ICP Setup>>**] button, you can select any IBP setup button to enter its corresponding setup menu, and then select [**Label**] and change current label to [**ICP**]) → select the [**Zero Ref. >>**] button.

   b. Check that the following icon is displayed in the [**ICP Zero**] menu. The monitor supports the Codman ICP transducer if the following icon is displayed in the [**ICP Zero**] menu.

2. Connect the ICP transducer, the ICP adapter cable and the module.
3. Follow the manufacturer's instructions to prepare the ICP transducer.
4. Zero the ICP transducer: when you see the message [**Zero Ref.?**] in the ICP numeric area, select the ICP waveform area or numeric area to enter the [**ICP Setup**] menu → select the [**Zero Ref. >>**] button → select the [**Zero**] button.
5. Record the zero reference value on the blank area of the ICP transducer for further reference.

If the ICP transducer zero calibration failed or you doubt the zero reference value, perform a zero calibration again.

15.4.2 Measuring ICP

To monitor ICP, follow this procedure:

1. Zero the Codman ICP transducer. For more information, see section ***15.4.1Zeroing the Codman ICP transducer***.
2. Disconnect the ICP transducer and ICP adapter cable. Follow the manufacturer's instructions to apply the ICP transducer to the patient.
3. Reconnect the ICP transducer and ICP adapter cable.
4. Check that the zero reference value displayed on the monitor is consistent with that recorded on the ICP transducer.
   - Consistent: select [**Accept**].
   - Incosistent: input the zero reference value recorded on the ICP transducer, and select [**Accept**].

If you have to transfer the patient who is taking ICP measurement, check that the target monitor supports the Codman ICP transducer. For more information, see ***15.4.1Zeroing the Codman ICP transducer***. If the target monitor does not support the Codman ICP transducer, do not use it for ICP monitoring.

If the target monitor supports the Codman ICP transducer, follow this procedure to transfer the patient:

1. Disconnect the ICP adapter cable from the measurement module, or remove the module from the monitor.

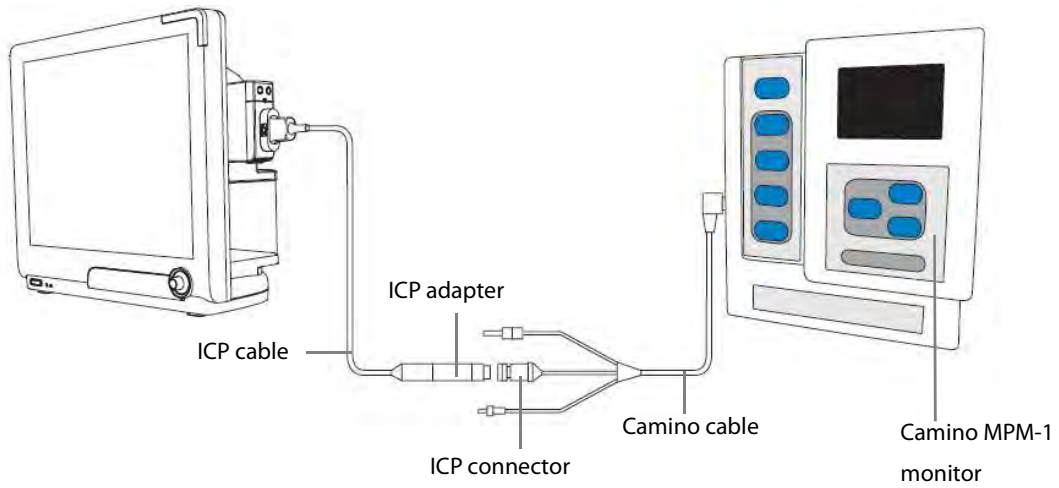
2. Connect the ICP adapter cable, measurement module, and the target monitor, or insert the measurement module into the target monitor.
3. Check that the zero reference value displayed on the monitor is consistent with that recorded on the ICP transducer.
   - Consistent: select [**Accept**].
   - Inconsistent: input the zero reference value recorded on the ICP transducer, and select [**Accept**].

15.5 Connecting a Camino device

The IBP module can interface with the Camino multi-parameter monitor (Model: MPM-1) to measure intracranial pressure (ICP).

To connect the Camino:

1. Plug the IBP module into the module rack of the monitor.
2. Connect the ICP cable (PN: 115-025257-00) to the IBP module.
3. Connect the ICP connector to the ICP adapter.
4. Connect the Camino cable to the Camino monitor.



WARNING

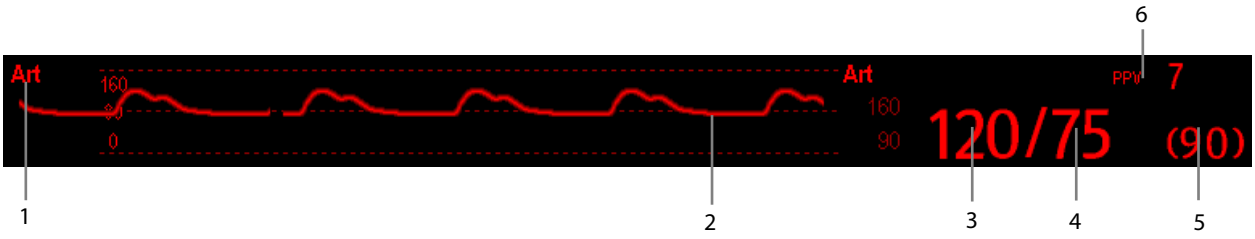
- **0bserve the Camino Operator's Manual to make settings and to connect the monitor with the patient.**
- **Because you can set the ICP alarm limits on this patient monitor, the ICP alarms settings on this patient monitor may be different from those on the Camino device. Please pay special attention to the alarms on the Camino.**

NOTE

- **Only IBP module can be used for connecting the Camino. IBP connectors on other modules, such as the MPM, PiCCO module, do not have this function.**

15.6 Understanding the IBP Display

The IBP measurement is displayed on the monitor as a waveform and numeric pressures. The figure below shows the waveform and numerics for the Art pressure. For different pressures, this display may be slightly different.



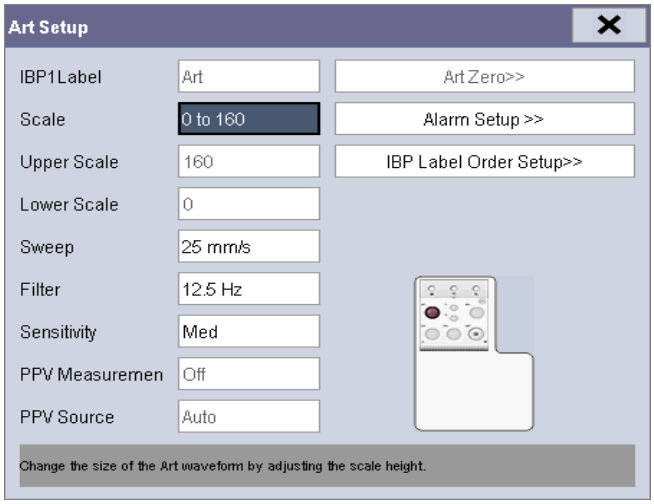
1. Pressure label
2. Waveform
3. Systolic pressure
4. Diastolic pressure
5. Mean pressure
6. PPV measurement

For some pressures, the parameter window may show the mean pressure only. For different pressures, their defaults unit may be different. If the Art and ICP pressures are measured simultaneously, the ICP parameter area will display numeric CPP, which is obtained by subtracting ICP from the Art mean.

15.7 Changing IBP Settings

15.7.1 Changing a Pressure for Monitoring

1. Select the pressure you want to change to enter its setup menu. In the menu, there is a figure showing the current IBP measurement connector.



2. Select [**Label**] and then select your desired label from the list. The already displayed labels cannot be selected.

Label	Description	Label	Description
PA	Pulmonary artery pressure	CVP	Central venous pressure
Ao	Aortic pressure	LAP	Left atrial pressure
UAP	Umbilical arterial pressure	RAP	Right atrial pressure
BAP	Brachial arterial pressure	ICP	Intracranial pressure
FAP	Femoral arterial pressure	UVP	Umbilical venous pressure
Art	Arterial blood pressure	LV	Left ventricular pressure
CPP	Cerebral perfusion pressure	P1 to P4	Non-specific pressure label

NOTE

- **When two pressures are deteted having the same label, the patient monitor changes one pressure label to a currently unused one.**

15.7.2 Setting the Pressure Label Order

Select [**IBP Label Order Setup >>**] from the parameter setup menu to set the display order of the pressure labels. The default display order is: Art, pArt, CVP, pCVP, ICP, PA, Ao, UAP, FAP, BAP, LV, LAP, RAP, UVP, P1, P2, P3, P4. To restore the default setting, you can select [**Defaults**] from the [**IBP Label Order Setup**] window.

15.7.3 Setting Alarm Properties

Select [**Alarm Setup >>**] from the parameter setup menu. You can set alarm properties for this parameter in the popup menu.

15.7.4 Changing Averaging Time

The IBP value displayed on the monitor screen is the average of data collected within a specific time. The shorter the averaging time is, the quicker the patient monitor responds to changes in the patient's blood pressure. Contrarily, the longer the averaging time is, the slower the patient monitor responds to changes in the patient's blood pressure, but the measurement accuracy will be improved. For critically ill patients, selecting shorter averaging time will help understanding the patient's state.

To set the averaging time, in the parameter setup menu, select [**Sensitivity**] and toggle between [**High**], [**Med**] and [**Low**], the corresponding averaging time is about 1 s, 8 s and 12 s respectively.

15.7.5 Setting the Pressure Unit

Select [**Unit Setup >>**] from the [**User Maintenance**] menu. In the popup menu, select [**Press. Unit**] and toggle between [**mmHg**] and [**kPa**]. Select [**CVP Unit**] and toggle between [**mmHg**], [**cmH_2O**] and [**kPa**].

15.7.6 Setting Up the IBP Wave

In the setup menu for the pressure, you can:

- Select [**Sweep**] and then select the appropriate setting. The faster the wave sweeps, the wider the wave is.
- Select [**Scale**] and then select the appropriate setting. If [**Auto**] is selected, the size of the pressure's waveform will be adjusted automatically.
- Select [**Filter**] and then select the desired option.

15.7.7 Enabling PPV Measurement and Setting PPV Source

PPV indicates pulse pressure variation. To enable PPV measurement, set [**PPV Measurement**] to [**On**].

You can select PPV source when PPV measurement is enabled.

⚠WARNING

- **This monitor can calculate PPV from beat-to-beat values of any arterial pulsatile pressure. The circumstances under which the calculation of a PPV value is clinically meaningful, appropriate and reliable must be determined by a physician.**
- **The clinical value of the derived PPV information must be determined by a physician. According to recent scientific literature, the clinical relevance of PPV information is restricted to sedated patients receiving controlled mechanical ventilation and mainly free from cardiac arrhythmia.**
- **PPV calculation may lead to inaccurate values in the following situations:**
  - **at respiration rates below 8 rpm**
  - **during ventilation with tidal volumes lower than 8 ml/kg**
  - **for patients with acute right ventricular dysfunction ("cor pulmonale").**
- **The PPV measurement has been validated only for adult patients.**

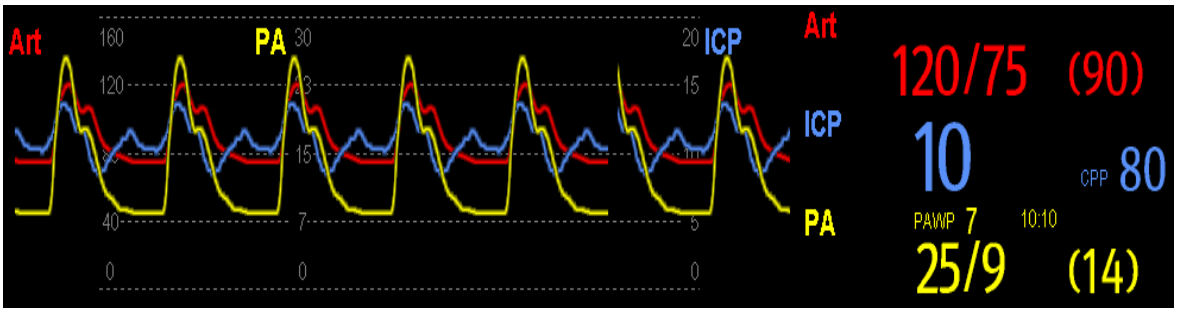
NOTE

- **The PPV measurement from IBP will automatically be switched off if PiCCO is working. The monitor will measure PPV through PiCCO module.**

15.7.8 IBP Overlapping

Set IBP wave overlapping:

1. Select the [**Screens**] button  in prompt message area, and then access the [**Screens**] window.
2. Select [**Screen Setup**] tab.
3. In the Area A, select the option [**IBP Overlap**] from the drop-down list, and then select the IBP waves to be overlapped on the left side of the same line. Refer to ***3.8 Setting the Screen*** for Area A.
4. Repeat Step 3, if necessary, in other places of Area A.
5. Select ✕ to save the setting and exit the window. The main screen will display the overlapped IBP waves.



Selecting the overlapped IBP waveforms on the main screen pops up the [**Overlapping Waveform Setup**] menu, where you can:

- Set [**Left Scale**] and **[Right Scale**] and then set the scales for the overlapped waveforms. The left scale is for Art, LV, Ao, FAP, BAP, UAP, and the arterial waveforms of P1~P4; the right scale is for CVP, ICP, LAP, RAP, UVP, and the venous waveforms of P1~P4.
- Set [**CVP Scale**] individually If CVP waveform is combined and CVP unit is different from IBP unit.
- Set [**PA Scale**] individually if PA waveform is combined.
- Set [**Gridlines**] to [**On**] or [**Off**] to show gridlines or not in the overlapped waveform area.
- Select [**Sweep**] and then set the sweep speed for the overlapped waveforms.
- Select [**Filter**] and then set the filter for the overlapped waveforms.

You can also change above settings from corresponding IBP setup menu.

NOTE

- **CVP scale is changed together with right scale. The unit of CVP scale is consistent with CVP parameter unit.**

15.8 Measuring PAWP

Pulmonary Artery Wedge Pressure (PAWP) values, used to assess cardiac function, are affected by fluid status, myocardial contractility, and valve and pulmonary circulation integrity.

Obtain the measurement by introducing a balloon-tipped pulmonary artery flotation catheter into the pulmonary artery. When the catheter is in one of the smaller pulmonary arteries, the inflated balloon occludes the artery allowing the monitor to record changes in the intrathoracic pressures that occur throughout the respiration cycle.

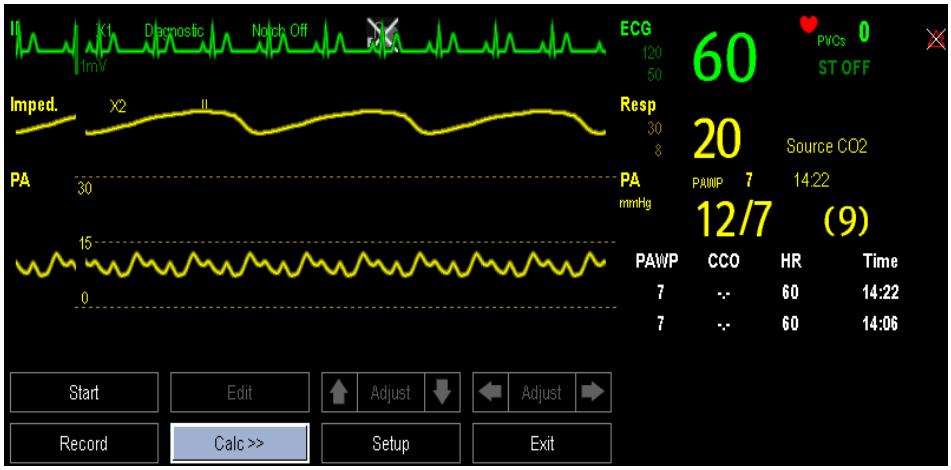
The pulmonary wedge pressure is the left ventricular end diastolic pressure when the airway pressure and valve function are normal. The most accurate PAWP values are obtained at the end of the respiration cycle when the intrathoracic pressure is fairly constant and the artifact caused by respiration is minimal.

⚠WARNING

- **PAWP monitoring is not intended for neonatal patients.**

15.8.1 Preparing to Measure PAWP

1. Prepare the same accessories as in the C.O. measurement. Connect the parts such as catheter, syringe, etc. following the C.O. measurement steps and use the balloon inflation port.
2. Connect the PAWP cable into the IBP connector. Since PAWP is measured on PA, selecting [**PA**] as the IBP label is recommended.
3. Select the PA parameter window or waveform area to enter its setup menu. Then, select [**PAWP**] to enter the PAWP measurement window. You can also enter the PAWP measurement window from the P1-P4 parameter window.

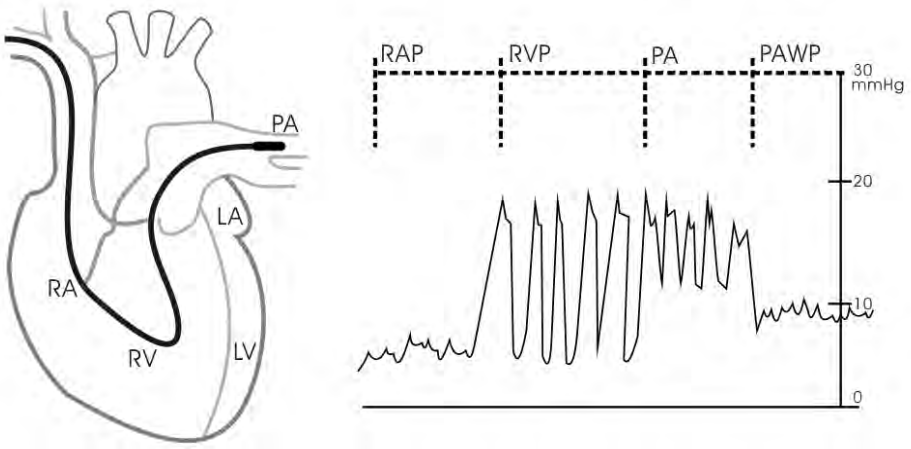


NOTE

- **After entering the PAWP measurement window, the monitor will turn off the PA alarm automatically.**

15.8.2 Setting Up the PAWP Measurement

1. Select [**Start**] in the PAWP measurement window.
2. Wedge the flotation catheter into the pulmonary artery. When the prompt message [**Ready for balloon inflation**] appears, inflate the balloon and pay attention to PA waveform changes on the screen.



3. When the prompt message [**Ready for balloon deflation**] appears, deflate the balloon. After the measurement finishes, the PAWP value displays under the PA waveform.
4. Select [**Edit**] → [**Confirm**] to save the PAWP value.
5. If you need to start a new measurement, select [**Start**] again.

If the measurement fails or you need to adjust the PAWP value, select [**Edit**] to freeze the waveforms and activate the [**Adjust**] button.

- Select the or beside the [**Adjust**] button to adjust the PAWP value.
- Select or beside the [**Adjust**] button to view the frozen waveforms of 40 seconds.
- Select [**Confirm**] to save the PAWP value.

⚠WARNING

- **Prolonged inflation can cause pulmonary hemorrhage, infarction or both. Inflate the balloon for the minimum time necessary to get an accurate measurement.**
- **If the PAWP is greater than the PA (systolic), deflate the balloon and report the incident in accordance with hospital policy. Because the pulmonary artery could be accidentally ruptured, and the PAWP value derived will not reflect the patient's hemodynamic state, but will merely reflect the pressure in the catheter or balloon.**

15.8.3 Understanding the PAWP Setup Menu

Select [**Setup**] to enter the [**PAWP Setup**] menu. In this menu, you can:

- Select a ECG lead wave as the first reference wave.
- Select a respiration wave as the second reference wave.
- Select a sweep speed for the displayed waveforms on the PAWP measurement screen.
- Change the size of the PA waveform by adjusting the scale height.

The setting of the [**Sweep**] and [**PA Scale**] is only applied to waveforms on the PAWP screen.

15.8.4 Performing Hemodynamic Calculation

In the PAWP window, select [**Calc.>>**] to enter the hemodynamic calculation menu. Refer to ***31.5 Hemodynamic Calculations*** for details.

15.9 Troubleshooting

This section lists the problems that might occur. If you encounter the problems when using the equipment or accessories, check the table below before requesting for services. If the problem persists, contact your service personnel.

⚠ CAUTION

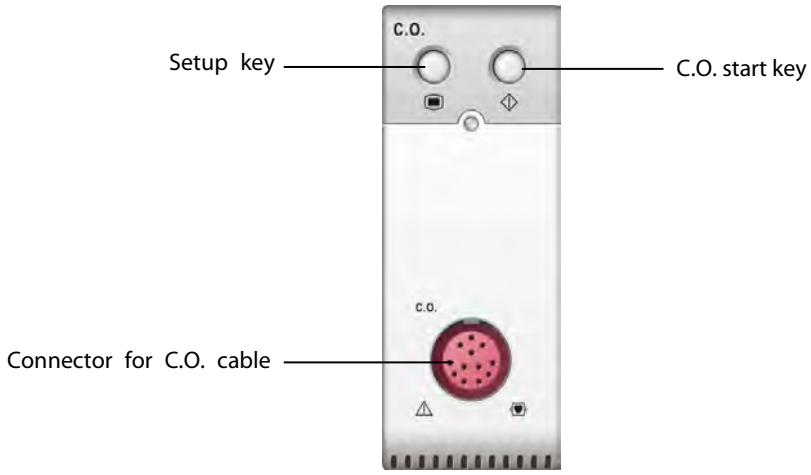
- **Never try to disassemble the equipment or supplied accessories. There are no internal user-serviceable parts.**

Symptoms	Possible Cause	Correction Action
Damped invasive waveform	Air bubbles in tubing	Eliminate air from tubing as described in ***15.3Measuring an Invasive Blood Pressure*** Setting Up the Pressure Measurement.
	Kinked catheter	Change the position of catheter.
	Blood in tubing	Pressurize the solution bag to 300 mmHg. For details, refer to the instructions for use of the solution bag.
IBP not displayed/no IBP waveform	Improper setup	Check display setup in monitor setup.
	Cable not plugged in	Check that the cables are properly connected.
	Transducer not connected.	Check that the transducer is properly connected.
	Stopcock turned improperly.	Check that the stopcock is turned to the correct position.
	Transducer not zeroed	Check and zero the transducer as described in ***15.3.2Zeroing the Transducer.***
Dashes "- -" display in place of numerics.	The measured result is invalid or out of range. IBP might be set to non-pulsatile labels like CVP, LA, RA, and ICP.	Change to a pulsatile label.
Abnormally high or low readings	Transducer too High or too Low.	Adjust the position of the transducer and make sure that it is level with the heart, approximately at the level of the midaxillary line. Zero the transducer as described in ***15.3.2Zeroing the Transducer.***.
Unable to Zero	Stopcock not open to atmosphere.	Check the transducer and make sure the stopcock is turned to the air.
PAWP button disabled	One IBP channel must be labeled PA	Label an IBP channel as PA. (Also Label an IBP channel as P1/P2/P3/P4, it will automatically change to PA)

16 Monitoring Cardiac Output

16.1 Introduction

The cardiac output (C.O.) measurement invasively measures cardiac output and other hemodynamic parameters using the right heart (atria) thermodilution method. A cold solution of known volume and temperature is injected into the right atrium through the proximal port of a pulmonary artery (PA) catheter. The cold solution mixes with the blood in the right ventricle and the change in blood temperature is measured with a thermistor at the distal end of the catheter in the pulmonary artery. The temperature change is displayed as a curve in the C.O. split screen, and the monitor calculates the C.O. value from this curve. The C.O. value is inversely proportional to the area under the curve. As cardiac output varies continuously, a series of measurements must be carried out to achieve a reliable C.O. average value. Always use the average of multiple thermodilution measurements for therapy decisions. The monitor is capable of storing 6 measurements.



NOTE

- **C.O. monitoring is restricted to adult patients only.**

16.2 Understanding the C.O. Display

The C.O. measurement is displayed on the monitor as numeric C.O., C.I. and TB in the C.O. parameter window as shown below. To enter the [**C.O. Setup**] menu, select the C.O. parameter window.

1. Cardiac output
2. Time at which the C.O. average is calculated
3. Cardiac index
4. Blood temperature

16.3 Influencing Factors

The factors that affect cardiac output are:

- temperature of injectate solution,
- volume of injectate solution,
- patient's baseline blood temperature,
- patient's inspiratory/expiratory cycle,
- placement of catheter with relation to proximity of lung field,
- the catheter itself,
- the patient rhythm and hemodynamic status, and
- any other rapid IV solutions which are infused while the C.O. measurement is being performed.

Followings are some technique suggestions to obtain accurate C.O.:

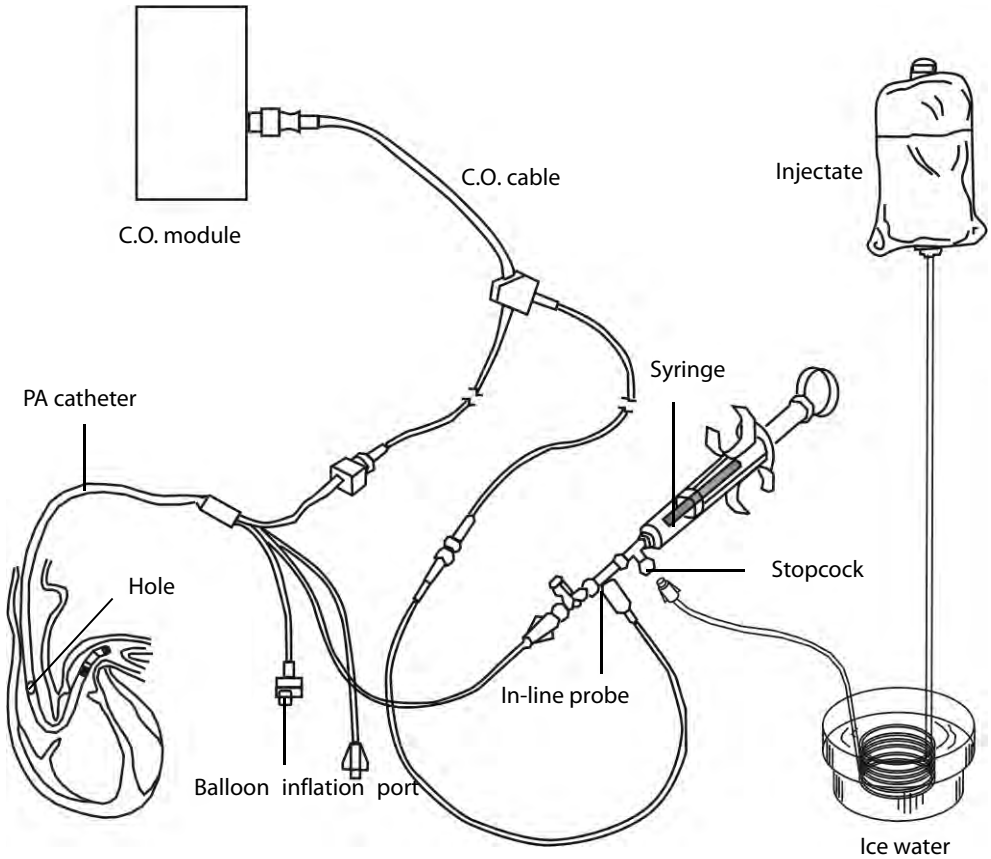
- Injectate solution must be cooler than the patient's blood.
- Inject solution rapidly and smoothly.
- Inject at end expiration.

16.4 Setting Up the C.O. Measurement

⚠WARNING

- **Use only accessories specified in this manual. Make sure that the accessories never come into contact with conductive parts.**

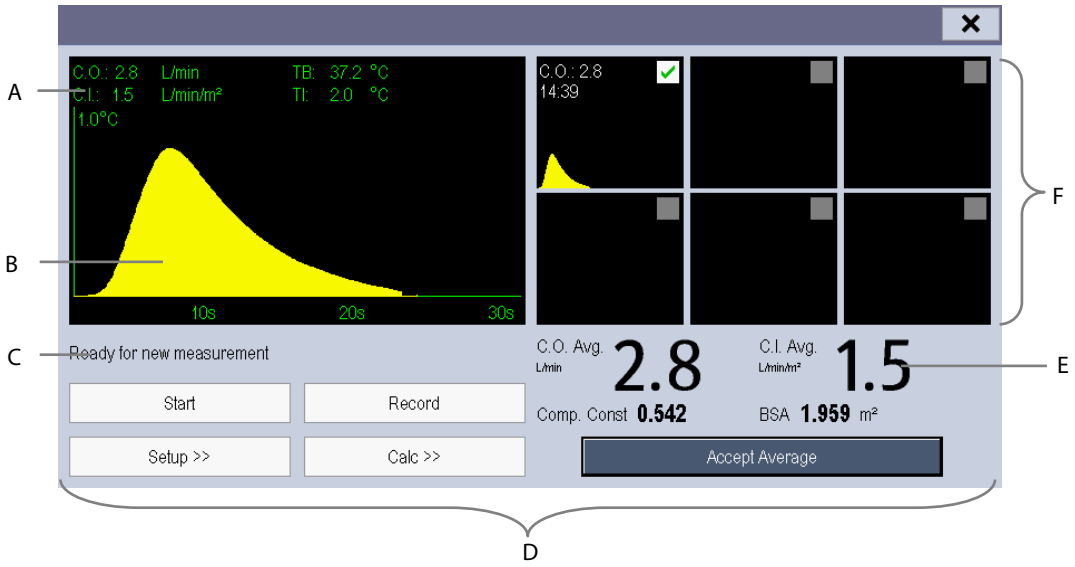
1. Connect the C.O. cable to the C.O. connector.
2. Interconnect the C.O. module, catheter and syringe as shown below. Make sure that:
   - ◆ The module is securely inserted.
   - ◆ The PA catheter is in place in the patient.
   - ◆ The C.O. cable is properly connected to the module.



NOTE

- **The above picture is connecting illustration when TI sensor PN 6000-10-02079 is used. The connection may be different if other TI sensors are used.**

3. Select the C.O. parameter window to enter the [**C.O. Setup**] menu. Check if the height and weight are appropriate for your patient. Change if necessary.
4. In the [**C.O. Setup**] menu:
   - Check that the correct computation constant is entered. Refer to the Instruction for Use of pulmonary artery catheter to determine the [**Comp. Const**] according to the entered injectate volume and temperature. To change the computation constant, select [**Comp. Const**] and then enter the correct value. When a new catheter is used, the computation constant should be adjusted in accordance with the manufacturer's instructions for use.
   - Set the [**Auto TI**] to [**Manual**] or [**Auto**]. If you select [**Auto**], the system automatically detects the injectate temperature, and the [**Manual TI**] is disabled. If you select [**Manual**], you need to enter the injectate temperature at [**Manual TI**] manually.
   - Set the [**Measuring Mode**] to [**Auto**] or [**Manual**]. In [**Auto**] mode, the monitor automatically takes the C.O. measurement after establishing a baseline blood temperature. In this mode, it is not necessary to select the [**Start**] button in the C.O. measurement window. In [**Manual**] mode, the monitor takes the C.O. measurement after [**Start**] button is selected.
5. Select [**Enter C.O. Screen**] to enter the C.O. measurements window.



A. Currently measured numeric
B. Currently measured C.O. curve
C. Prompt message area
D. Buttons
E. Averaged values
F. Measurement windows

6. Proceed as follows.
   - In [**Manual**] measure mode, when you see the message [**Ready for new set of measurement**], select the [**Start**] button and then inject the solution quickly. As shown in the figure above, during the measurement, the currently measured thermodilution curve is displayed. At the end of the measurement, the thermodilution curve is transferred to one of the 6 measurement windows and the monitor prompts you to wait for a certain period of time before starting a new measurement.
   - In [**Auto**] measure mode, the C.O. measurements can be performed consecutively, without the need for pressing the [**Start**] button between measurements. A new thermodilution measurement is possible as soon as [**Inject now!**] is displayed on the screen. The patient monitor automatically detects further thermodilution measurements.
7. Consecutively take 3 to 5 single measurements as instructed by Step 6.

A maximum of 6 measurements can be stored. If you perform more than six measurements without rejecting any, the oldest will automatically be deleted when a seventh curve is stored. Select from the 6 measurement curves and the system will automatically calculate and display the averaged C.O. and C.I. values. Then select the [**Accept Average**] button to accept and store the averaged values.

When injecting, the stopcock to the PA catheter is open and the stopcock to the injectate solution is closed. After the measurement is completed, turn off the stopcock to the PA catheter and turn on the stopcock to the injectate solution, and then draw the injectate solution into the injectate syringe.

In the buttons area, you can:

- Select [**Start**] to start a C.O. measurement.
- Select [**Stop**] to stop the current measurement.
- Select [**Cancel**] during a measurement to cancel the measurement.
- Select [**Record**] to print out the curves selected for average calculation, numerics and averaged values by the recorder.
- Select [**Setup >>**] to access the [**C.O. Setup**] menu.
- Select [**Calc >>**]→[**Hemodynamic >>**] to access the [**Hemodynamic Calculation**] menu.

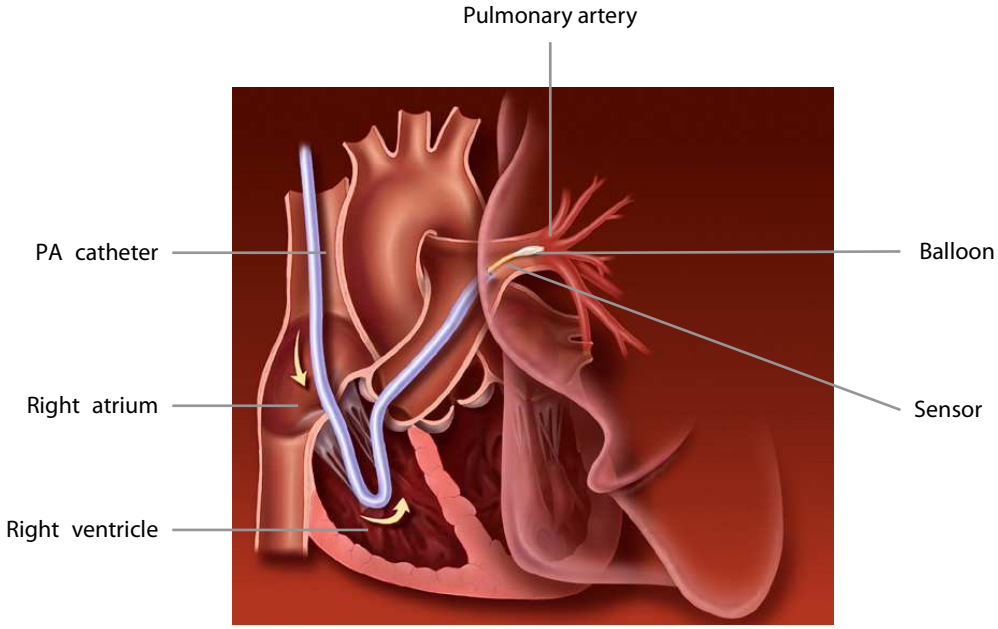
The system can automatically adjust the X-axis scale range to 30 s or 60 s and Y-axis scale range to 0.5℃, 1.0℃, or 2.0℃.

NOTE

- **Starting measuring without blood temperature being stable yet may cause measuring failure.**
- **During the cardiac output measurement, blood temperature alarms are inactive.**
- **Please refer to the Instructions for Use of pulmonary artery catheter delivered with the patient monitor to determine the [Comp. Const] and the volume of injectate.**

16.5 Measuring the Blood Temperature

As shown below, the blood temperature is measured with a temperature sensor at the distal end of the catheter in the pulmonary artery. During C.O. measurements, blood temperature alarms are suppressed to avoid false alarms. They will automatically recover as soon as the C.O. measurements are completed.



16.6 Changing C.O. Settings

16.6.1 Setting the Temperature Unit

Select [**Unit Setup >>**] from the [**User Maintenance**] menu. In the popup menu, select [**Temp Unit**] to toggle between [℃] and [℉].

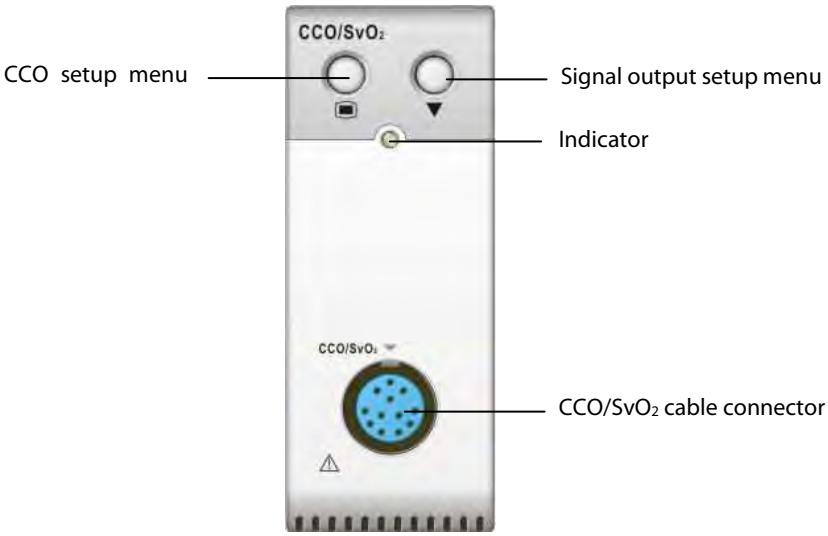
16.6.2 Setting Alarm Properties

Select [**Alarm Setup >>**] from the [**C.O. Setup**] menu. You can set alarm properties for this parameter in the popup menu.

17 Monitoring CCO/SvO_2

17.1 Introduction

The Edwards Vigilance II® monitor, Vigileo™ monitor, and EV1000 monitor measure continuous cardiac output (CCO), mixed venous oxygen saturation (SvO_2), central venous oxygen saturation ($ScvO_2$) etc. They also calculate hemodynamic and oxygenation parameters. This patient monitor can be connected to the Vigilance II® monitor / Vigileo™ monitor/EV1000 monitor, and can display, store, and review the measured and calculated parameter values from these monitors. This patient monitor can also give alarms of these measured parameters. You must set alarm on/off, alarm limits, alarm level, and alarm record separately on this monitor. The alarm is Off by default.



17.2 Safety

⚠WARNING

- **The Vigilance II® monitor, Vigileo™ monitor and EV1000 monitor are manufactured by Edwards Lifesciences. This company provides the technology of measuring and calculating the relevant parameters. We only provide the connection between this patient monitor and Vigilance II® monitor/ Vigileo™ monitor/EV1000.**
- **If you have any doubts about the operation and maintenance of the Vigilance II® monitor/ Vigileo™ monitor/EV1000 monitor, please read the Operator's Manual of these monitors or contact Edwards Lifesciences (www.edwards.com) directly.**
- **Fully observe the Vigilance II® monitor/ Vigileo™ monitor/EV1000 monitor Operator's Manual to make settings and to connect the monitor with the patient.**
- **This patient monitor gives disconnection alarms when it is disconnected from the Vigilance II®, Vigileo™, and EV1000 monitor. But these alarms may be delayed.**

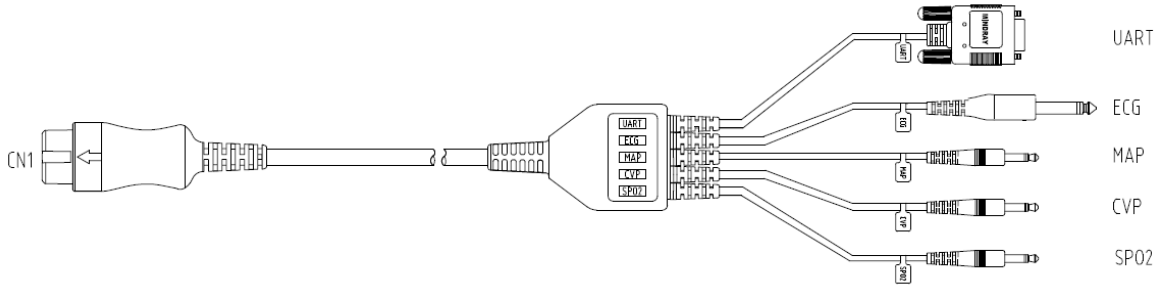
17.3 Automatic Communication Detection

The relevant parameter window is not displayed on the screen if this patient monitor detects communication failure between the CCO/SvO_2 module and Vigilance II® monitor / Vigileo™ monitor/EV1000 monitor.

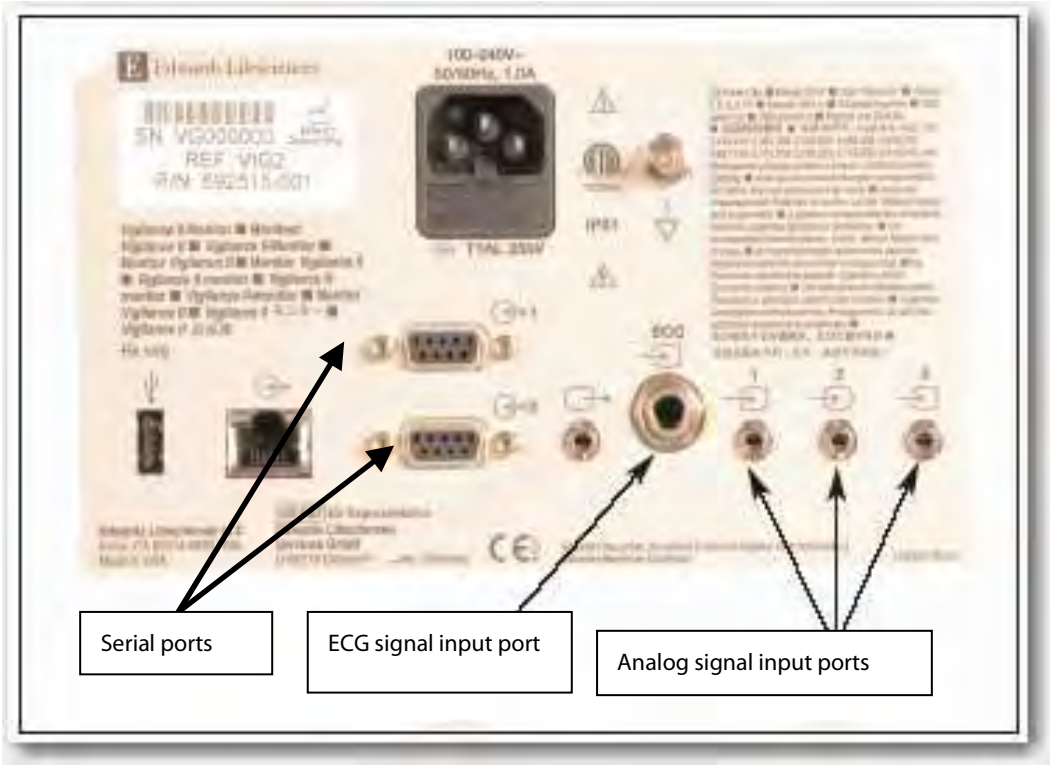
17.4 Connecting the Device

17.4.1 Connecting the Vigilance II® Monitor

The following figure shows how to connect this patient monitor to the Vigilance II® monitor through cables.



The following figure shows the rear housing of the Vigilance II® monitor.



To connect the Vigilance II® monitor,

1. Connect CN1 with the CCO/SvO_2 connector on the patient monitor.
2. Insert the ECG signal end into the ECG signal input port marked 

on the rear housing of the Vigilance II® monitor.

3. Insert the MAP signal end into the analog signal input port 1 marked  , the CVP signal end into port 2 marked  , and SPO_2 signal end into port 3 marked  respectively on the rear housing of the Vigilance II® monitor.

4. Insert UART into either of the serial ports (marked ) on the rear housing of the Vigilance II® monitor

5. Set the Vigilance II® monitor as follows:

- Access the [**Serial Port Setup**] menu.
  - Set [**Device**] to [**IFMou**t], [**Baud Rate**] to [**19200**], [**Parity**] to [**None**], [**Stop Bits**] to [**1**], [**Data Bits**] to [**8**], and [**Flow Control**] to [**2 s**].
- Access the [**Analog Input Setup**] menu.
  - For port 1, set [**Parameter**] to [**MAP**], [**Voltage Range**] to [**0-5 v**], [**Full Scale Range**] to **500 mmHg** (66.7 kPa), [**Simulated High Value**] to **500 mmHg** (66.7 kPa), and [**Simulated Low Value**] to **0 mmHg** (0.0 kPa).
  - For port 2, set [**Parameter**] to [**CVP**], [**Voltage Range**] to [**0-5 v**], [**Full Scale Range**] to **100 mmHg** (13.3 kPa), [**Simulated High Value**] to **100 mmHg** (13.3 kPa), and [**Simulated Low Value**] to **0 mmHg** (0.0 kPa).
  - For port 3, set [**Parameter**] to [**SaO_2**], [**Voltage Range**] to [**0-10 v**], [**Full Scale Range**] to [**100%**], [**Simulated High Value**] to [**100%**], and [**Simulated Low Value**] to [**0%**].

Refer to the Vigilance II® Operator's Manual for the operation of the monitor.

⚠WARNING

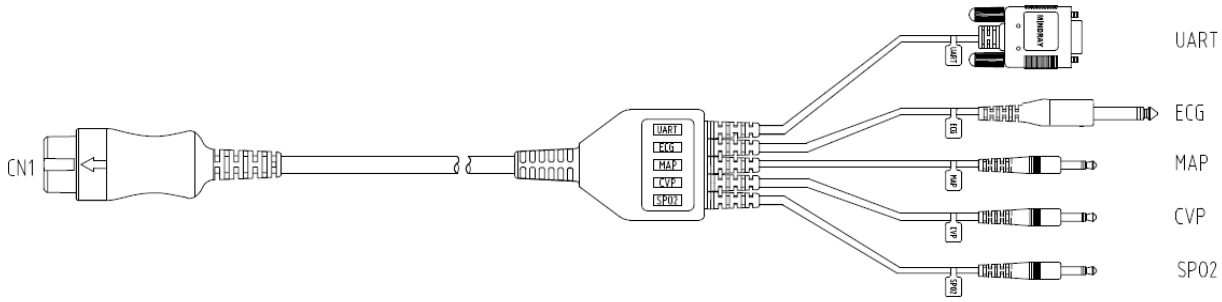
- **Calibrate the Vigilance II® monitor before monitoring. Refer to the Vigilance II® Operator's Manual for the calibration of the monitor.**

NOTE

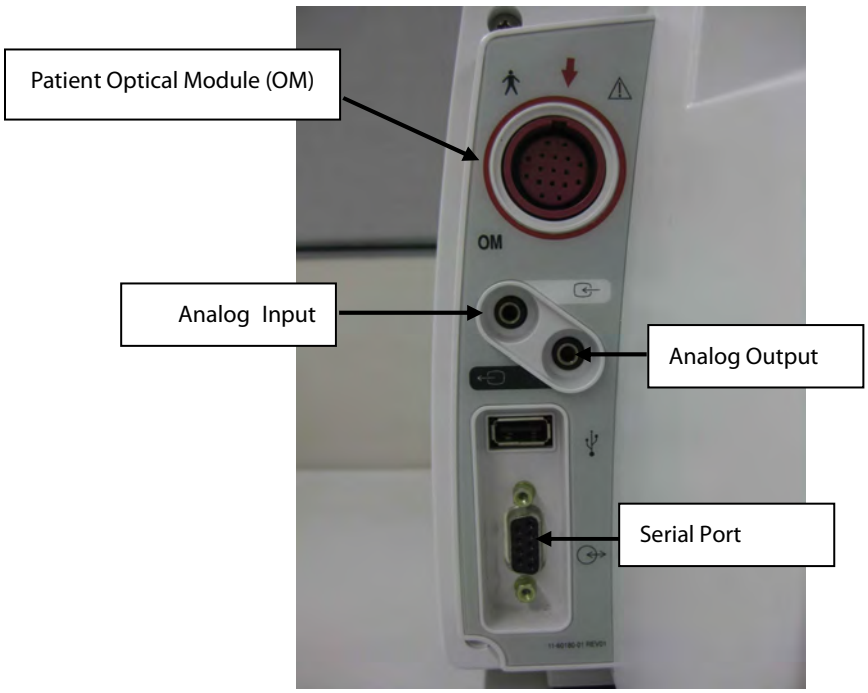
- **For the Vigilance II® monitor, [**Flow Control**] must be set to 2 seconds.**

17.4.2 Connecting the Vigileo™ Monitor

The following figure shows how to connect this patient monitor to the Vigileo™ monitor through cables.



The following figure shows the rear housing of the Vigileo™ monitor.



To connect the Vigileo™ monitor,

1. Connect CN1 with the CCO/SvO_2 connector on the patient monitor.
2. Insert the CVP signal end into the analog signal input port on the rear housing of the Vigileo™ monitor.
3. Insert UART into the serial port on the rear housing of the Vigileo™ monitor.
4. Set the Vigileo™ monitor as follows:

- Access the [**Serial Port Setup**] menu.
  - Set [**Device**] to [**IFMou**t], [**Baud Rate**] to [**19200**], [**Parity**] to [**None**], [**Stop Bits**] to [**1**], [**Data Bits**] to [**8**], and [**Flow Control**] to [**2 seconds**].
- Access the [**Analog Input Port Setup**] menu.
  - Set [**Parameter**] to [**CVP**], [**Voltage Range**] to [**0-5 v**], [**Full Scale Range**] to **100 mmHg** (13.3 kPa), [**Simulated High Value**] to **100 mmHg** (13.3 kPa), and [**Simulated Low Value**] to **0 mmHg** (0.0 kPa).

Refer to the Vigileo™ Operator's Manual for the operation of the monitor.

⚠WARNING

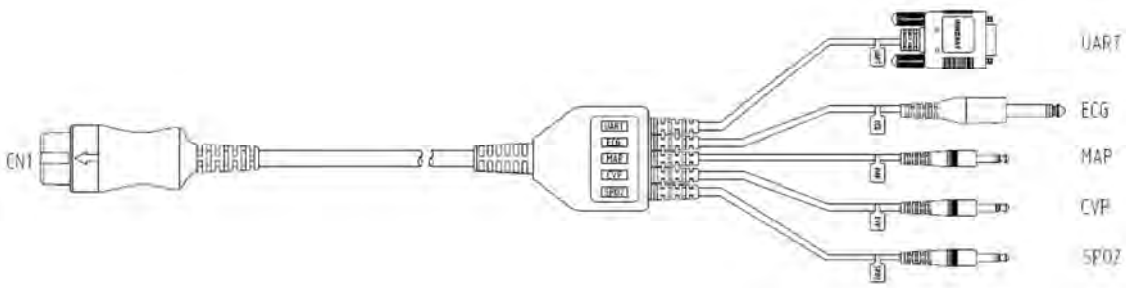
- **Calibrate the Vigileo™ monitor before monitoring. Refer to the Vigileo™ Operator's Manual for the calibration of the monitor.**

NOTE

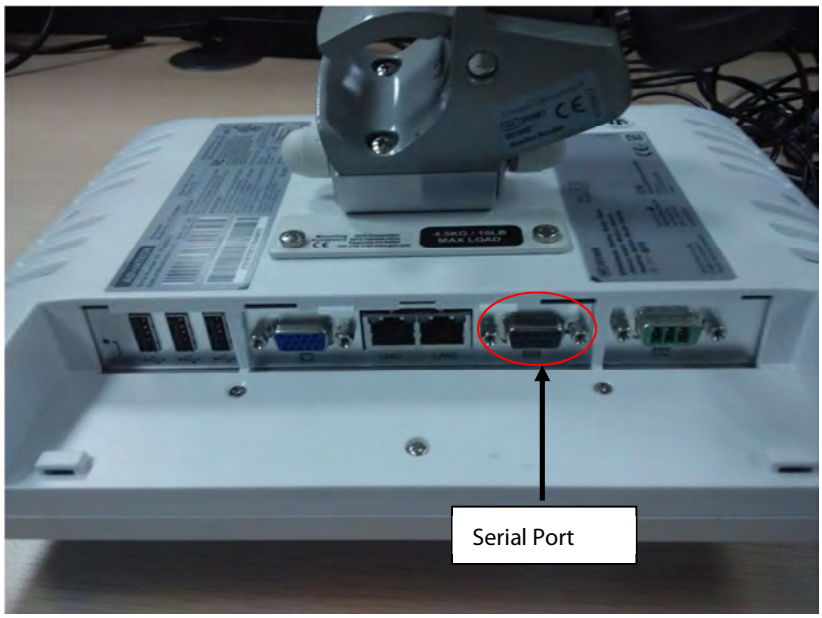
- **For the Vigileo™ monitor, [Flow Control] must be set to 2 seconds.**

17.4.3 Connecting the EV1000 Monitor

The following figure shows how to connect this monitor to the EV1000 monitor through cables.



The following figure shows the rear housing of the EV1000 monitor.



To connect the EV1000 monitor:

1. Connect CN1 with the CCO/SvO_2 connector on the patient monitor.
2. Insert UART into the serial port on the rear housing of the EV1000 monitor.
3. Access the [**Serial Port Setup**] menu.
4. Set [**Device**] to [**IFMou**t], [**Baud Rate**] to [**19200**], [**Parity**] to [**None**], [**Stop Bits**] to [**1**], [**Data Bits**] to [**8**], and [**Flow Control**] to [**2 s**].

Refer to the EV1000 Operator's Manual for the operation of the monitor.

⚠WARNING

- **Calibrate the EV1000 monitor before monitoring. Refer to the EV1000 Operator's Manual for the calibration instructions.**

NOTE

- **For the EV1000 monitor, [Flow Control] must be set to 2 seconds.**
- **Before connecting the CCO/SvO_2 module and the EV1000 monitor, you should ensure that the software versions meet the following requirements:**
  - The CCO/SvO_2 module software version is 01.02.00 or later.
  - The monitor system software version is 05.35.00 or later.

17.5 Understanding CCO Parameters

When the patient monitor is connected to the Vigilance II® monitor/Vigileo™ monitor/EV1000 monitor, select the CCO parameter window→[**Hemodynamic Parameters >>**] to view the hemodynamic parameters for evaluation of the patient's hemodynamic status.

17.5.1 Hemodynamic Parameters from Vigilance II® Monitor

Abbreviation	Unit	Full spelling
CCO	L/min	continuous cardiac output
CCI	L/min/m^2	continuous cardiac index
C.O.	L/min	cardiac output
C.I.	L/min/m^2	cardiac index
EDV	ml	end diastolic volume
EDVI	ml/m^2	end diastolic volume index
SV	ml	stroke volume
SVI	ml/m^2	stroke volume index
SVR	DS/cm^5 or kPa-s/l	systemic vascular resistance
SVRI	DS·m^2/cm^5 or kPa-s-m^2/l	systemic vascular resistance index
RVEF	%	right ventricular ejection fraction
BT	℃ or ℉	blood temperature
ESV	ml	end systolic volume
ESVI	ml/m^2	end systolic volume index
CVP	cmH_2O, kPa or mmHg	central venous pressure
MAP	mmHg or kPa	mean arterial pressure
HR	rpm	heart rate

17.5.2 Hemodynamic Parameters from Vigileo™ Monitor

Abbreviation	Unit	Full spelling
CCO	L/min	continuous cardiac output
CCI	L/min/m^2	continuous cardiac index
SV	ml	stroke volume
SVI	ml/m^2	stroke volume index
SVV	%	stroke volume variation
SVR	DS/cm^5 or kPa-s/l	systemic vascular resistance
SVRI	DS·m^2/cm^5 or kPa-s-m2/l	systemic vascular resistance index
CVP	cmH_2O, kPa or mmHg	central venous pressure
MAP	mmHg or kPa	mean arterial pressure
HR	rpm	heart rate

17.5.3 Hemodynamic Parameters from EV1000 Monitor

Abbreviation	Unit	Full Spelling
CCO	L/min	continuous cardiac output
CCI	L/min/m^2	continuous cardiac index
C.O.	L/min	cardiac output
C.I.	L/min/m^2	cardiac index
SV	ml	stroke volume
SVI	ml/m^2	stroke volume index
GEF	%	global ejection fraction
CFI	1/min	cardiac function index
GEDV	ml	global end diastolic volume
GEDI	ml/m^2	global end diastolic volume index
ITBV	ml	intra-thoracic blood volume
ITBI	ml/m^2	intra-thoracic blood volume index
SVV	%	stroke volume variation
CVP	cmH_2O, kPa, or mmHg	central venous pressure
SVR	DS/cm^5	systemic vascular resistance
	kPa-s/l	
SVRI	DS·m^2/cm^5	systemic vascular resistance index
	kPa-s-m^2/l	
MAP	mmHg or kPa	mean arterial pressure
EVLW	ml	extravascular lung water
ELWI	ml/kg	extravascular lung water index
PVPI	none	pulmonary vascular permeability index
TB	°C	blood temperature
	°F	

17.6 Understanding the CCO Display

The parameter area displays the parameter measurements from the Vigilance II® monitor, Vigileo™ monitor, or EV1000 monitor. You can select the desired parameters to be displayed. For the configuration of the parameters to be displayed,, see section***17.7.2Selecting the Displayed Parameters***.

17.7 Changing CCO Settings

17.7.1 Selecting Vascular Resistance Unit

To select vascular resistance unit:

1. Access the [**CCO Setup**] menu.
2. Select [**SVR Unit**] and toggle between [**DS/cm5**] and [**kPa-s/l**].

17.7.2 Selecting the Displayed Parameters

17.7.2.1 Selecting the Displayed Parameters for Vigilance II Monitor and Vigileo™ Monitor

To select the parameter to be displayed:

1. Access the [**CCO Setup**] menu.
2. Select [**Select Parameters >>**].
3. Select the parameters to be displayed from the pop-up menu.

17.7.2.2 Selecting the Displayed Parameters for EV1000 Monitor

To select the parameter to be displayed:

1. Access the [**CCO Setup**] menu.
2. Select [**Select Parameter >>**].
3. Set[**Parameter Display**] to [**Absolute**] or [**Indexed**].
4. Select the desired secondary parameters. You can select up to three secondary parameters

17.7.3 Checking the C.O. Measurements

When the patient monitor connects Vigilance II® monitor, you can check the C.O. measurements in the intermittent measurement mode.

To check the C.O. measurements:

1. Access the [**CCO Setup**] menu.
2. Select [**C.O. Measurements >>**].

17.7.4 Setting Signal Output

- When the patient monitor connects Vigilance II® monitor:

This patient monitor outputs analog signals for the Vigilance II® monitor. You can select [**Signal Output Setup >>**] from the [**CCO Setup**] menu to set the source of MAP signals. You can also select [**Simulated High Value**] or [**Simulated Low Value**] to provide simulated high value or low value signals for calibrating the Vigilance II® monitor. Refer to the Vigilance II® Operator's Manual for the calibration of the monitor.

- When the patient monitor connects Vigileo™ monitor:

Select [**Signal Output Setup >>**] from the [**CCO Setup**] menu. In the popup menu, you can select [**Simulated High Value**] or [**Simulated Low Value**] to provide simulated high value or low value signals for calibrating the Vigileo™ monitor. Refer to the Vigileo™ Operator's Manual for the calibration of the monitor.

17.7.5 Selecting Alarm Properties

You can select [**Alarm Setup >>**] from the [**CCO Setup**] menu to set the alarm properties for the relevant parameters.

⚠WARNING

- **Because the alarm limits of the relevant measured parameters can be set on this patient monitor, the alarms of these parameters on this patient monitor may be different from those on the Vigilance II® / Vigileo™ monitor/EV1000 monitor. Please pay special attention to the alarms on the Vigilance II® / Vigileo™ monitor/EV1000 monitor.**
- **The alarm of the relevant measured parameters on this patient monitor is Off by default. Please pay special attention to the alarms on the Vigilance II® / Vigileo™ monitor/EV1000 monitor.**

17.8 Understanding SvO_2/$ScvO_2$ Parameters

When the monitor is connected to the Vigilance II® monitor/Vigileo™ monitor/EV1000 monitor, you can view the oxygenation parameters.

To view the oxygenation parameters, following this procedure:

1. Select the SvO_2 parameter window to enter the [**SvO_2 Setup**] memu, or select the $ScvO_2$ parameter window to enter the [**$ScvO_2$ Setup**] memu.
2. Select [**Oxygenation Parameters >>**].

17.8.1 Oxygenation Parameters for Vigilance II® Monitor

Abbreviation	Unit	Full spelling
SvO_2	%	mixed venous oxygen saturation
$ScvO_2$	%	central venous oxygen saturation
SaO_2	%	arterial oxygen saturation
DO_2	ml/min	oxygen delivery
VO_2	ml/min	oxygen consumption
O_2EI	%	oxygen extraction index

17.8.2 Oxygenation Parameters for Vigileo™ Monitor

Abbreviation	Unit	Full spelling
SvO_2	%	mixed venous oxygen saturation
$ScvO_2$	%	central venous oxygen saturation

17.8.3 Oxygenation Parameters for EV1000 Monitor

Abbreviation	Unit	Full Spelling
SvO_2	%	mixed venous oxygen saturation
$ScvO_2$	%	central venous oxygen saturation
DO_2	ml/min	oxygen delivery
DO_2I	$ml/min/m^2$	oxygen delivery index
VO_2	ml/min	oxygen consumption
VO_2I	$ml/min/m^2$	oxygen consumption index
VO_2e	ml/min	estimated oxygen consumption index when $ScvO_2$ is being monitored
VO_2Ie	$ml/min/m^2$	estimated oxygen consumption index
Hb	g/L, g/dl or mmol/L	hemoglobin
SpO_2	%	arterial oxygen saturation from pulse oximetry

17.9 Understanding the SvO_2/$ScvO_2$Display

The monitor displays either the SvO_2 numeric area or $ScvO_2$ numeric area. Depending on the setup of the Vigilance II® monitor, Vigileo™, or EV1000 monitor, SvO_2 numeric area and $ScvO_2$ numeric area cannot display simultaneously.

17.10 Changing SvO_2/$ScvO_2$ Settings

17.10.1 Setting Signal Output

This patient monitor outputs analog signals for the Vigilance II® monitor. You can select [**Signal Output Setup >>**] from the [**SvO_2 Setup**] menu or [**$ScvO_2$ Setup**] menu to set the source of MAP signals. You can also select [**Simulated High Value**] or [**Simulated Low Value**] to provide simulated high value or low value signals for the Vigilance II® monitor. Refer to the Vigilance II® Operator's Manual for the calibration of the monitor.

17.10.2 Selecting Alarm Properties

When the patient monitor connects Vigilance II® monitor or EV1000 monitor, you can select [**Alarm Setup >>**] from the [**SvO_2 Setup**] menu or [**$ScvO_2$ Setup**] menu to set the alarm properties for the relevant parameters.

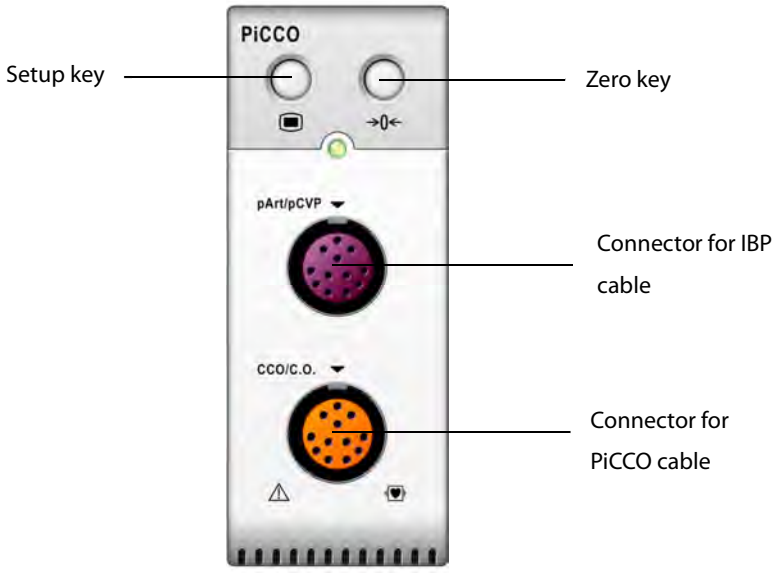
When the patient monitor connects Vigileo™ monitor, select SvO_2 or $ScvO_2$ parameter area. You can set the alarm properties for the relevant parameters in the popup menu

FOR YOUR NOTES

18 Monitoring PiCCO

18.1 Introduction

The PiCCO method combines transpulmonary thermodilution and pulse contour analysis on the blood pressure waveform. A cold bolus (e.g. normal saline 0.9%) with a known volume and temperature is injected into the right atrium through a central venous catheter. The cold bolus mixes with the blood in the heart and the change in blood temperature is measured with a thermistor at the distal end of the arterial thermodilution catheter placed in one of the bigger systemic arteries, for example, the femoral artery. The monitor uses the transpulmonary thermodilution method to measure C.O., GEDV (Global End Diastolic Volume) and EVLW (Extra Vascular Lung Water). With the C.O. value measured with the transpulmonary thermodilution method and the result of the pulse contour analysis, a patient-specific calibration factor is calculated. The monitor uses this value to compute CCO and the other continuous hemodynamic parameters.



18.2 Safety Information

⚠ WARNING

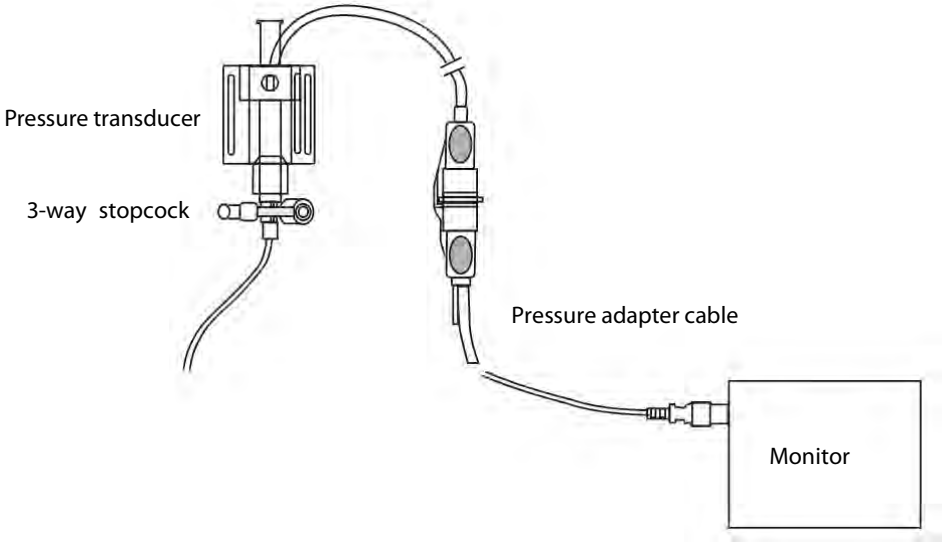
- **PiCCO monitoring is restricted to adult and pediatric patients.**
- **Use only pressure transducers specified in this manual. Never reuse disposable pressure transducers.**
- **Make sure that the applied parts never contact other conductive parts.**
- **To reduce the hazard of burns during high-frequency surgical procedure, ensure that the monitor's cables and transducers never come into contact with the high-frequency surgical units.**
- **When using accessories, their operating temperature should be taken into consideration. For details, refer to instructions for use of accessories.**

18.3 Zeroing the Transducer

To avoid inaccurate pressure readings, the monitor requires a valid zeroing. Zero the transducer in accordance with your hospital policy (at least once per shift). Zero whenever:

- A new transducer or adapter cable is used.
- You reconnect the transducer cable to the monitor.
- The monitor restarts.
- You doubt the readings.

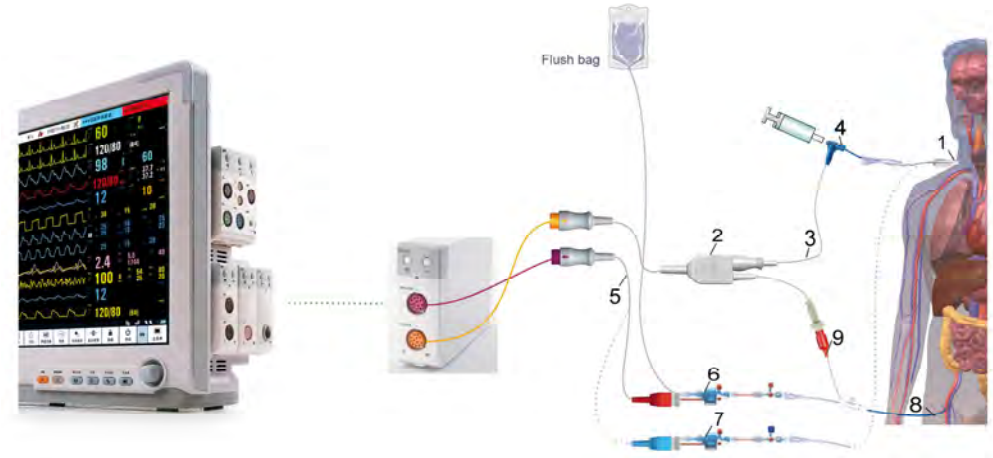
1. Turn off the stopcock to the patient.



2. Vent the transducer to the atmospheric pressure by turning on the stopcock to the air.
3. Press the →0← hardkey on the module, or, in the setup menu for the pressure (e.g. pArt), select [**pArt Zero >>**] →[**Zero**]. During zero calibration, the [**Zero**] button appears dimmed. It recovers after the zero calibration is completed. To zero all IBP channels, select [**Zero IBP**] hotkey, and then select [**Zero All Channels**] in the popup menu.
4. After the zero calibration is completed, close the stopcock to the air and open the stopcock to the patient.

18.4 Setting up the PiCCO Measurements

Please refer to the following figure and procedure to set up the PiCCO measurements:



1. Central venous catheter
2. PiCCO cable
3. Injectate temperature sensor cable
4. Injectate temperature sensor
5. IBP cable
6. Arterial pressure transducer
7. CVP transducer
8. Arterial thermodilution catheter
9. Blood temperature sensor

18.5 Preparation for PiCCO Measurements

1. Place the arterial thermodilution catheter.

⚠WARNING

- **The arterial thermodilution catheter must be placed in one of the bigger systemic arteries, for example, the femoral, the brachial or the axillary artery.**
- **You must use the approved catheters and puncture locations.**

2. Place the central venous catheter.
3. Connect the injectate temperature sensor to the central venous catheter.

4. Plug the PiCCO cable into the CCO/C.O. connector on the PiCCO module, and connect the following devices to the PiCCO cable:
   - ◆ Injectate temperature sensor probe
   - ◆ Blood temperature sensor connector.
5. Connect one end of the arterial pressure transducer to the arterial thermodilution catheter and the other end to the IBP cable marked with pArt.

⚠WARNING

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

6. Connect one end of the CVP transducer to the central venous catheter and the other end to the IBP cable marked with pCVP (neglect this procedure if CVP measurement is not performed). Then plug the IBP cable to the pArt/pCVP connector on the PiCCO module.
7. Access the [**CCO Setup**] menu by selecting [**PiCCO Measurement**] → [**Setup>>**] → [**CCO Setup**]**.** You can also select [**Main Menu**]→[**Parameters**]→[**CCO Setup>>**] to access the [**CCO Setup**] menu.

8. Check that the correct arterial catheter constant is displayed at [**Cat.Type**] in [**CCO Setup**] menu. The monitor can recognize the arterial catheter automatically when the PiCCO cable is connected to the CCO/C.O. connector.

NOTE

- **If the catheter constant is not recognized, enter the correct value for the catheter in the [Cat.Type] edit box. The catheter constant is usually written either on the catheter or on the catheter packaging.**

9. Set up the patient information in [**CCO Setup**] menu.

NOTE

- **Correct input of height, weight, category and gender is mandatory for the accuracy of the displayed parameters as well as for the correct indexing of some parameters.**
- **Input a proper pCVP value in the [CCO Setup] menu if CVP is not measured. The system adopts 5mmHg by default if the pCVP value is neither measured nor input manually.**

10. Enter the [**CCO Setup**] menu to select the injectate volume. If the injectate volume is not selected, the system sets the volume by default, which is 15ml for adult and 10 ml for pediatric. The following table displays the recommended injectate volume depending on body weight and ELWI (Extravascular Lung Water Index):

	ELWI < 10	**ELWI > 10**	**ELWI < 10**
Patient Weight (kg)	**Iced Injectate**	**Iced Injectate**	**Room Temperature Injectate**
<3	2ml	2ml	3ml
<10	2ml	3ml	3ml
<25	3ml	5ml	5ml
<50	5ml	10ml	10ml
<100	10ml	15ml	15ml
⩾100	15ml	20ml	20ml

11. Set up the C.O. measure mode by selecting [**C.O. Measure**] from the [**CCO Setup**] menu, and toggling between [**Auto**] and [**Manual**].

- If you select [**Manual**], you should start each measurement manually by pressing the [**Start**] key in the [**PiCCO Measurement**].
- If you select [**Auto**], the C.O. measurements can be performed consecutively, without the need for pressing the [**Start**] key.

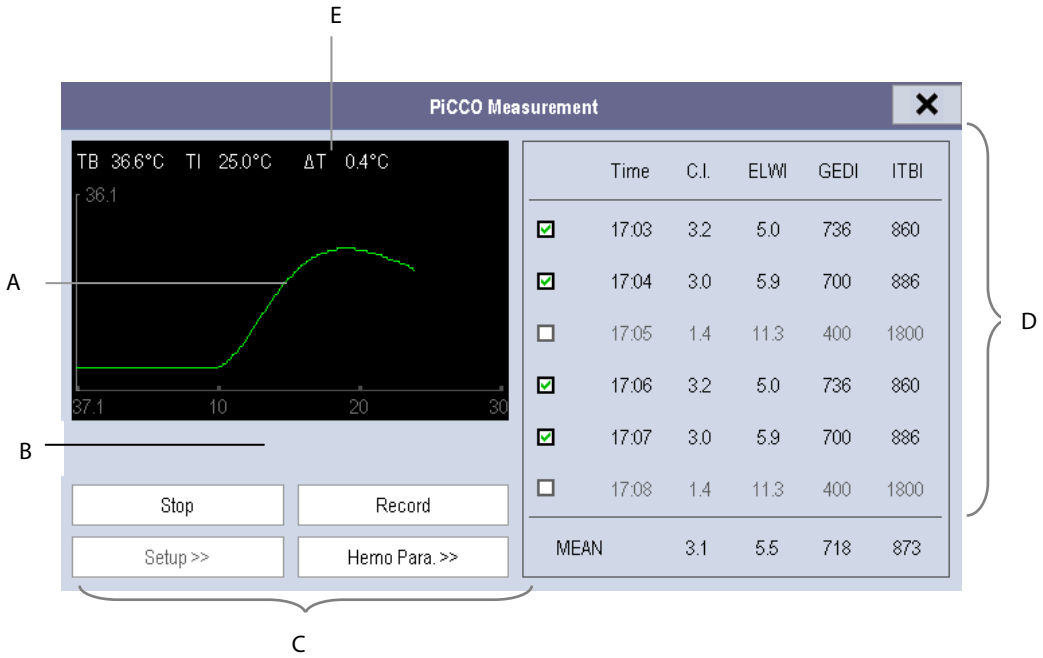
NOTE

- **Steps 8 to 10 can also be conducted with the [C.O. Measure (Transpulmonary) Setup Guide] menu, which can be accessed by selecting [PiCCO Guide>>] in [CCO Setup] menu. In order to enssure correct PiCCO calibration, please be sure the information you have entered is correct.**

18.6 Performing PiCCO Measurements and CCO Calibration

Please perform the PiCCO measurements according to the following procedure:

1. Open the [**PiCCO Measurement**] menu.



A. Thermodilution curve

B. Prompt message area

C. Buttons

D. History window

E. Measurement quality: △T

2. Select the [**Start**] button and inject the bolus rapidly (<7sec) and smoothly as soon as the message [**Inject xx ml!**] and prompt tone appear. As shown in the figure above, during the measurement, the currently measured thermodilution curve is displayed. At the end of the measurement, the measured values are displayed in the history window and the monitor prompts you to wait for a certain period of time before starting a new measurement. The △T value should be greater than 0.15°C to ensure high accuracy. A low △T can be caused by a very high ELWI or an extreme low CI. If △T is too low, you can try to increase it by
   - ◆ Injecting more volume (remember to reenter the injectate volume in [**CCO Setup**] menu before injecting).
   - ◆ Injecting colder bolus.
   - ◆ Injecting the bolus in a shorter time.
3. Perform 3 to 5 single measurements direct after each other within a maximum of 10 minutes as described in Step 2. A new measurement is available when you see the blood temperature is steady in the [**PiCCO Measurement**] window.
   - ◆ If you've selected [**Manual**] measure in the [**CCO Setup**] menu, you should repeat Step 2 manually.
   - ◆ If you've selected [**Auto**] measure in the [**CCO Setup**] menu, the C.O. measurements can be performed consecutively, without the need for pressing the [**Start**] button between measurements. A new thermodilution measurement is possible as soon as [**Inject xx ml!**] is displayed on the screen. The patient monitor automatically detects further thermodilution measurements.

4. A maximum of 6 measurements can be stored. If you perform more than six measurements without rejecting any, the oldest will be automatically deleted when a seventh curve is stored. Select the measurement values and the system will automatically perform calibration and calculate the averaged CCO and CCI values.

In the buttons area, you can:

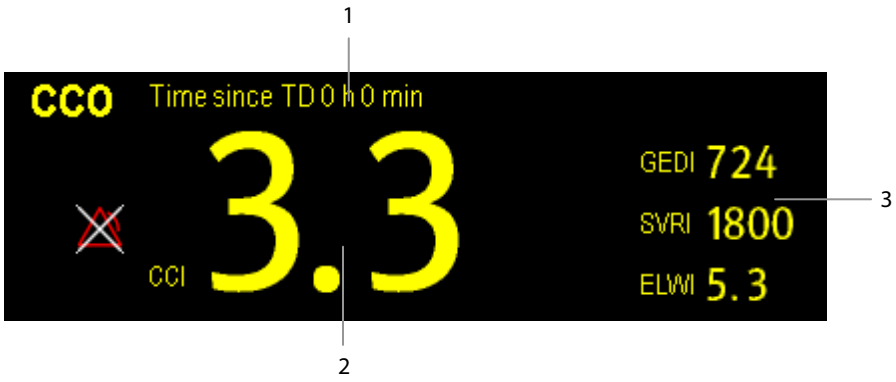
- Select [**Stop**] during a measurement to stop the measurement.
- Select [**Record**] to print out the curves selected for average calculation, numerics and averaged values by the recorder.
- Select [**Setup >>**] to access the [**CCO Setup**] menu.
- Select [**Hemo Para.>>**] to access the [**Hemodynamic Parameters**] menu.

⚠ CAUTION

- **Three to five single thermodilution measurements within 10 minutes are recommended. For a stable patient it is recommended to perform a thermodilution measurement every 8 hours. For an unstable patient it may be necessary to perform thermodilution measurements more frequently in order to determine the patient´s volume status and to recalibrate the continuous determination of C.O..**
- **As the pulse contour cardiac output of children has not been sufficiently validated thus far, the C.O. should be checked by thermodilution before therapeutic interventions.**
- **If the system can not get a reliable pArt value during a C.O. measure, the corresponding C.O. value is invalid for PiCCO calibration.**
- **Recalibration is recommended with significant changes in hemodynamic conditions, such as volume shifts or changes to medication.**
- **If the option of the auto pCVP measure is not used, pCVP should be updated as soon as a new value is obtained to accurately calculate SVR and CCO.**
- **If the displayed continuous parameters are not plausible, they should be checked by a thermodilution measurement. The PiCCO measurement will be recalibrated automatically.**
- **Faulty measurements can be caused by incorrectly placed catheters, interfering signal transmission e.g. of arterial pressure, defective connections or sensors, or by electromagnetic interference (e.g. electric blankets, electric coagulation).**
- **Aortic aneurysms may cause the displayed blood volume (GEDV/ITBV) derived by thermodiution measurement to be erroneously high if the arterial thermodilution catheter is placed in the femoral artery.**

18.7 Understanding the Displayed PiCCO Parameters

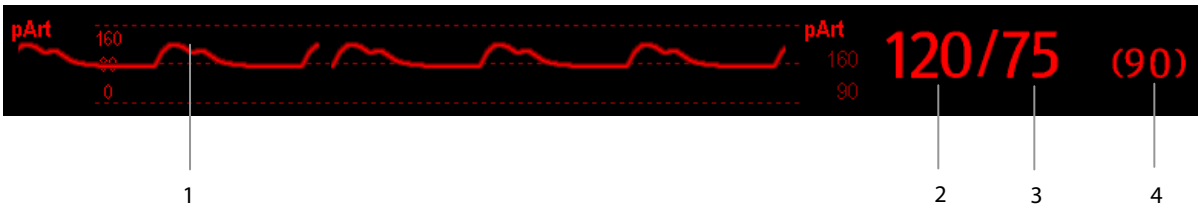
18.7.1 Understanding the CCO Display



1. Prompt message: the time since previous TD measurement
2. Label and value for main parameter
3. Labels and values for secondary parameters

18.7.2 Understanding the pArt Display

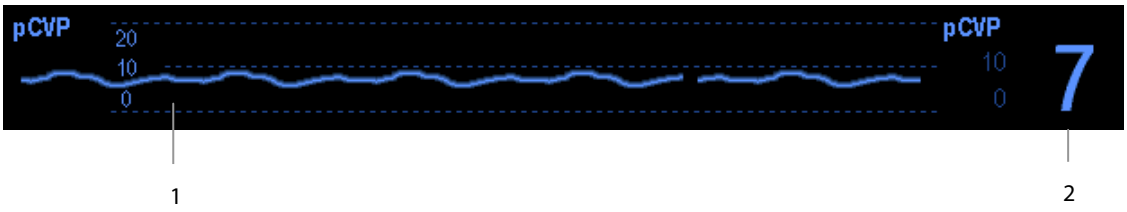
The artery pressure is displayed on the monitor as a waveform and numeric pressures. The figure below shows the pArt waveform and numerics.



1. Waveform
2. Systolic pressure
3. Diastolic pressure
4. Mean pressure

18.7.3 Understanding the pCVP Display

The central venous pressure is displayed on the monitor as a waveform and numeric pressures. The figure below shows the pCVP waveform and numerics.



1. Waveform
2. Central venous pressure

18.8 Understanding PiCCO Parameters

You can enter the [**Hemodynamic Parameters]** menu either by:

- Accessing the [**CCO Setup**] menu and selecting [**Hemo Para.>>**], or
- Accessing the [**PiCCO Measurement**] menu and selecting [**Hemo Para.>>**].

18.8.1 Spider Vision

18.8.1.1 Spider Vision Diagram

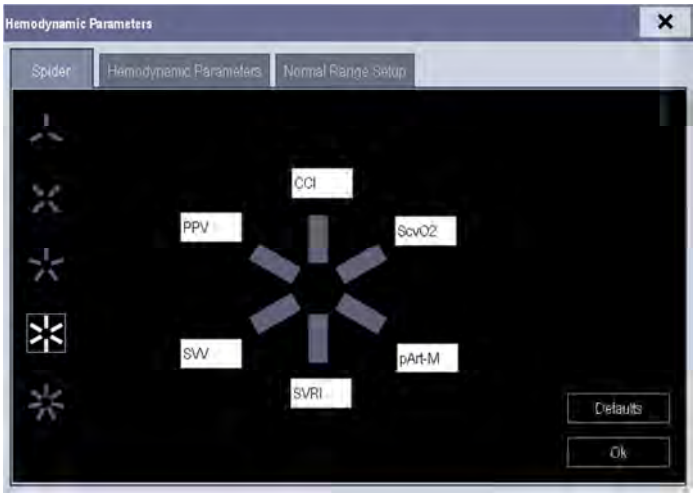
The spider vision diagram shows all continuous parameters in dynamic conjunction.

Each spider leg is divided into 3 segments indicating different value ranges for the respective parameters. The segment in the middle indicates the normal range for the respective parameter. The outer segment will be highlighted when corresponding parameter value exceeds the upper limit. The inner segment will be highlighted when its corresponding parameter value exceeds the lower limit.

- The diagram is displayed green when all displayed parameters are within the normal range.
- The diagram is displayed yellow immediately when one of the displayed parameters goes outside the normal range.
- The diagram appears red when two or more displayed parameters are outside the normal range.

The parameter whose default normal range is changed will be marked with the symbol  .

18.8.1.2 Spider Configuration



The spider vision diagram can be configured individually. You can select [**Setup>>**] in the spider vision screen and set the diagram by the following procedure:

1. Select the number of spider legs (3to7).
2. Select the parameter to be displayed.

18.8.2 Hemodynamic Parameters

Select [**Hemodynamic Parameters**] tab from the [**Hemodynamic Parameters**] menu to view the patient's hemodynamic parameters. In the [**Hemodynamic Parameters**] menu, you can select [**Range**] to view the referential normal range of each parameter. If a parameter value exceeds its normal range, the system will add a "↑" or "↓" to the right of the parameter.

	Abbreviation	**Full Spelling**	**Unit**	**Default Normal Range**
Output	CCO	Continuous Cardiac Output	L/min	/
	CCI	Continuous Cardiac Index	L/min/m^2	3.0-5.0
	SV	Stroke Volume	ml	/
	SVI	Stroke Volume Index	ml/m^2	40-60
	HR	Heart Rate	bpm	60-80
Contractility	GEF	Global Ejection Fraction	%	25-35
	CFI	Cardiac Function Index	L/min	4.5-6.5
	dPmx	Left Ventricular Contractility	mmHg/s	/
Preload Volume	GEDV	Global End Diastolic Volume	ml	/
	GEDI	Global End Diastolic Volume Index	ml/m^2	680-800
	ITBV	Intrathoracic Blood Volume	ml	/
	ITBI	Intrathoracic Blood Volume Index	ml/m^2	850-1000
	SVV	Stroke Volume Variation	%	0-10
	PPV	Pulse Pressure Variation	%	0-10
Afterload	SVR	Systemic Vascular Resistance	DS/cm^5 or kPa-s/l	/
	SVRI	Systemic Vascular Resistance Index	DS·m^2/cm^5 or kPa-s-m^2/l	1700-2400

	Abbreviation	Full Spelling	Unit	Default Normal Range
	pArt-M	Mean Artery Pressure	mmHg/kPa or cmH_2O	70-90
	pArt-D	Diastolic Artery Pressure	mmHg/kPa or cmH_2O	60-80
	pArt-S	Systolic Artery Pressure	mmHg/kPa or cmH_2O	100-140
Organ Function	EVLW	Extravascular Lung Water	ml	/
	ELWI	Extravascular Lung Water Index	ml/kg	3.0-7.0
	CPO	Cardiac Power Output	W	/
	CPI	Cardiac Power Index	W/ m^2	0.5-0.7
	PVPI	Pulmonary Vascular Permeability Index	no unit	1.0-3.0
	TB	Blood Temperature	ºC	/
Oxygenation Parameters	$ScvO_2$	Central Venous Oxygen Saturation	%	70-80
	Hb	Hemoglobin	g/dl	/
	DO_2	Oxygen Delivery	ml/min	/
	DO_2I	Oxygen Delivery Index	ml/min/m^2	400-650
	VO_2	Oxygen Consumption	ml/min	/
	VO_2I	Oxygen Consumption Index	ml/min/m^2	125-175
	SaO_2	Arterial Oxygen Saturation	%	90-100

18.8.3 Normal Range Setup

You can select [**Normal Range Setup**] tab from the [**Hemodynamic Parameters**] menu to set up the normal ranges for 20 parameters. The system adopts the default normal ranges for the parameters if the ranges are not set up manually. Please refer to the above table for the hemodynamic parameters to see the default normal ranges of the hemodynamic parameters.

NOTE

- **The normal ranges are based upon clinical experience and can vary from patient to patient. The stated values are therefore offered without guarantee. Indexed parameters are related to body surface area, predicted body weight or predicted body surface area and can also be displayed as absolute values.**
- **The values listed are not recommended for use on a specific patient. The treating physician is in any case responsible for determining and utilizing the appropriate diagnostic and therapeutic measures for each individual patient.**

18.9 Changing PiCCO Settings

18.9.1 Selecting the Displayed Parameters

Select [**Select Parameter>>**] from the [**CCO Setup**] menu. In the pop-up menu, select the parameters to be displayed.

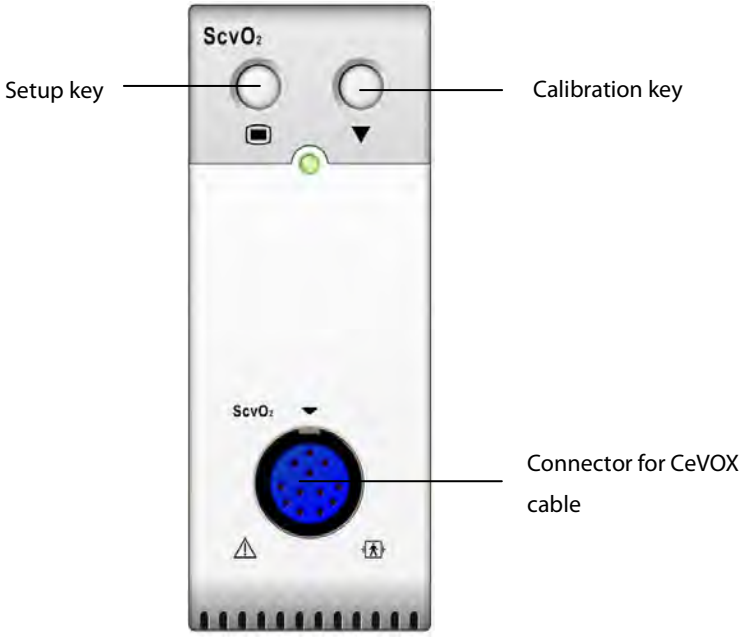
18.9.2 Selecting Alarm Properties

Select [**Alarm Setup >>**] from the [**CCO Setup**] menu to set the alarm properties for the relevant parameters.

19 Monitoring $ScvO_2$

19.1 Introduction

Central venous oxygen saturation ($ScvO_2$) is measured across spectrophotometry. Spectrophotometry involves the use of light emitting diodes (LED) that produce light of various wavelengths in red and infrared spectra. The light is transmitted to the blood through a fiberoptic in the probe, reflected off the red blood cells and transmitted back through a separate fiberoptic to an optical module. The central venous oxygen saturation is calculated through the analysis of the reflected spectra.

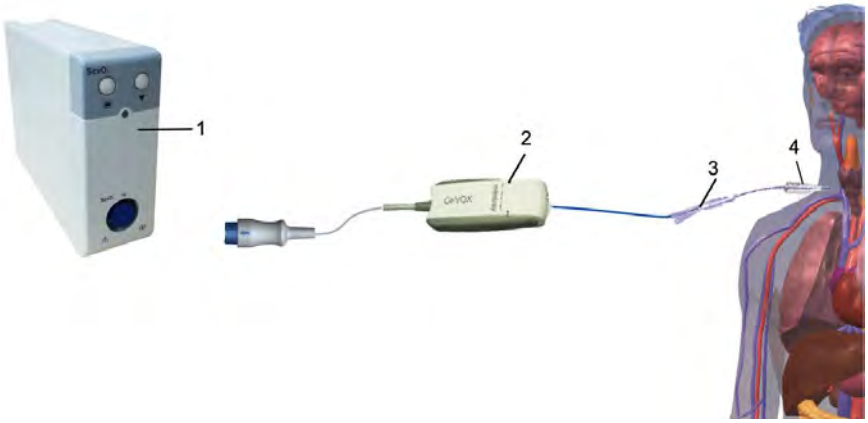


19.2 Safety Information

WARNING

- **$ScvO_2$ monitoring is restricted to adult and pediatric patients.**

19.3 Performing $ScvO_2$ Measurements



1. $ScvO_2$ module 2. CeVOX optical module 3. Fiberoptic probe 4. Central venous catheter

Please refer to the following procedure to perform the $ScvO_2$ measurements:

1. Apply the central venous catheter.
2. Place one end of the fiberoptic probe into the central venous catheter through the distal lumina, and connect the other end to the CeVOX optical module. Then plug the CeVOX cable into the $ScvO_2$ module.
3. If you see the message [**Calibration Required**], calibrate the $ScvO_2$ before performing the measurements. For detailed information on $ScvO_2$ calibration, please see ***19.4 ScvO2 Calibration.***
4. Check the reading in the $ScvO_2$ parameter window.

⚠ WARNING

- **To avoid installation failure, ensure that proper fiberoptic probe is selected.**
- **Incorrect placement of the fiberoptic probe can lead to vessel perforation. Therefore check the correct position of the probe as indicated in the probe's instructions for use.**

19.4 $ScvO_2$ Calibration

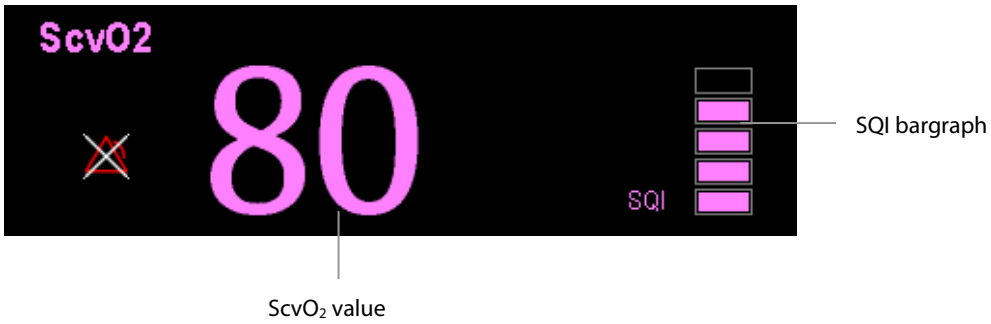
Regular in vivo calibration is required using blood gas analysis of a central venous blood sample to ensure accurate measurement of continuous $ScvO_2$. For optimal accuracy, it is recommended that an in vivo calibration be performed at least every 24 hours or if hemoglobin is changing (for more details, check the notes below). Please refer to the following procedure to perform calibration:

1. Check central venous catheter and CeVOX probe for proper placement.
2. Check the quality of the signal. The Signal Quality Indicator (SQI) is used for assessing the quality of fiberoptical signals during probe placement, calibration and measurement. The signal quality is indicated by bars of different height levels. Generally, the higher the level, the better the signal.
3. Withdraw a sufficient amount of central venous blood from the side port of the CeVOX probe to avoid intermixture of infusion/injection with the withdrawn blood.
4. Slowly withdraw 2ml blood from the side port of the CeVOX probe. Do not pull too strongly in order to avoid a hemolysis.
5. Immediately confirm by pressing the [**Sample drawn**] button.
6. If necessary put blood sample on ice and perform an analysis by a blood gas analysis device or a laboratory oximeter.
7. Input lab values for Hb/Hct and $ScvO_2$ and press [**Calibrate**] to confirm.

NOTE

- **The SQI signal can be affected by the presence of electrosurgical units. Keep electrocautery equipment and cables away from the monitor and use separate power socket if possible.**
- **To achieve optimal accuracy, it is recommended that the entered hemoglobin and hematocrit values are updated when there is a change of 6 % or more in hematocrit, or of 1.8 g/dl (1.1 mmol/l) or more in hemoglobin. A change in hemoglobin may also affect SQI.**
- **Dye (e.g. Indocyanine Green) or other substances, containing dyes which usually modify the light absorption capacities, can lead to faulty measurement values of the oxygen saturation.**

19.5 Understanding the $ScvO_2$ Display



19.6 Understanding $ScvO_2$ Parameters

Apart from $ScvO_2$, the patient monitor can also monitor DO_2, VO_2, DO_2I, and VO_2I. You can access the [**$ScvO_2$ Calibration**] menu from the [**$ScvO_2$ Setup**] menu and input a SaO_2 value in [**SaO_2**] edit box. The patient monitor will calculate the values for oxygention parameters automatically, and displays these parameters at [**Oxygention Parameters**] in the [**$ScvO_2$ Setup**] menu. If a parameter value exceeds its normal range, the system will add a "↑" or "↓" to the right of the parameter.

WARNING

- **The patient monitor may only be regarded as a device providing early warning. If there is an indication of a trend towards de-oxygenation of the patient, blood samples must be taken and tested on a laboratory oximeter in order to arrive at a decision concerning the condition of the patient.**

19.7 Changing $ScvO_2$ Settings

19.7.1 Selecting Hb/Hct

1. Open the [**$ScvO_2$ Setup**] menu.
2. Select [**Hb/Hct**] and toggle between [**Hb**] and [**Hct**].

19.7.2 Selecting Alarm Properties

Select [**Alarm Setup >>**] from the [**$ScvO_2$ Setup**] menu to set the alarm properties for the relevant parameters.

20 Monitoring Carbon Dioxide

20.1 Introduction

CO_2 monitoring is a continuous, non-invasive technique for determining the concentration of CO_2 in the patient' airway by measuring the absorption of infrared (IR) light of specific wavelengths. The CO_2 has its own absorption characteristic and the amount of light passing the gas probe depends on the concentration of the measured CO_2. When a specific band of IR light is passed through respiratory gas samples, some of IR light will be absorbed by the CO_2 molecules. The amount of IR light transmitted after it has been passed through the respiratory gas sample is measured with a photodetector. From the amount of IR light measured, the concentration of CO_2 is calculated.

There are two methods for measuring CO_2 in the patient's airway:

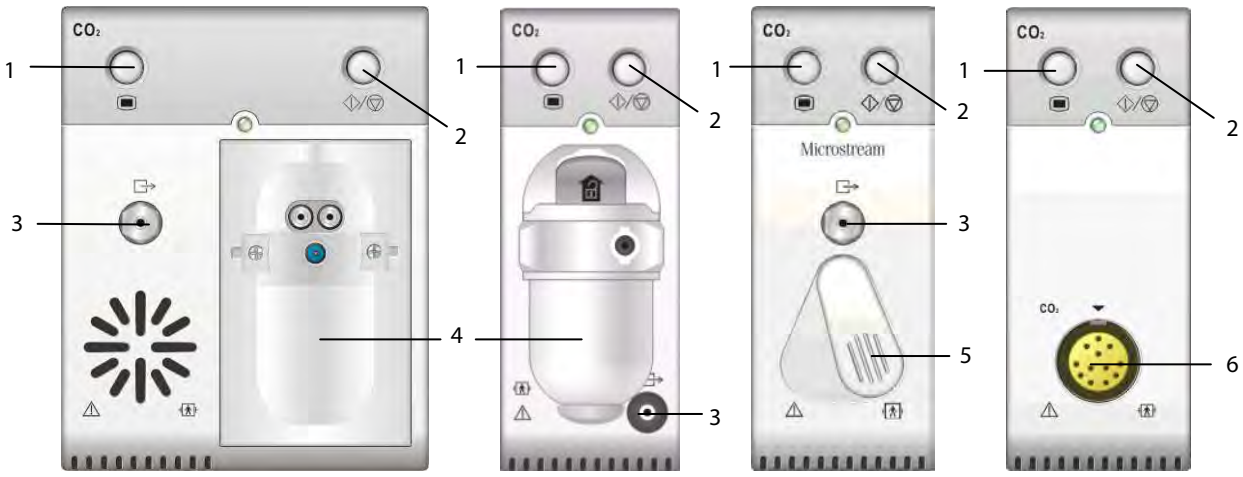
- Mainstream measurement uses a CO_2 sensor attached to an airway adapter directly inserted into the patient's breathing system.
- Sidestream/Microstream measurement samples expired patient gas at a constant sample flow from the patient's airway and analyzes it with a CO_2 sensor built into the CO_2 module.

The sidestream CO_2 module can be configured with a paramagnetic oxygen sensor. The paramagnetic oxygen sensor measures oxygen relying on its paramagnetic properties.

The mainstream CO_2 measurement can be used, with specified accessories, with intubated adult, pediatric and neonatal patients. The sidestream and microstream CO_2 measurement can be used, with specified accessories, with intubated and non-intubated adult, pediatric, and neonatal patients. With intubated patients, a sample of the respiratory gas is drawn from the patient's breathing circuit through an airway adapter and a gas sampling line. With non-intubated patients, the gas sample is drawn through a nasal cannula.

20.2 Identifying CO_2 Modules

From left to right are sidestream CO_2 module(2 slots), sidestream CO_2 module(1 slot),microstream CO_2 module and mainstream CO_2.



1. Setup key to enter the CO_2 setup menu
2. Measure/standby
3. Gas outlet
4. CO_2 watertrap seat
5. Connector for sampling line
6. Connector for CO_2 transducer

If you measure CO_2 using the AG module, see the section ***Monitoring AG***.

20.3 Preparing to Measure CO_2

WARNING

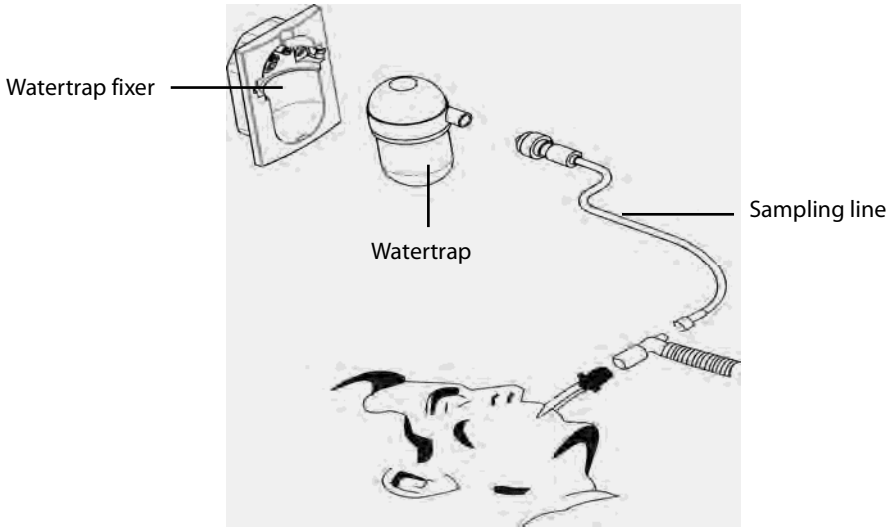
- **Eliminate the exhausted gas before performing the measurement.**
- **Check that the alarm limit settings are appropriate before taking measurement.**

NOTE

- **Perform the measurement in a well-ventilated environment.**

20.3.1 Using a Sidestream CO_2 Module

1. Attach the watertrap to the module and then connect the CO_2 components as shown below.



2. By default, the sidestream CO_2 module is in measure mode. The [**CO_2 Startup**] message appears on the screen when the CO_2 module is plugged.
3. After start-up is finished, the CO_2 module needs time to warm up to reach the operating temperature. The message [**CO_2 Sensor Warmup**] is displayed. If you perform CO_2 measurements during warm-up, the measurement accuracy may be compromised.
4. After warm-up is finished, you can perform CO_2 measurements.

NOTE

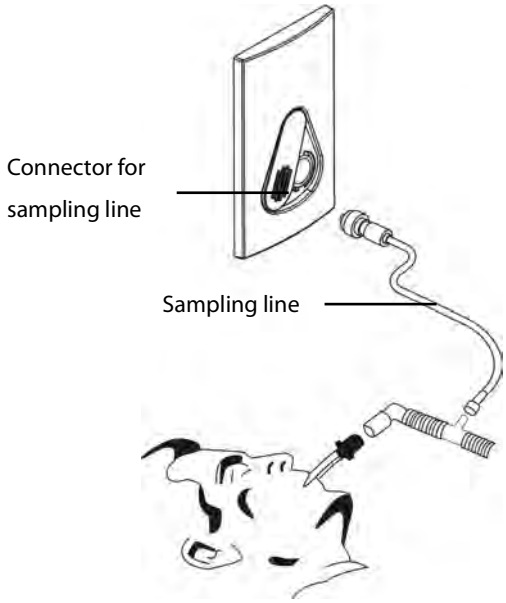
- **Do not apply adult watertrap to the neonate patient. Otherwise, patient injury could result.**
- **To extend the lifetime of the watertrap and module, disconnect the watertrap and set the operating mode to standby mode when CO_2 monitoring is not required.**

⚠ CAUTION

- **The watertrap collects water drops condensed in the sampling line and therefore prevents them from entering the module. If the collected water reaches a certain amount , you should drain it to avoid blocking the airway. Dispose of accumulated fluids in accordance with the hospital policy or your local regulations.**
- **The watertrap has a filter preventing bacterium, water and secretions from entering the module. After a long-term use, dust or other substances may compromise the performance of the filter or even block the airway. In this case, replace the watertrap. It is recommended to replace the watertrap every month, or when the watertrap is found leaky, damaged or contaminated.**

20.3.2 Using a Microstream CO_2 Module

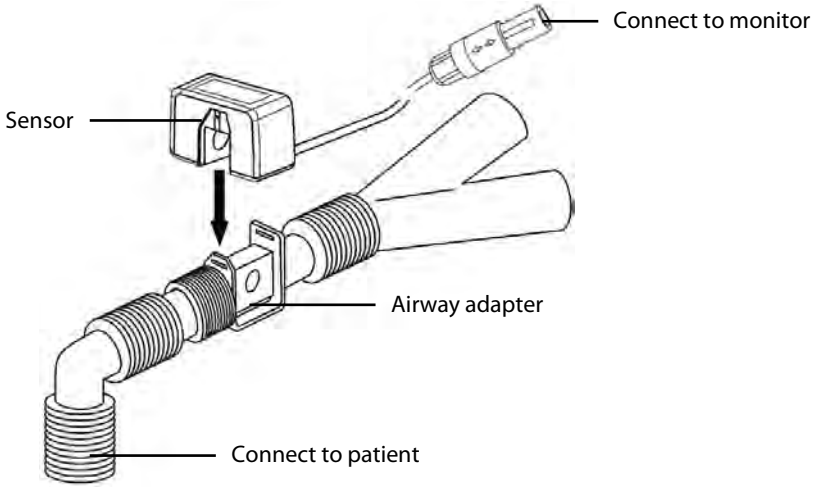
1. Connect the sampling line to the module and then connect the CO_2 components as shown below.



2. By default, the microstream CO_2 module is in measure mode. The message [**CO_2 Sensor Warmup**] appears on the screen when the CO_2 module is plugged.
3. After warm-up, you can perform CO_2 measurements.

20.3.3 Using a Mainstream CO_2 Module

1. Connect the sensor to the module.
2. By default, the mainstream CO_2 module is in measure mode. The message [**CO_2 Sensor Warmup**] appears on the screen when the CO_2 module is plugged.
3. After warm-up is finished, connect the transducer to the airway adapter.
4. Perform a zero calibration per the ***Zeroing the Sensor*** section.
5. After the zero calibration is finished, connect the airway as shown below.



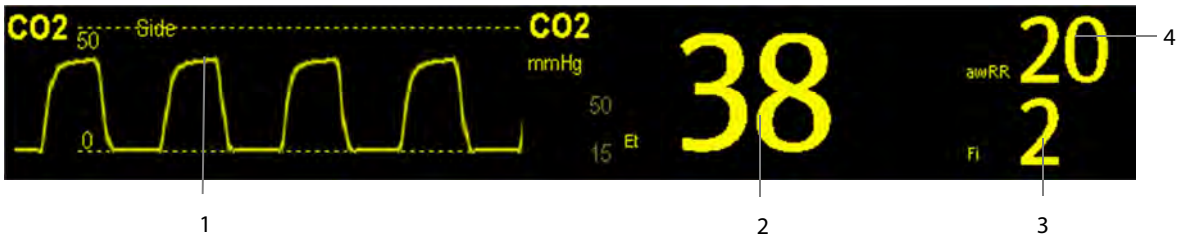
6. Make sure there are no leakages in the airway and then start a measurement.

NOTE

- **Always position the sensor with the adapter in an upright position to avoid collection of fluids on the windows of the adapter. Large concentrations of fluids at this point will obstruct gas analysis.**

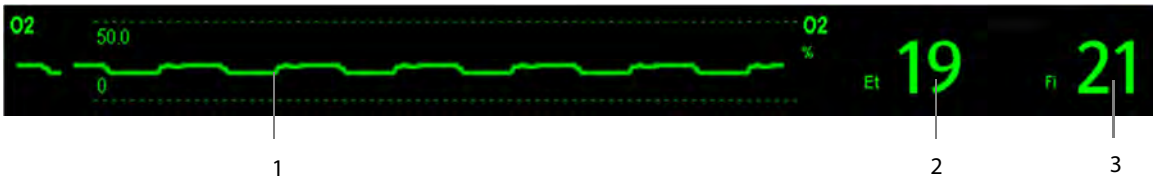
20.4 CO_2 Display

The CO_2 numeric and waveform area provide $FiCO_2$ measurement, $EtCO_2$ measurement, awRR measurement, and a CO_2 waveform.



1. CO_2 waveform
2. $EtCO_2$ measurement
3. $FiCO_2$ measurement
4. awRR measurement

If your sidestream CO_2 module is configured with the oxygen sensor, O_2 waveform and parameters can be displayed as follows:



1. O_2 waveform 2. EtO_2 measurement 3. FiO_2 measurement

20.5 Changing CO_2 Settings

20.5.1 Accessing CO_2 Menus

By selecting the CO_2 parameter window or waveform, you can access the [**CO_2 Setup**] menu.

20.5.2 Entering the Standby Mode

The standby mode of the CO_2 module relates to the standby mode of the monitor as follows:

- If the monitor enters the standby mode, the CO_2 module will also enter the standby mode.
- If the monitor exits the standby mode, the CO_2 module will also exit the standby mode.
- If the CO_2 module enters or exits the standby mode, it will not affect the monitor.

To enter or exit the standby mode manually,

- select the ◇/▽ hardkey on the module, or
- select [**Operating Mode**] in the [**CO_2 Setup**] menu and then toggle between [**Standby**] and [**Measure**].

When you set the sidestream CO_2 module to the strandby mode, the CO_2 gas sample intake pump automatically sets the sample flow rate to zero. When exiting the standby mode, the CO_2 module continues to work at the preset sample flow rate with no need to warm up again. After nearly 1 minute, the module enters the full accuracy mode.

For the sidestream CO_2 module, you can set the delay time. After the delay time the CO_2 module enters the standby mode if no breath is detected.

For the microstream CO_2 module, you can also set a period of time after which the CO_2 module enters the standby mode if no breath is detected since the CO_2 module is powered on or the CO_2 module switches to the measuring mode or the automatic standby time is re-set. To set the standby time, in the [**CO_2 Setup**] menu, select [**Auto Standby**] and then select the appropriate setting.

20.5.3 Setting the CO_2 Unit

Select [**Unit Setup >>**] from the [**User Maintenance**] menu. In the popup menu, select [**CO_2 Unit**] and toggle between [**mmHg**], [**%**] and [**kPa**].

20.5.4 Setting up Gas Compensations

⚠ WARNING

- **Make sure that the appropriate compensations are used. Inappropriate compensations may cause inaccurate measurement values and result in misdiagnosis.**

For the sidestream CO_2 module:

1. Select [**CO_2 Setup**].
2. According to the actual condition, set the concentration required for the following compensations:
   - ◆ [**O_2 Compen**]
   - ◆ [**N_2O Compen**]
   - ◆ [**Des Compen**]

For the microstream CO_2 module, gas compensations are not required.

For the mainstream CO_2 module, in the [**CO_2 Setup**] menu, respectively select:

- [**Balance Gas**] and toggle between [**Room Air**] and [**N_2O**]. Select [**Room Air**] when air predominates in the ventilation gas mixture and select [**N_2O**] when N_2O predominates in the ventilation gas mixture and select [**He**] when He predominates in the ventilation gas mixture.
- [**O_2 Compen**] and then select [**Off**] or an appropriate setting according to the amount of O_2 in the ventilation gas mixture. When the amount of O_2 is less than 30%, you'd better switch this compensation off.
- [**AG Compen**] and enter the concentration of anesthetic gas present in the ventilation gas mixture. This could compensate for the effect of AG on the readings.

20.5.5 Setting up Humidity Compensation

Sidestream and microstream CO_2 modules are configured to compensate CO_2 readings for either Body Temperature and Pressure, Saturated Gas (BTPS), to account for humidity in the patient's breath, or Ambient Temperature and Pressure, Dry Gas (ATPD).

1. ATPD: $P_{co2}(mmHg) = CO_2(vol\%) \times P_{amb} / 100$
2. BTPS: $P_{CO2}(mmHg) = CO_2(vol\%) \times (P_{amb} - 47) / 100$

Where, P_{CO2} = partial pressure, $vol\%$ = CO_2 concentration, P_{amb} = ambient pressure, and unit is mmHg.

As the mainstream CO_2 module has a built-in heating component to prevent water vapour from condensing, setting humidity compensation is not needed. For the sidestream and microstream CO_2 module, you can set the humidity compensation on or off according to the actual condition. To set the humidity compensation:

1. In the [**CO_2 Setup**] menu, select [**BTPS Compen**].
2. Select either [**On**] for BTPS or [**Off**] for ATPD, depending on which compensation applies.

20.5.6 Setting the Apnea Alarm Delay

In the [**CO_2 Setup**] menu, select [**Apnea Delay**] and then select the appropriate setting. The monitor will alarm if the patient has stopped breathing for longer than the preset apnea time. The [**Apnea Delay**] of Resp, CO_2, AG, and RM module keeps consistent with each other.

⚠WARNING

- **The respiration measurement does not recognize the cause of apneas. It only indicates an alarm if no breath is detected when a pre-adjusted time has elapsed since the last detected breath. Therefore, it cannot be used for diagnostic purpose.**

20.5.7 Choosing a Time Interval for Peak-Picking

For microstream and mainstream CO_2 modules, you can select a time interval for picking the highest CO_2 as the $EtCO_2$ and the lowest as the $FiCO_2$.

To set the time interval:

1. Enter the [**CO_2 Setup**] menu.
2. Select [**Max Hold**].
3. Toggle between [**Single Breath**], [**10 s**], [**20 s**] and [**30 s**] if microstream CO_2 module is configured; toggle between [**Single Breath**], [**10 s**] and [**20 s**] if mainstream CO_2 module is configured.
   - [**Single Breath**]: $EtCO_2$ and $FiCO_2$ are calculated for every breath.
   - [**10 s**], [**20 s**], or [**30 s**]: $EtCO_2$ and $FiCO_2$ are calculated using 10, 20 or 30 seconds of data.

20.5.8 Setting the Flow Rate

For the sidestream CO_2 module, you can change the sampling rate of respiratory gas in the patient's airway by setting the flow rate. To set the flow rate, enter the [**CO_2 Setup**] menu and select an appropriate setting from [**Flow Rate**].

⚠ WARNING

- **Please consider the patient's actual bearing capability and select the appropriate flow rate when setting the flow rate.**

20.5.9 Setting up the CO_2 Wave

In the [**CO_2 Setup**] menu, you can:

- Select [**Wave Type**] and toggle between [**Draw**] and [**Fill**]:
  - [**Draw**]: The CO_2 wave is displayed as a curved line.
  - [**Fill**]: The CO_2 wave is displayed as a filled area.
- Select [**Sweep**] and then select the appropriate setting. The faster the wave sweeps, the wider the wave is.
- Change the size of the CO_2 waveform by adjusting the wave [**Scale**].

20.6 Changing O_2 Settings (For Sidestream CO_2 Module with O_2 Sensor)

20.6.1 Changing O_2 Alarm Settings

To change the O_2 alarm settings, follow this procedure:

1. Select the CO2 numeric area or waveform area to enter the [**CO2 Setup**] menu.
2. Select the [**Alarm Setup >>**] button.
3. Set the following alarm properties:
   - ◆ Switch on or switch off the alarms or alarm recording.
   - ◆ Adjust the alarm limits or alarm priority.
   - ◆ Select [**Apnea Delay**] to set the delay time of the apnea alarm.

20.6.2 Changing the O_2 Unit

To change the O_2 unit, follow this procedure:

1. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password→ [**Module Maintenance >>**].
2. Set [**O2 Unit**].

20.6.3 Setting the O_2 Waveform

To set the O_2 waveform, follow this procedure:

1. Select the CO_2 numeric area or waveform area to enter the [**CO2 Setup**] menu.
2. Set [**Sweep**] and **[O2 Scale**].

20.7 Setting RR Source

To set RR source:

1. Enter the [**CO_2 Setup**] menu.
2. Select [**RR Source**] and then select a source or [**Auto**] from the dropdown list.

The [**RR Source**] settings of Resp, CO_2, AG and RM module are linked. For details, please refer to the section ***Setting RR Source*** of chapter ***Resp***.

20.8 Setting Barometric Pressure Compensation

Both sidestream and microstream CO_2 modules have the function of automatic barometric pressure compensation (the system automatically measures the barometric pressure which the patient monitor is exposed to). However, the mainstream CO_2 module does not have such function. For the mainstream CO_2 module, the default barometric pressure is 760 mmHg. You must modify the barometric pressure based on the actual situation as follows:

1. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password→ [**Module Maintenance >>**]→[**Maintain CO_2 >>**].
2. Select [**Barometric Pressure**] and then enter the value of barometric pressure to which the patient monitor is exposed to.

⚠WARNING

- **Be sure to set the barometric pressure properly before using the mainstream CO_2 module. Improper settings will result in erroneous CO_2 reading.**

20.9 Measurement Limitations

The following factors may influence the accuracy of measurement:

- Leaks or internal venting of sampled gas
- Mechanical shock
- Cyclic pressure up to 10 kPa (100 cmH_2O)
- Other sources of interference, if any

Measurement accuracy of the sidestream CO_2 module may be affected by the breath rate and I/E ratio as follows:

- $etCO_2$ is within specification for breath rate ≤ 60 bpm and I/E ratio ≤ 1:1;
- $etCO_2$ is within specification for breath rate ≤ 30 bpm and I/E ratio ≤ 2:1.

Measurement accuracy of the microstream CO_2 module may be affected by the breath rate as follows:

- $EtCO_2$ value is within specification for breath rate ≤ 80 rpm.
- $EtCO_2$ accuracy is 4 mmHg or ±12% of the reading, whichever is greater, for breath rate > 80 rpm and $EtCO_2$ > 18 mmHg.

20.10 Leakage test

When the modules need maintenance, the monitor will prompt on the CO_2 parameter window: [**Need maintenance. Enter CO_2 setup menu.**] Then, select [**User Maintenance >>**]→[**Module Maintenance >>**]→[**Maintain CO_2**], and perform leakage test according to the prompt messages on the menu.

20.11 Troubleshooting the Sidestream CO_2 Sampling System

When the sampling system of the sidestream CO_2 module works incorrectly, check if the sampling line is kinked. If not, remove it from the watertrap. If the monitor gives a message indicating the airway still works incorrectly, it indicates that the watertrap must have been blocked, and you should replace with a new one. Otherwise, you can determine that the sampling line must have been blocked. Replace with a new sampling line.

20.12 Removing Exhaust Gases from the System

⚠WARNING

- **When using the Sidestream or Microstream CO_2 measurement on patients who are receiving or have recently received anesthetics, connect the outlet to a scavenging system to avoid exposing medical staff to anesthetics.**

To remove the sample gas to a scavenging system, connect an exhaust tube to the gas outlet connector of the module.

20.13 Zeroing the Sensor

The zero calibration eliminates the effect of baseline drift during CO_2 measurement exerted on the readings and therefore maintains the accuracy of the CO_2 measurements.

20.13.1 For Sidestream and Microstream CO_2 Modules

For sidestream and microstream CO_2 modules, a zero calibration is carried out automatically when necessary. You can also start a manual zero calibration if necessary. To manually start a zero calibration, from the [**User Maintenance**] menu, select [**Module Maintenance >>**]→[**Maintain CO_2 >>**]→[**Calibrate CO_2 >>**]→[**Start Zero Cal.**]. Disconnecting the patient airway is not required when performing a zero calibration.

20.13.2 For Mainstream CO_2 Modules

For mainstream CO_2 modules, zero the sensor whenever:

- A new adapter is used;
- You reconnect the sensor to the module;
- You see the message [**CO_2 Zero Required**]. In this case, check the airway adapter for any blockage, e.g. mucus, etc. If a blockage is detected, clear or replace the adapter.

To zero the sensor, follow this procedure:

1. Connect the sensor to the module.
2. In the [**CO_2 Setup**] menu, set the [**Operating Mode**] to [**Measure**]. The message [**CO_2 Sensor Warmup**] is displayed.
3. After warm-up is finished, connect the sensor to a clean, dry airway adapter. The adapter should be vented to the air and isolated from CO_2 sources, such as ventilator, the patient's breathing, your own breathing, etc.
4. Select [**Start Zero Cal.**] in the [**CO_2 Setup**] menu. The message [**CO_2 Zero Running**] is displayed.
5. It takes about 15 to 20 seconds. The message disappears when the zero calibration is completed.

⚠WARNING

- **When perform a zero calibration during the measurement, disconnect the transducer from the patient's airway first.**
- **Please do not rely on the readings during zeroing.**

20.14 Calibrating the Sensor

For sidestream or microstream CO_2 modules, a calibration should be performed once every year or when the readings go far beyond the range. For mainstream CO_2 modules, no calibration is required. For details, refer to the chapter ***39 Maintenance***.

20.15 Oridion Information

Microstream

This trademark is registered in Israel, Japan, German and America.

Oridion Patents

The capnography component of this product is covered by one or more of the following US patents: 6,428,483; 6,997,880; 6,437,316; 7,488,229; 7,726,954 and their foreign equivalents. Additional patent applications pending.

No Implied License

Possession or purchase of this device does not convey any express or implied license to use the device with unauthorized CO_2 sampling consumables which would, alone, or in combination with this device, fall within the scope of one or more of the patents relating to this device and/or CO_2 sampling consumable.

21 Monitoring tcGas

21.1 Introduction

This patient monitor can connect the external device for continuous transcutaneous blood gas monitoring.

This patient monitor can display, store and review measurements from the external device, as well as present related alarms. On this patient monitor, you can separately set the level of tcGas related alarms and switch on or off alarm recording; you can also view external device settings of alarm limits and alarm switch.

This patient monitor can integrate the following external devices:

- TCM CombiM monitor
- TCM TOSCA monitor
- SenTec Digital Monitor(SDM)

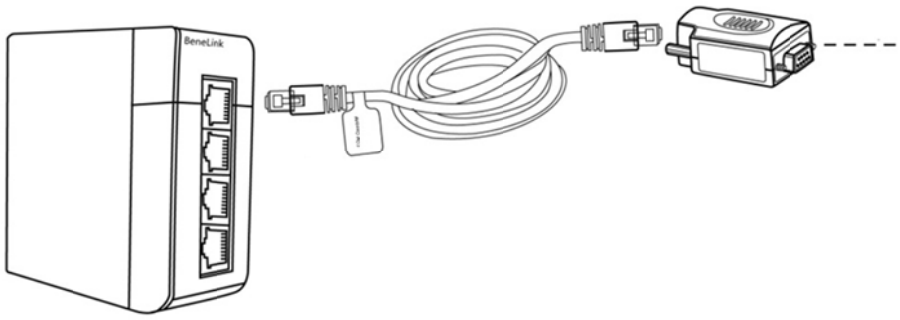
21.2 Safety

⚠WARNING

- **TCM monitors are manufacutred by Radiometer Medical ApS. This company provides the technology for measuring tcGas parameters. We only provide the connection between this patient monitor and TCM monitors.**
- **The SenTec Digital Monitor (SDM) is manufacutred by SenTec AG. This company provides the technology for measuring tcGas parameters. We only provide the connection between this patient monitor and the SenTec Digital Monitor.**
- **If you have any doubts about the operation and maintenance of the external device, please refer to the operator's manual of the external device or directly contact its manufacturer.**
- **Fully observe the operator's manual of the external device to make settings and to connect the external device with a patient.**
- **For the intended use and contraindication of the external devices, refer to their operator's manuals.**

21.3 Connecting an external device

The external device connects with BeneLink module through an ID adapter, see the picture below.



Please refer to the following procedure to connect the external device:

1. Insert a BeneLink module into a BeneView patient monitor module rack.
2. Connect the ID adapter that matches the external device to the BeneLink module with an RJ45 connecting cable.
3. Connect the ID adapter to the external device:
   - For the TCM monitor, connect the ID adapter to the serial port (COM port) of the TCM monitor with Mindray type C serial port adapting cable (PN: 009-001769-00) and an interface cable provided with the TCM monitor.
   - For the SenTec Digital Monitor, connect the ID adapter to the serial port (COM port) of the SenTec Digital Monitor with Mindray type C serial port adapting cable (PN: 009-001769-00).
4. Stick a label indicating device name to the RJ45 connecting cable at the end nearby the BeneLink module. When the BeneLink module is connected to several external devices, you can tell the devices easily with these labels.
5. Turn on both the monitor and the external device.

NOTE

- **For the ID adapter setup of the tcGas monitor, refer to section 29.5 Connecting an External Device..**

21.4 tcGas Parameters

TCM CombiM monitor provides the following measurements:

- $tcpCO_2$
- $tcpO_2$
- Power
- Tsensor

In which, $tcpCO_2$ and $tcpO_2$ are primary parameters, and the others are secondary parameters.

TCM TOSCA monitor provides the following measurements:

- $tcpCO_2$
- SpO_2
- PR
- Power

- Tsensor

In which, $tcpCO_2$ is primary parameter, and the others are secondary parameters.

SenTec Digital Monitor provide the following measurements:

- $tcpCO_2$
- $tcpO_2$
- SpO_2
- PR
- Power
- Tsensor

In which up to two parameters can be selected as primary parameters and the others are secondary parameters. Options for primary parameters are $tcpCO_2$, $tcpO_2$, SpO_2, and PR, with $tcpCO_2$ and $tcpO_2$ being the defaults.

NOTE

- **On the SenTec Digital Monitor it is possible to disable/enable the parameters to be monitored. For $tcpO_2$ monitoring an OxiVenT™ Sensor and activated PO_2-option are required. If the SenTec Digital Monitor is operated in neonatal mode, SpO_2 and PR are not supported.**

21.5 Displaying tcGas Parameters

To display tcGas parameters on this patient monitor, select the [**Screen Setup**] button  to enter the [**Screens**] window, and then select [**Screen Setup**]. You can choose where to display the tcGas parameters on the screen.

21.6 Enter the tcGas Setup menu

You can access the [**+tcGas Setup**] menu by selecting the tcGas area or selecting **[Main Menu]** →[**Parameters >>**]→ [**+tcGas Setup>>**]. In the [**+tcGas Setup**] menu, you can

- Toggle [**Alarm Sound**] between [**On**] and [**Off**] to switch on or off tcGas alarms on this patient monitor.
- Choose the secondary parameters to be displayed. The tcGas area can display maximum three secondary parameters.

  For TCM CombiM monitor, only two secondary parameters, Power and Tsensor, are measured, so in [**+tcGas Setup**] menu the option [**Change Secondary Parameters >>**] is not available.
- Set alarm level for tcGas parameters, switch on or off alarm record.

21.7 Setting $tcpCO_2/tcpO_2$ Unit

You can enter the [**User Maintenance**] menu to [**Unit Setup >>**] to set [**$tcpCO_2/tcpO_2$ Unit**] to [**mmHg**] or [**kPa**].

21.8 tcGas Display

If TCM CombiM monitor is connected, the tcGas area is shown as follows:

If TCM TOSCA monitor is connected, the tcGas area is shown as follows:

If SenTec Digital Monitor is connected, the tcGas area is shown as follows:

22 Monitoring AG

22.1 Introduction

The anaesthetic gas (AG) module measures the patient's anesthetic and respiratory gases by connecting to the airway of intubated patients or collecting the gases with specified accessories. It also incorporates the features of the O_2 module and BIS module as well. The AG measurement is applicable for adult, pediatric and neonatal patients.

The AG module determines the concentration of certain gases using the infrared (IR) light absorption measurement. The gases that can be measured by the AG module absorb IR light. Each gas has its own absorption characteristic. The gas is transported into a sample cell, and an optical IR filter selects a specific band of IR light to pass through the gas. For multiple gas measurement, there are multiple IR filters. The higher the concentration of gas in a given volume the more IR light is absorbed. This means that higher concentration of IR absorbing gas cause a lower transmission of IR light. The amount of IR light transmitted after it has been passed though an IR absorbing gas is measured. From the amount of IR light measured, the concentration of gas present can be calculated.

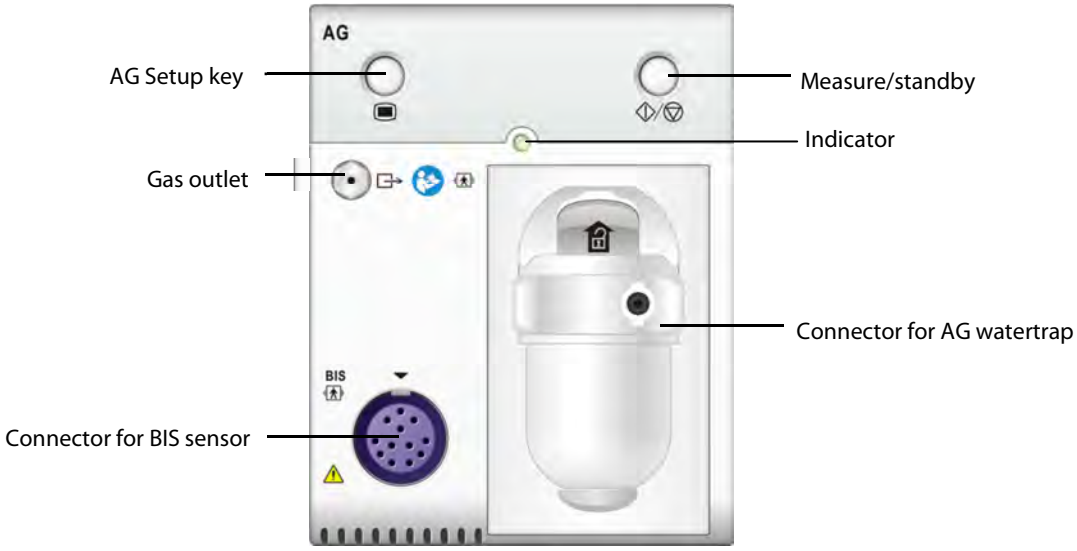
Oxygen does not absorb IR light as other breathing gases and is therefore measured relying on its paramagnetic properties. Inside the O_2 sensor are two nitrogen-filled glass spheres mounted on a strong rare metal taut-band suspension. This assembly is suspended in a symmetrical non-uniform magnetic field. In the presence of paramagnetic oxygen, the glass spheres are pushed further away from the strongest part of the magnetic field. The strength of the torque acting on the suspension is proportional to the oxygen concentration. From the strength of the torque, the concentration of oxygen is calculated.

NOTE

- **Perform the measurement in a well-ventilated environment.**

22.2 Identifying AG Modules

AG module can identify two anesthetic gases in a mixture automatically and distinguish between them according to their contributions to the MAC value for display as the primary and secondary anesthetis agent.

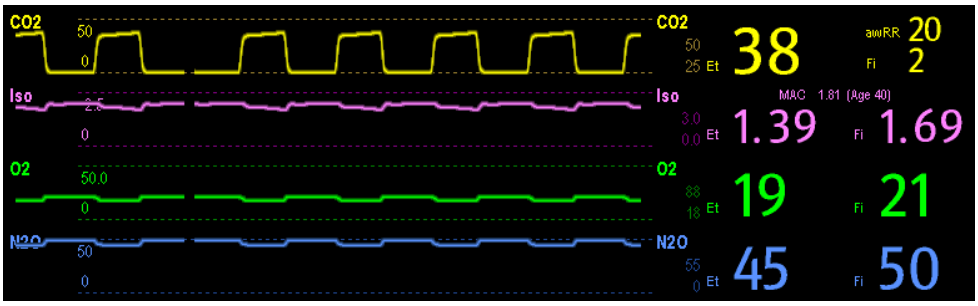


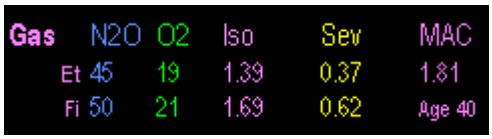
For details on BIS, refer to the chapter ***24 Monitoring BIS.***

NOTE

- **The AG module is configured with automatic barometric pressure compensation function.**

22.3 Understanding the AG Display





The AG module can send waves and numerics for all measured anesthetic gases for display on the monitor, including:

- CO_2, O_2, N_2O and AA waves
- awRR: airway respiratory rate
- MAC: minimum alveolar concentration
- End tidal (Et) and fraction of inspired (Fi) numerics for CO_2, O_2, N_2O and AA

Where AA represents Des (desflurane), Iso (isoflurane), Enf (enflurane), Sev (sevoflurane), or Hal (halothane).
The AA waveform area displays the primary anesthetic gas's waveform. When O_2 module does not exist, no O_2 waveform will be displayed. When O_2 module exists, the O_2 waveform will be displayed only when the O_2 waveform is currently switched on.

⚠WARNING

- **To avoid explosion hazard, do not use flammable anesthetic agent such as ether and cyclopropane for this equipment.**

22.4 MAC Values

Minimum alveolar concentration (MAC) is the minimum concentration of the agent in the alveoli. It is a basic index to indicate the depth of anesthesia. The standard ISO 21647 defines MAC as this: alveolar concentration of an inhaled anesthetic agent that, in the absence of other anesthetic agents and at equilibrium, prevents 50% of patients from moving in response to a standard surgical stimulus.

Minimum alveolar concentration (MAC) values are listed below:

Agent	Des	Iso	Enf	Sev	Hal	N2O
1 MAC	6%	1.15%	1.7%	2.1%	0.77%	105%*

* indicates 1 MAC nitrous oxide can only be reached in hyperbaric chamber.

NOTE

- **The MAC values shown in the table above are those published by the U.S. Food and Drug Administration for a healthy 40-year-old adult male patient.**
- **In actual applications, the MAC value may be affected by age, weight and other factors.**

The formula to calculate the MAC value is as follows:

$$MAC = \sum_{i=0}^{N-1} \frac{EtAgent_i}{AgentVol_{age}i}$$

Where N is the number of all agents (including N_2O) that the AG module can measure, EtAgenti is the concentration of each agent, and $AgentVol_{age}i$ is the concentration of each agent at 1 MAC with age correction.

The formula for calculating age correction of 1 MAC is:

$$MAC_{age} = MAC_{40} \times 10^{(-0.00269 \times (age - 40))}$$

For example, the Des concentration at 1 MAC of a 60-year old patient is $6\% \times 10^{(-0.00269 \times (60-40))} = 6\% \times 0.88$.

The AG module measures there are 4% of Des, 0.5% of Hal and 50% of N_2O in this patient's end-tidal gas:

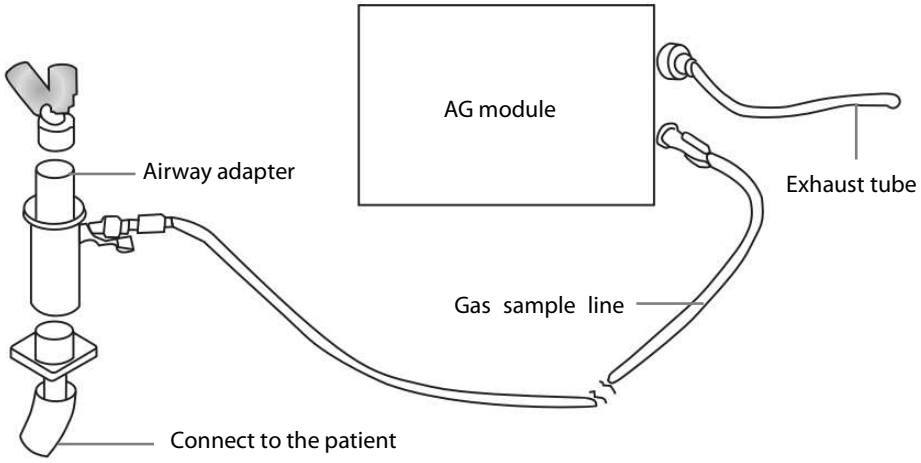
$$MAC = \frac{4.0\%}{6\% \times 0.88} + \frac{0.5\%}{0.77\% \times 0.88} + \frac{50\%}{105\% \times 0.88} = 2.04$$

NOTE

- **The formula above is only suitable for patients who are older than one year. If the patient is less than one year, the system uses one year to do age correction.**

22.5 Preparing to Measure AG

1. Select an appropriate watertrap according to patient category and attach it to the module.
2. Connect the gas sample line to the connector of the watertrap.
3. Connect the other end of the gas sampling line to the patient via the airway adapter.
4. Connect the gas outlet to a scavenging system using an exhaust tube.



5. Insert the AG module into the SMR or the patient monitor and the patient monitor will prompt [**AG Startup**]. Within 10 minutes after startup is finished, the AG module enters the iso accuracy mode. After that, the module enters the full accuracy mode.

⚠ WARNING

- **Make sure that the connections are tight. Any leak in the system can result in erroneous readings due to ambient air mixing with patient gases.**
- **Do not apply adult watertrap to the neonate patient. Otherwise, patient injury could result.**
- **Using high-frequency electrosurgical units may increase the risk of skin burn. In this case, do not use antistatic or conductive respiratory tubing.**

⚠CAUTION

- **Position the airway adapter so that the part connecting to the gas sample line is pointing upwards. This prevents condensed water from passing into the gas sample line and causing an occlusion.**
- **The watertrap collects water drops condensed in the sampling line and therefore prevents them from entering the module. If the collected water reaches to a certain amount, you should drain it to avoid blocking the airway. Dispose of accumulated fluids in accordance with the hospital policy or your local regulations.**
- **The watertrap has a filter preventing bacterium, water and secretions from entering the module. After a long-term use, dust or other substances may compromise the performance of the filter or even block the airway. In this case, replace the watertrap. Replacing the watertrap once a month is recommended.**
- **Check that the alarm limit settings are appropriate before taking measurement.**

22.6 Changing AG Settings

22.6.1 Setting Gas Unit

For N_2O and AA, the unit of the measured gas is fixed to "%".

Select [**Unit Setup >>**] from the [**User Maintenance**] menu. In the popup menu, you can select [**CO_2 Unit**] or [**O_2 Unit**] and toggle between [**mmHg**], [**%**] and [**kPa**].

22.6.2 Setting the Apnea Alarm Delay

In the [**AG Setup**] menu, select [**Apnea Delay**] and select the appropriate setting. The monitor will alarm if the patient has stopped breathing for longer than the preset apnea time.

The [**Apnea Delay**] of Resp, CO_2, AG, and RM module keeps consistent with each other.

⚠WARNING

- **The respiration measurement does not recognize the cause of apneas. It only indicates an alarm if no breath is detected when a pre-adjusted time has elapsed since the last detected breath. Therefore, it cannot be used for diagnostic purpose.**

22.6.3 Changing the Sample Flow Rate

In the setup menu for any gas, select [**Flow Rate**] and then choose either:

- [**High**]: 200 ml/min for adult and pediatric patients, and 120 ml/min for neonatal patients.
- [**Med**]: 150 ml/min for adult and pediatric patients, and 90 ml/min for neonatal patients.
- [**Low**]: 120 ml/min for adult and pediatric patients, and 70 ml/min for neonatal patients.

22.6.4 Setting up the O_2 Compensation

If the AG module does not incorporate the O_2 module, you need to manually select [**O_2 Compen**] and then select [**Off**] or an appropriate setting according to the amount of O_2 in the ventilation gas mixture. When the amount of O_2 is less than 30%, you'd better switch this compensation off.

If the AG module incorporates the O_2 module, the system will directly use the O_2 concentration detected by the O_2 module to make compensation. At this time, the [**O_2 Compen**] in the setup menu for any gas is fixed to [**Off**].

⚠WARNING

- **Make sure to use the appropriate compensations. Inappropriate compensations may cause inaccurate measurement values and result in misdiagnosis.**

22.6.5 Entering the Standby Mode

For the AG module, the default operating mode is measure. When you set the AG module to the standby mode, the AG gas sample intake pump automatically sets the sample flow rate to zero. When exiting the standby mode, the AG module continues to work at preset sample flow rate with no need to warm up again. After nearly 1 minute, the module enters the full accuracy mode. The standby mode of the AG module relates to the standby mode of the monitor as follows:

- If the monitor enters the standby mode, the AG module will also enter the standby mode.
- If the monitor exits the standby mode, the AG module will also exit the standby mode.
- If the AG module enters or exits the standby mode, it will not affect the monitor.

To enter or exit the standby mode manually, in the agent's setup menu, select [**Operating Mode**] and then toggle between [**Standby**] and [**Measure**]. You can also set a period of time after which the AG module enters the standby mode automatically if no breath is detected since the last detected breath. To set the standby time, in the agent's setup menu, select [**Auto Standby (min)**] and then select the appropriate setting.

22.6.6 Setting up the AG Wave

In the [**AG Setup**] menu, you can:

- Select [**CO_2 Wave Type**] and toggle between [**Draw**] and [**Fill**]:
  - [**Draw**]: The CO_2 wave is displayed as a curved line.
  - [**Fill**]: The CO_2 wave is displayed as a filled area.
- Select [**Sweep(CO2/O2)**], [**Sweep(AA)**] or [**Sweep(N2O)**] to change the wave sweep. The faster the wave sweeps, the wider the wave is.
- Select [**CO2 Scale**], [**AA Scale**] or [**N2O Scale**] to change the size of the waveform.

22.6.7 Setting RR Source

To set RR source:

1. Enter the [**AG Setup**] menu.
2. Select [**RR Source**] and then select a source or [**Auto**] from the dropdown list.

The [**RR Source**] settings of Resp, CO_2, AG and RM module are linked. For details, please refer to the section ***Setting RR Source*** of chapter ***Resp***.

22.7 Changing the Anesthetic Agent

When the anesthetic agent used on the patient is changed, the AG module can detect the mixed anesthetic gas during the transition of two anesthetic agents. The time required for completing the replacement of anesthetic agent depends on anesthesia type (low flow or high flow) and the characteristics of anesthetic agents (pharmacokinetics). During the transition of two anesthetic agents, the patient monitor gives no prompt messages and the MAC value displayed may be inaccurate.

The AG module can identify two anesthetic agents automatically. When the proportion of the primary and secondary anesthetic agents in the mixture changes, the AG module can distinguish between them according to their contributions to the MAC value. Then the primary and secondary anesthetic agents will be exchanged for display.

22.8 Measurement Limitations

The following factors may influence the accuracy of measurement:

- Leaks or internal venting of sampled gas
- Mechanical shock
- Cyclic pressure up to 10 kPa (100 cmH_2O)
- Other sources of interference, if any

22.9 Troubleshooting

22.9.1 When the Gas Inlet is Blocked

If the gas inlet (including watertrap, sampling line and airway adapter) is occluded by condensed water, the message [**AG Airway Occluded**] will appear.

To remove the occlusion:

- Check the airway adapter for an occlusion and replace if necessary.
- Check the sampling line for an occlusion or kinking and replace if necessary.
- Check the watertrap for a build up of water. Empty the watertrap. If the problem persists, replace the watertrap.

22.9.2 When an Internal Occlusion Occurs

Condensed water may enter the module and cause contamination and/or internal occlusions. In this case, the message [**AG Airway Occluded**] will be displayed.

To remove the occlusion:

- Check for any occlusion in the gas inlet and/or outlet system.
- If the problem persists, internal occlusions may exist. Contact your service personnel.

22.10 Removing Exhaust Gases from the System

⚠WARNING

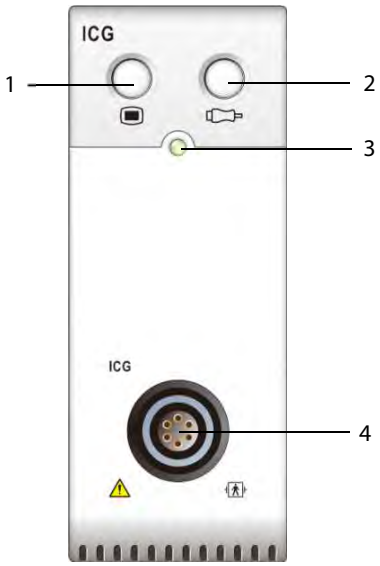
- **When using the AG measurement on patients who are receiving or have recently received anesthetics, connect the outlet to a scavenging system to avoid exposing medical staff to anesthetics.**

To remove the sample gas to a scavenging system, connect an exhaust tube to the gas outlet connector of the module.

23 Monitoring ICG

23.1 Introduction

Impedance cardiography (ICG) measures a patient's hemodynamic status using a safe, non-invasive method based on thoracic electrical bioimpedance (TEB) technology. ICG uses four pairs of sensors to transmit a small electrical signal through the thorax. As velocity and volume of blood in the aorta change, the ICG measures the changes in impedance from systole to diastole to calculate hemodynamic parameters.



1. Open/Close the [**ICG Setup**] menu 2. Check the sensor 3. Indicator 4. ICG patient cable connector

23.2 Safety Information

⚠WARNING

- **Apply ICG monitoring only to patients in height of 122 to 229 cm, weight of 30 to 155 kg, and in age no less than 13.**
- **ICG monitoring should not be used concurrently on patients with minute ventilation pacemakers when the MV sensor function is activated.**
- **The ICG module is not intended to be used while exposing the patient to high frequency current.**

⚠CAUTION

- **During ICG monitoring, make sure that the conductive paste on the ICG sensors never come into contact with other conductive parts.**

23.3 ICG Limitations

The measurement accuracy may be compromised when patients present with the following conditions or anomalies:

- Septic shock
- Aortic valve regurgitation and defect of septum
- Severe aortic sclerosis or aortic prosthesis
- Severe hypertension (MAP > 130 mmHg)
- Cardiac arrhythmia
- Tachycardia with a heart rate higher than 200 bpm
- The patient's weight and height are out of range: patient heights below 120 cm (48") or above 230 cm (90"), and patient weights less than 30 kg (67 lbs.) or greater than 155 kg (341 lbs.)）
- Aortic balloon or aortic balloon pump
- Patient movement
- Signal interference from cable connections and/or power cords.
- During operations on the opened thorax the current distribution can be distorted and can lead to inaccuracies.
- Simultaneous use of electrical cautery systems during surgical procedures

NOTE

- **The ICG module allows the examination of adult patients in a resting position. The measured parameters can be used only if the ICG waveform has sufficient signal quality and is without artefact.**

23.4 Understanding ICG Parameters

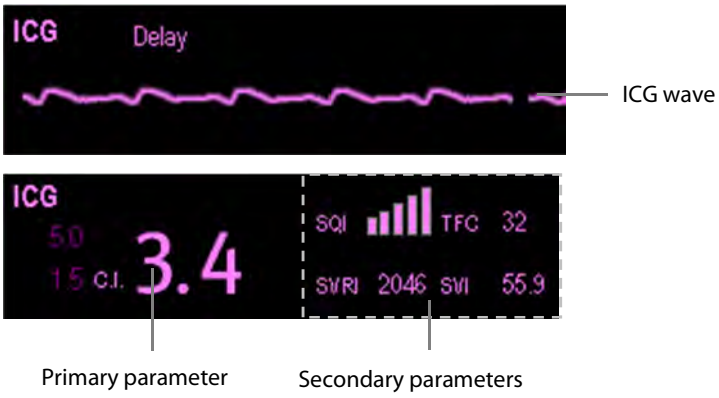
By selecting the ICG parameter window→[**ICG Setup**]→[**Hemodynamic Parameters >>**], you can view the hemodynamic parameters for evaluation of the patient's hemodynamic status.

Abbreviation	Full spelling	Unit
ACI	acceleration index	/100s^2
VI	velocity index	/1000s
PEP	pre-ejection period	ms
LVET	left ventricular ejection time	ms
TFI	thoracic fluid index	Ω
TFC	thoracic fluid content	/kΩ
HR	heart rate	bpm

Abbreviation	Full spelling	Unit
BSA	body surface area	m^2
C.O.	cardiac output	L/min
C.I.	cardiac index	$L/min/m^2$
SV	stroke volume	ml
SVI	stroke volume index	ml/m^2
SVR	systemic vascular resistance	DS/cm^5
SVRI	systemic vascular resistance index	$DS·m^2/cm^5$
PVR	pulmonary vascular resistance	DS/cm^5
PVRI	pulmonary vascular resistance index	$DS·m^2/cm^5$
LCW	left cardiac work	kg·m
LCWI	left cardiac work index	$kg·m/m^2$
LVSW	left ventricular stroke work	g·m
LVSWI	left ventricular stroke work index	$g·m/m^2$
STR	systolic time ratio	无
VEPT	volume of electrically participating tissue	ml

23.5 ICG Display

The ICG monitoring provides a continuous display of the impedance waveform and five numerics. Of five numerics, one is the primary parameter C.I. and the other four are secondary parameters.



23.6 Preparing to Monitor ICG

To prepare to monitor ICG, follow this procedure:

1. Prepare the patient's skin. Refer to section ***23.6.1 Preparing the Skin***.
2. Place the ICG sensors on the patient. Refer to section ***23.6.2 Placing the ICG Sensors***.
3. Connect one end of the patient cable to the ICG module.
4. Connect the electrode wires of the patient cable to the sensors on the patient by matching the right and left electrode wire colors and numbers. Refer to the section ***23.6.3 Connecting the ICG Patient Cable***.
5. Enter the patient information. Refer to section ***23.7.2 Changing the Patient Information***.

⚠WARNING

- **Before monitoring patients with pacemakers, ensure that the function of the pacemaker cannot be influenced by the measuring current used for impedance cardiography. In the case of minute ventilation pacemakers the use of the ICG module is not allowed if the minute ventilation function of the pacemaker is activated.**

23.6.1 Preparing the Skin

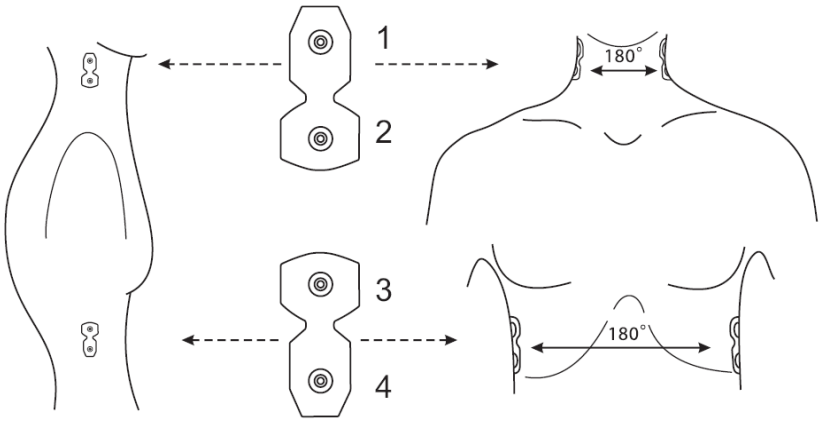
Good sensor-to-skin contact is important for good signal quality. Before applying the sensors, clean the application site of oil and dirt and avoid placing the sensors over excessive body hair or lesions. Insufficient cleaning of the skin can cause high skin impedance which could cause the stimulation to stop.

To properly prepare the skin, follow this procedure:

1. Select sites with intact skin, without lesion of any kind.
2. Shave hair from skin at chosen sites.
3. Gently rub skin surface at sites to remove dead skin cells.
4. Thoroughly cleanse the site with a mild soap and water solution.
5. Dry the skin completely before applying the sensors.

23.6.2 Placing the ICG Sensors

Appropriate sensor placement is important for good signal quality and accurate measurements. Attach ICG sensors to the patient as shown below:



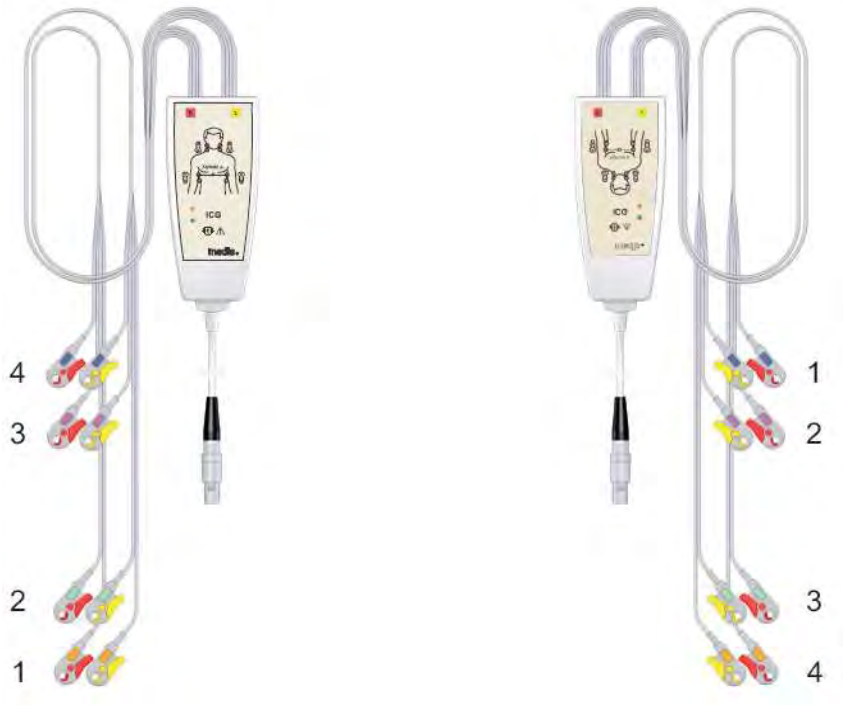
1. Place two sensors on each side of the neck: one is at the base (or root) of the neck and the other is directly superior and in line with the earlobe.
2. Place two sensors on each side of the thorax: one is at the level with the xyphoid process and the other is directly inferior and in line with the midaxillary line.

CAUTION

- **Each pair of sensors should be opposite directly to each other (180°) as shown in the figure above.**
- **The sensors must not have a direct contact to other electrically conductive materials.（Medis ICG spec V124 p10）**
- **Only use disposable ICG sensors.**

23.6.3 Connecting the ICG Patient Cable

The ICG patient cable is used to connect the ICG module and the sensors on the patient. The left electrode wires (yellow-colored) and right electrode wires (red-colored) should be connected with the patient sensors by matching the numbers. See section ***23.6.2Placing the ICG Sensors*** for details.



The ICG patient cable contains a small box, which includes a cable splitter with integrated electronics. On the outside of the box two small LEDs (green and orange) display the current function of the patient cable, as indicated below:

Green	Orange	Description of function
●	○	Measurement is running; sensor contact is good
○	○	The electronic part of the patient cable is not connected with the power supply; cable is disconnected or the device is switched off (Power down mode)
☼	○	Patient cable is ready to use, but the measurement has not been started
○	☼	Patient cable has power but the software cannot access the cable; software has not been started or is not ready for measurement
●	●	Insufficient contact between sensors and patient: at least one lead wire is disconnected or not properly fixed; sensors are too dry (new sensors are necessary)

Legend: ○LED off ☼ LED flashing ●LED on

23.7 Changing ICG Settings

23.7.1 Changing the ICG Alarm Settings

To change the ICG alarm settings, follow this procedure:

1. Select the ICG parameter window or waveform area to access the [**ICG Setup**] menu.
2. Select [**Alarm Setup >>**].
3. Set the alarm properties of C.I. and TFC.

23.7.2 Changing the Patient Information

To change the patient information, follow this procedure:

1. Select the ICG parameter window or waveform area to access the [**ICG Setup**] menu.
2. Select [**Patient Demographics >>**].
3. Set [**Height**], [**Weight**], [**Gender**], [**Age**] and [**Paced**] of the patient.
3. Enter the measurements of [**Art Sys**], [**Art Dia**], [**Art Mean], [CVP**], [**PAWP**], and [**PA Mean**] if the system fails to automatically obtain these measurements. For example, measurements of CVP, PA mean and Art mean can be obtained from the IBP measurements. If measurement of Art mean is unavailable from the IBP module, it can also be obtained from the NIBP measurements (mean pressure). If it is unavailable from the NIBP module, you should enter the Art mean manually.

23.7.3 Changing the Wave Sweep Speed

To set the sweep speed of ICG waveform, follow this procedure:

1. Select the ICG parameter window or waveform area to access the [**ICG Setup**] menu.
2. Set [**Sweep**].

23.7.4 Selecting ICG Parameters

The ICG parameter area displays one primary parameter (C.I. by default) and four secondary parameters (SVRI, SVI , C.O. and TFC by default). You can also select your desired primary and secondary parameters for display.

1. Select the ICG parameter window or waveform area to access the [**ICG Setup**] menu.
2. Select [**Select Parameter >>**]
3. Select the parameters to be displayed.

FOR YOUR NOTES

24 Monitoring BIS

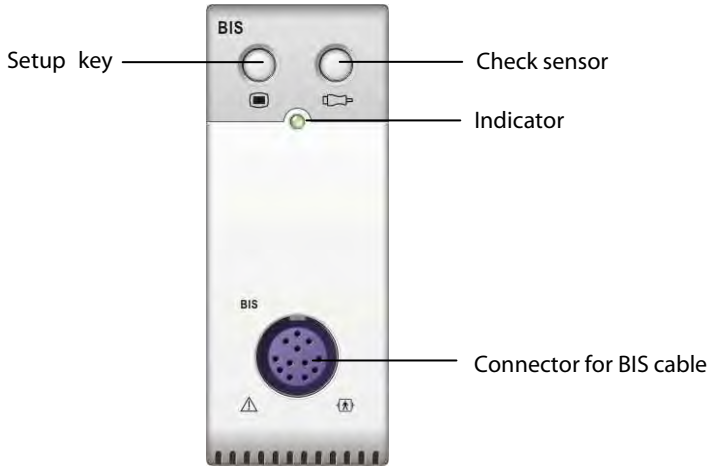
24.1 Introduction

Bispectral index (BIS) monitoring is for use on adult and pediatric patients within a hospital or medial facility providing patient care to monitor the state of the brain by data acquisition of EEG signals.

The BIS, a processed EEG variable, may be used as an aid in monitoring the effects of certain anesthetic agents. Use of BIS monitoring to help guide anesthetic administration may be associated with the reduction of the incidence of awareness with recall during general anesthesia or sedation.

BISx is for brain's single side BIS monitoring. BISx4 is for brain's single side or both sides BIS monitoring. BISx4 can be used for brain's both sides BIS monitoring only when BIS Bilateral Sensor is connected.

The BISx or BISx4 equipment must be used under the direct supervision of a licensed healthcare practitioner or by personnel trained in its proper use.



24.2 Safety Information

For patients with neurological disorders, patients taking psychoactive medication, and children below the age of 1 year, BIS values should be interpreted cautiously.

⚠WARNING

- **The conductive parts of sensors and connectors should not come into contact with other conductive parts, including earth.**
- **To reduce the hazard of burns in the high-frequency surgical neutral electrode connection, the BIS sensor should not be located between the surgical site and the electro-surgical unit return electrode.**
- **To reduce the hazard of burns during use of brain-stimulating devices (e.g., transcranial electrical motor evoked potential), place stimulating electrodes as far as possible from the BIS sensor and make certain that sensor is placed according to package instructions.**
- **The BIS sensor must not be located between defibrillator pads when a defibrillator is used on a patient connected to the patient monitor.**
- **The BIS component using on our monitor is purchased from Aspect Medical System. It is important to recognize this index is derived using solely that company's proprietary technology. Therefore, it is recommended that clinicians have reviewed applicable information on its utility and/or risks in published articles and literature/web site information from Aspect Medical Systems, Inc. or contact that company itself at www.aspectmedical.com, if you have clinical-based BIS questions relating to this module portion of the patient monitor. Failure to do so could potentially result in the incorrect administration of anesthetic agents and/or other potential complications of anesthesia or sedation. We recommend that clinicians also review the following practice advisory (that includes a section on BIS monitoring): The American Society of Anesthesiologists, Practice Advisory for Intraoperative Awareness and Brain Function Monitoring (Anesthesiology 2006;104:847-64). Clinicians are also recommended to maintain current knowledge of FDA or other federal-based regulatory, practice or research information on BIS and related topics.**
- **The Bispectral Index is a complex technology, intended for use only as an adjunct to clinical judgment and training.**
- **The clinical utility, risk/benefit and application of the BIS component have not undergone full evaluation in the pediatric population.**

24.3 Understanding the BIS Display

24.3.1 BIS Parameter Area

For brain's single side BIS monitoring, the BIS parameter area displays the following parameters:

1. Bispectral Index (BIS)

   The BIS numeric reflects the patient's level of consciousness. It ranges from 100 for wide awake to 0 in the absence of brain activity.

BIS numeric	Description
100	The patient is widely awake.
70	The patient is underdosed but still unlikely to become aware.
60	The patient is under general anesthesia and loses consciousness.
40	The patient is overdosed and in deep hypnosis.
0	The EEG waveform is displayed as a flat line, and the patient has no electrical brain activity.

2. Electromyograph (EMG)

   EMG bar graph reflects the electrical power of muscle activity and high frequency artifacts. The power range is 30-55 dB. When the EMG indicator is low, it indicates that EMG activity is low. BIS monitoring conditions are optimal when the bar is empty.

   1 bar represents power in the 31-35 range.

   2 bars represent power in the 36-40 range.

   3 bars represent power in the 41-45 range.

   4 bars represent power in the 46-50 range.

   5 bars represent power greater than 51.

   - EMG>55 dB: this is an unacceptable EMG.
   - EMG<55 dB: this is an acceptable EMG.
   - EMG≤30 dB: this is an optimal EMG.

3. Suppression Ratio (SR)

   SR numeric is the percentage of time over the last 63-second period during which the EEG is considered to be in a suppressed state.

4. Spectral Edge Frequency (SEF)

   The SEF is a frequency below which 95% of the total power is measured.

5. Signal Quality Index (SQI)

   The SQI numeric reflects signal quality and provides information about the reliability of the BIS, SEF, TP, and SR numerics during the last minute. Signal quality is optimal when all five bars of the SQI icon are filled with color. SQI ranges from 0-100%.

   1 bar represents SQI in the 1%-20% range.

   2 bars represent SQI in the 21%-40% range.

   3 bars represent SQI in the 41%-60% range.

   4 bars represent SQI in the 61%-80% range.

   5 bars represent SQI in the 81%-100% range.

   - 0 to 15%: the numerics cannot be derived.
   - 15% to 50%: the numerics cannot be reliably derived.
   - 50% to 100%: the numerics are reliable.

6. Total Power (TP)

   TP numeric which only monitors the state of the brain indicates the power in the frequency band 0.5-30Hz. The useful range is 40-100db.

7. Burst Count (BC)

   A burst means a period (at least 0.5 second) of EEG activity followed and preceded by inactivity. The BC numeric helps you quantify suppression by measuring the number of EEG bursts per minute. This parameter is intended for the BIS module with the Extend Sensor or Bilateral Sensor only. BC numeric is valid only when SQI≥15% and SR≥5%.

For brain's both sides BIS monitoring, the BIS parameter area displays the following parameters (L: Left brain hemisphere; R: Right brain hemisphere):

1. BIS L BIS R
2. EMG L EMG R
3. SR L SR R
4. SEF L SEF R
5. SQI L SQI R
6. TP L TP R
7. BC L BC R
8. sBIS L sBIS R

sBIS (BIS Variability Index)

This numeric represents the standard deviation of the BIS variable over the last three minutes.

9. sEMG LsEMG R

sEMG (EMG Variability Index)

This numeric represents the standard deviation of the EMG value over the last three minutes.

10. ASYM

Asymmetry (ASYM) is a processed variable indicating the percentage of EEG power present in left or right hemispheres with respect to total (left and right) EEG power.

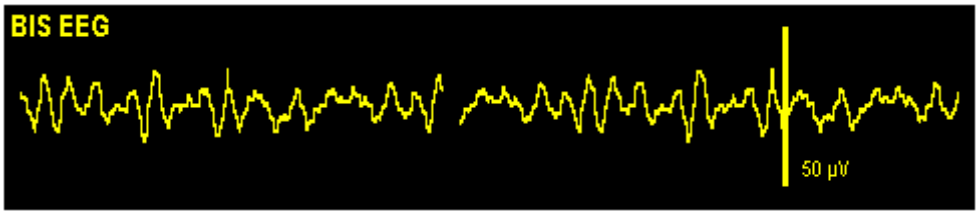
Designation 'L' of the asymmetry data indicates asymmetry to the left side.

Designation 'R' of the asymmetry data indicates asymmetry to the right side.

24.3.2 BIS Waveform Area

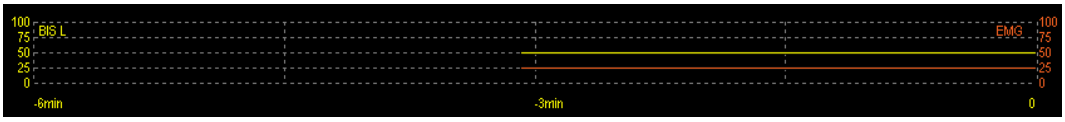
The BIS waveform area allows you to view either EEG waveform or BIS trend. A secondary parameter's trend line can also be displayed together with BIS trend line.

1. Enter the [**BIS Setup**] menu.
2. Select [**Display**] and then select the desired option.
   - [**EEG**]



   - [**BIS Trend**]

   - The available options for BIS trend superimpose display include: [**BIS+EMG Trend**], [**BIS+SQI Trend**], [**BIS+SR Trend**], [**BIS L+R Trend**], [**BIS+BC Trend**], [**BIS+sBIS Trend**] or [**BIS+sEMG Trend**], depending on the sensor type.

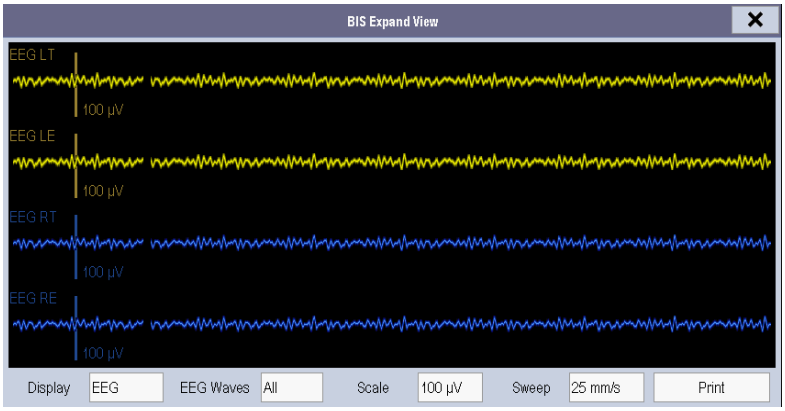


24.3.3 BIS Expand View

When BIS Bilateral Sensor is used for bilateral monitoring, BIS expand view can be displayed.

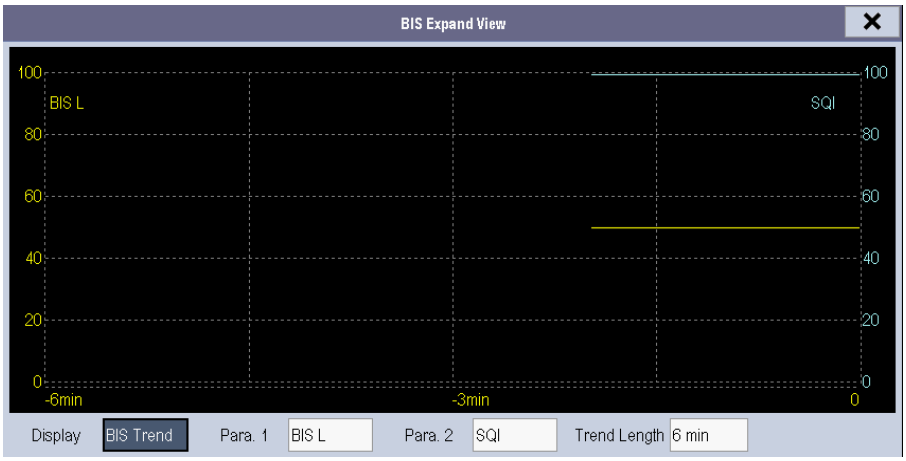
1. Enter the [**BIS Setup**] menu.
2. Select [**BIS Expand View >>**].
3. Select [**Display**] and then toggle between [**EEG**], [**BIS Trend**] and [**DSA**].

24.3.3.1 Displaying EEG Waveforms



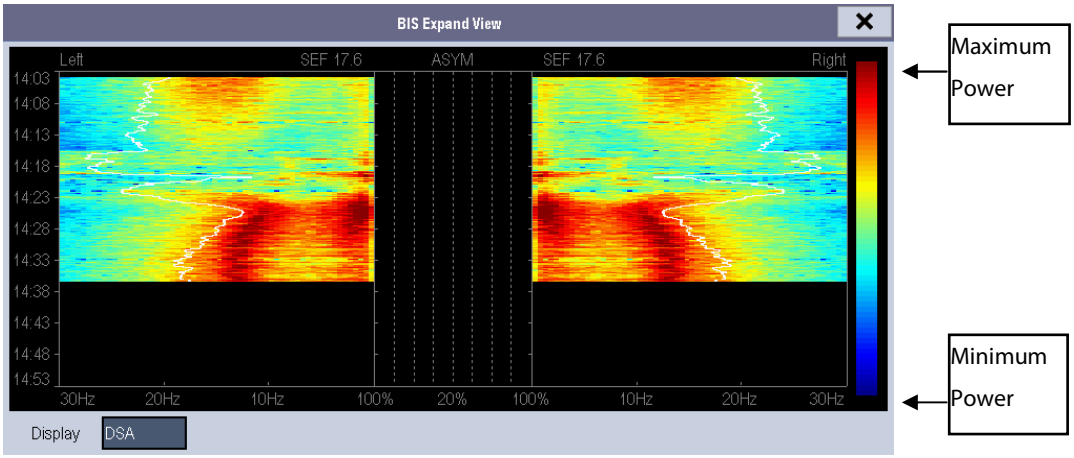
You can select the EEG waveforms to be displayed. You can also select the desired scale and sweep speed.

24.3.3.2 Displaying BIS Trend



You can the desired trend lines to be displayed and set the time scale. The artifact mark is displayed at the bottom to indicate SQI value. When SQI<15%, the artifact mark is yellow and the corresponding trend lines of BIS, SR, BC and sBIS are not displayed. When 15%≤SQI<50%, the artifact mark is brown.

24.3.3.3 Displaying DSA



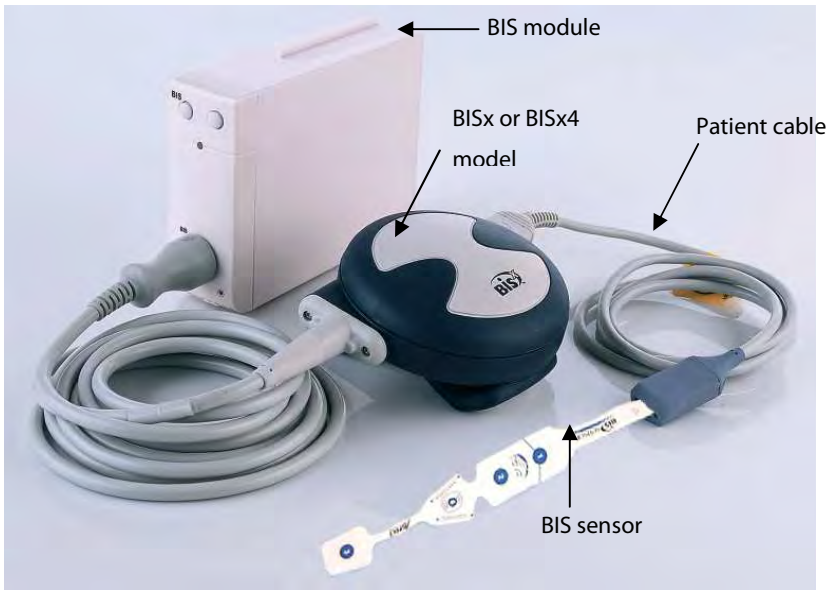
The Density Spectral Array (DSA) shows changes in the power spectrum distribution over a certain time period. The DSA represents the power spectra ranging from 49-94 dB. The color bar to the right of the time scale shows the range of colors used to indicate minimum and maximum power. The frequency scale is shown on the horizontal axis with a range from 0-30 Hz.

A white Spectral Edge line is superimposed on the graph where 95% of the total power lies on one side of the line (toward the inside of the graph) and 5% lies on the other. The Spectral Edge Frequency value (SEF) displays above the graph.

The ASYM graph in the center of the screen shows the degree of asymmetry in EEG power between the left and right hemispheres. The ASYM scale begins at 20% at the center line and runs left or right to 100%. Asymmetry data less than 20% are not displayed on the graph, but are available in the tabular trends.

24.4 Setting up the BIS Measurement

1. Connect the BISx or BISx4 model to the BIS module.



2. Use the attachment clip to secure the BISx or BISx4 model near, but not above the level of the patient's head.
3. Connect the BISx or BISx4 model to the patient cable.
4. Attach the BIS sensor to the patient following the instructions supplied with sensor.

NOTE

- **Make sure the patient's skin is dry. A wet sensor or a salt bridge could result in erroneous BIS and impedance values.**

5. Connect the BIS sensor to the patient interface cable.

⚠CAUTION

- **Do not use if sensor is dry. To avoid dry out, do not open pack until ready for use. Due to intimate skin contact, reuse may pose risk of infection. If skin rash or other unusual symptom develops, stop use and remove. Limited to short-term use (maximum of 24 hours). Do not cut sensor components, as this can result in improper operation.**

24.5 Auto Impedance Check

By default, this check is switched on. It checks:

- The combined impedance of the signal electrodes plus the reference electrode. This is done automatically and continuously and does not affect the EEG wave. As long as the impedances are within the valid range, there is no prompt message of this check or its results.
- The impedance of the ground electrode. This is done every ten minutes and takes approximately four seconds. It causes an artifact in the EEG wave, and the message [**BIS Ground Checking**] is displayed on the monitor during the check. If the ground electrode does not pass this check, another check is initiated. This continues until the ground electrode passes the check.

If the auto impedance check interferes with other measurements, it can be switched off. To do this:

1. Select [**Sensor Check**] in the [**BIS Setup**] menu to open the sensor check window.
2. Set [**Automatic Check**] to [**Off**].

⚠CAUTION

- **Switching the auto impedance check off will disable automatic prompt to the user of impedance value changes, which may lead to incorrect BIS values. Therefore, this should only be done if the check interferes with or disturbs other measurements.**

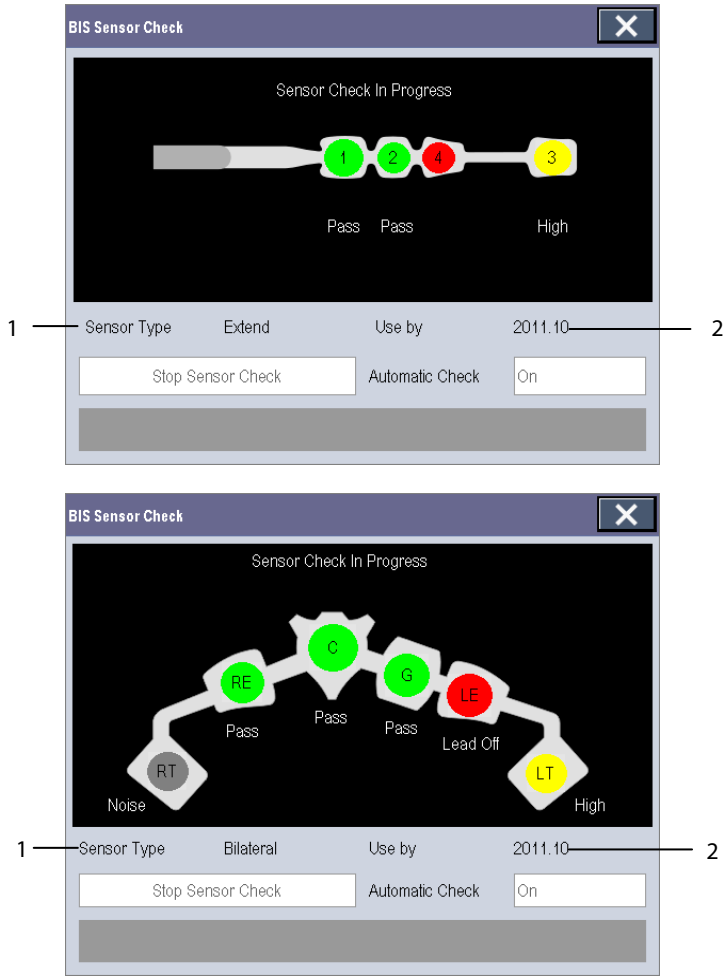
24.6 Sensor Check

This measures the exact impedance of each individual electrode. It causes a disturbed EEG wave, and a prompt message is displayed on the monitor

- The sensor check is automatically initiated when a sensor is connected. To manually start a sensor check, you can either:
  - Press the hardkey on the BIS module.
  - Select [**Sensor Check**] in the [**BIS Setup**] menu.
  - Select [**Start Sensor Check**] in the BIS sensor window.
- The sensor check stops automatically if the impedances of all electrodes are within the valid range. To manually stop a sensor check, you can either:
  - Press the hardkey on the BIS module.
  - Select [**Stop Sensor Check**] in the sensor check window.

24.7 BIS Sensor Check Window

To open the sensor check window, select [**Sensor Check**] in the [**BIS Setup**] menu. The graphic in the BIS sensor check window automatically adapts to show the type of sensor you are using, show each electrode as required. Each symbol in the graphic represents an electrode and illustrates the most recently-measured impedance status of the electrodes.



1. Sensor Type 2. Expiration Time or Usable Times

Different colors indicate different statuses. The electrode status is displayed below each electrode:

Color	Status	Description	Action
Red	[**Lead Off**]	Electrode falls off and has no skin contact	Reconnect electrode, or check the sensor-to-skin contact. If necessary, clean and dry skin.
Grey	[**Noise**]	The EEG signal is too noisy. Impedance cannot be measured	Check the sensor-to-skin contact. If necessary, clean and dry skin.
Yellow	[**High**]	The impedance is above the limit	
Green	[**Pass**]	The impedance is within valid range	No action necessary.

Although BIS may still be measured when the electrode status is [**Noise**] or [**High**], for best performance, all electrodes should be in [**Pass**] status.

24.8 Choosing the BIS Smoothing Rate

To change the smoothing rate:

1. Select the BIS parameter window to enter the [**BIS Setup**] menu.
2. Select [**Smoothing Rate**] and then toggle between [**10 s**], [**15 s**] and [**30 s**]

The smoothing rate defines how the monitor averages the BIS value. With the smoothing rate becoming smaller, the monitor provides increased response to changes in the patient's state. Contrarily, the monitor provides a smoother BIS trend with decreased variability and sensitivity to artifacts.

NOTE

- **When [Smoothing Rate] is set as [10 s] or [30 s], sBIS and sEMG are displayed as invalid values.**

24.9 Changing the Secondary Parameters

You can choose the desired secondary parameters for display on the screen.

1. Enter the [**BIS Setup**] menu.
2. Select [**Change Secondary Parameter**>>] and then select at most 2 desired parameters from the popup menu.

24.10 Changing the EEG Wave Size

1. Enter the [**BIS Setup**] menu.
2. Select [**EEG**] from [**Display**].
3. Select [**Scale**] and then select the appropriate setting.

24.11 Changing the Speed of the EEG Wave

1. Enter the [**BIS Setup**] menu.
2. Select [**EEG**] from [**Display**].
3. Select [**Sweep**] and then select the appropriate setting. The faster the wave sweeps, the wider the wave is.

24.12 Setting the Trend Length

1. Enter the [**BIS Setup**] menu.
2. Select a BIS trend option from [**Display**].
3. Select [**Trend Length**] and then select the appropriate BIS time length setting.

24.13 Switching the Filter On or Off

1. Enter the [**BIS Setup**] menu.
2. Select [**Filter**] and then toggle between [**On**] and [**Off**]. The default is [**On**].

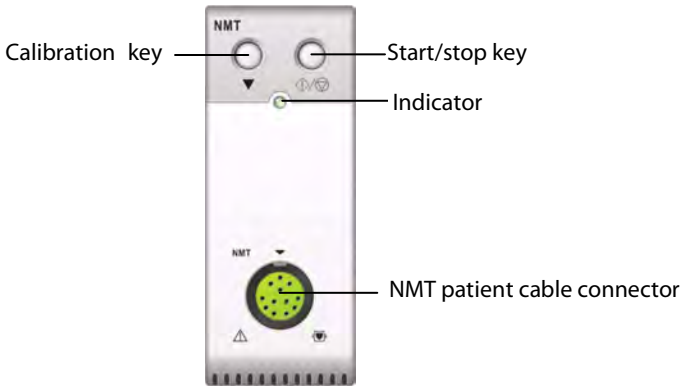
The filter screens out undesirable interference from the raw EEG wave display. The notch filter includes filters for both 50 and 60 Hz. Filter settings do not affect processing of the trend variables (i.e., BIS, EMG, and SR).

FOR YOUR NOTES

25 Monitoring NMT (from Mindray NMT Module)

25.1 Introduction

The neuromuscular transmission (NMT) module evaluates muscle relaxation of patients under neuromuscular block by measuring the strength of muscle reaction after electrically stimulating the dedicated motor nerve. The electrodes are placed on the patient's skin over dedicated nerve, a controllable current source delivers stimulation pulses to two skin surface electrodes for the nerve stimulation, and the muscle response is measured with an acceleration sensor.



25.2 Safety

⚠WARNING

- **The NMT measurement is not intended for neonatal patients.**
- **The NMT stimulation should not be applied across or through the head, directly on the eyes, covering the mouth, on the front of the neck, especially the carotid sinus, or from electrodes placed on the chest and the upper back or cross over the heart.**
- **Application of electrodes near the thorax may increase the risk of cardiac fibrillation.**
- **Never apply electrodes to patients in areas where inflammation or injury is evident.**
- **When you are connecting the electrodes or the patient cable, make sure that the connectors do not touch any electrically conductive material including earth.**
- **Patients with nerve damage or other neuromuscular problems may not respond properly to stimulation. The NMT measurement may show unusual patterns when monitoring muscle paralysis in these patients.**
- **NMT stimulation current pulses may interfere with other sensitive equipment, for example, implanted cardiac pacemakers. Do not use the NMT measurement on patients with implanted medical devices unless so directed by a medical specialist.**
- **Simultaneous use of the NMT with high frequency electrosurgical equipment (ESU) may result in burns at the stimulation site and can also adversely affect measurement accuracy. Make sure the ESU return electrode is properly applied to the patient.**

⚠WARNING

- **Do not use the NMT in close proximity to shortwave or microtherapy devices, there is a risk of adversely affecting the NMT measurement.**
- **Never touch the electrodes unless the stimulation has been stopped.**
- **Check each time before use that the material insulating the NMT sensor and the stimulation cable is intact and does not show signs of wear and tear.**
- **Do not use in the presence of flammable anesthetics or gases, such as a flammable anesthetic mixture with air, oxygen or nitrous oxide. Use of the device in such an environment may present an explosion hazard.**

⚠ CAUTION

- **NMT monitoring is intended as an adjunct in patient assessment and must be used in conjunction with observation of clinical signs and symptoms.**
- **NMT stimulation can be painful to a non-sedated patient. It is recommended not to stimulate before the patient is adequately sedated.**
- **Pay special attention to current densities exceeding 2 mA r.m.s/cm2 for any electrodes.**

25.3 Stimulation Modes

The NMT module provides the following stimulation modes. Some stimulation modes require a minimum neurophysiological recovery time and during this recovery phase no new stimulation can be started. So you cannot start a measurement or calibration.

25.3.1 Train-Of-Four (TOF)

TOF mode is recommended for most cases. It is also the factory default setting.

In Train of Four stimulus mode, four stimulation pulses are generated at 0.5 second intervals. Each stimulation of the train causes the muscle to contract. The fade in the individual response to each single stimulation provides a basis for evaluation. The response is measured after each stimulus and the ratio of the fourth to the first response of the TOF sequence is calculated resulting in TOF-Ratio.

When relaxation deepens, the TOF% declines until the fourth response disappears and no TOF% is calculated.
When no TOF% is available, the degree of neuromuscular block is estimated from the number of responses or TOF Counts. The fewer the response count is detected, the deeper is the relaxation.

If NMT calibration establishes the reference response amplitude, response to the first stimulus (T1) as percentage of the reference value is calculated resulting in T1%.

In TOF mode, the minimum neurophysiological recovery time is 10 seconds. If NMT measurement or calibration is initiated during this period, it will be automatically delayed.

25.3.2 Single Twitch (ST)

In single twitch (ST) stimulation, the module sends a single electrical pulse and measures the strength of the resulting twitch, the module then calculates the ratio of measured response to the reference twitch resulting in ST-Ratio.

ST mode is practical when using depolarizing relaxants since TOF% does not give any additional information about the patient status. Additionally, when the change of patient's relaxation level is considered, ST stimulation at a frequency of 1 Hz can indicate the relaxation change in a more real-time way.

25.3.3 Post-Tetanic Count (PTC)

When neuromuscular block deepens, different parameters are needed to measure the response. At first, when the response to the fourth TOF stimulation pulse disappears or the first twitch is very weak, the TOF% is not available and only the number of detected counts can be observed. When stimulation pulses no longer give any stimulation response, you do not get the TOF count either. To monitor the relaxation level, you can start tetanic stimulation and estimate the relaxation level from the Post Tetanic Count (PTC).

PTC stimulation mode starts with a sequence of four current pulses delivered at at2 Hz. If a muscle response is detected, the PTC sequence is stopped and the TOF result is reported. If there is no muscle response, the sequence continues with a five seconds long tetanic stimulation delivered at 50 Hz, followed by a pause of 3 seconds, followed by 20 single current pulses delivered at 1 Hz. The number of detected responses is counted and expressed as PTC. The fewer responses are detected, the deeper is the relaxation.

After tetanic stimulation, NMT measurements and calibration are disabled for 20 seconds and PTC is disabled for 2 minutes.

25.3.4 Double-Burst Stimulation (DBS)

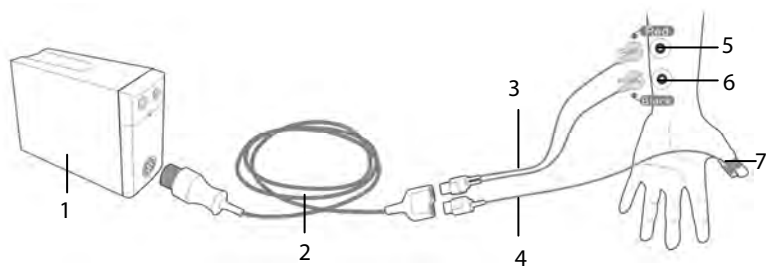
Double Burst Stimulation (DBS) enables better visual observing of the fading in the responses. DBS consists of two separate bursts at an interval of 750 ms, where each burst consists of certain pulses directly after each other at a frequency of 50 Hz. The response ratio of the second to the first burst is calculated resulting in DBS-Ratio, while the number of responses is detected and expressed as DBS Count.

The module supports DBS 3.2 and DBS 3.3. For DBS3.2 mode, the first burst consists of 3 consecutive pulses, and the second burst consists of 2 consecutive pulses. For DBS3.3 mode, both bursts consist of 3 consecutive pulses.

In DBS mode, the minimum neurophysiological recovery time is 15 seconds. If NMT measurement or calibration is initiated during this period, it will be automatically delayed.

25.4 Preparing for NMT Measurement

To take NMT measurement, connect the NMT patient cable to the NMT module. The following picture shows NMT cable and patient connection.



1. NMT module
2. NMT patient cable
3. NMT stimulation cable
4. NMT sensor cable
5. Proximal electrode
6. Distal electrode
7. NMT sensor

25.4.1 Skin Preparation

Good electrode-to-skin contact is important for good signal quality. Before applying the electrodes, clean the application site of oil and dirt and avoid placing the electrodes over excessive body hair or lesions. Insufficient cleaning of the skin can cause high skin impedance which could cause the stimulation to stop.

To properly prepare the skin:

1. Select sites with intact skin, without lesion of any kind.
2. Clip or shave hair from application sites as necessary.
3. Thoroughly clean the sites with mild soap and water, leaving no soap residue.
   We do not recommend using ether or pure alcohol because this dries the skin and increases the impedance.
4. Dry the skin thoroughly.

⚠WARNING

- **The NMT measurement is not intended for neonatal patients.**

25.4.2 Placing the Electrodes and Sensor

Stimulation of the ulnar nerve in the wrist and acceleration measurements at the adductor pollicis is preferred for routine monitoring.

When monitoring neuromuscular transmission, round surface electrodes with snap connection are a must. Small (pediatric or neonatal) electrodes are advisable to obtain a sufficient current density. In order to ensure a steady signal quality, be sure only to use CE marked electrodes.
Ensure that the thumb can move freely before applying NMT electrodes and sensor. Follow this procedure to place the electrodes and sensor.

1. Place the distal electrode near the wrist.
2. Place the proximal electrode 2 to 3 cm proximal of the distal electrode.
3. Attach the red cable clamp cable to the proximal electrode.
4. Attach the black cable clamp cable to the distal electrode.
5. Affix the sensor with its large flat side against the palmar side of the thumb with a piece of tape. The cable should be attached in such a way that it does not 'pull' at the sensor and that movement of the thumb is not obstructed.

The arm used for the NMT measurement should be kept immobile during the whole procedure.

⚠ CAUTION

- **To avoid unintentional electrical shocks always make sure that the NMT stimulation has been stopped before touching the electrodes.**
- **Take care to handle the the NMT sensor, avoiding forcefully striking the sensor.**
- **After repositioning the patient, check that the sensor is still applied and that the thumb can move freely.**

NOTE

- **Correct positioning of the electrodes is important. Small displacements may result in considerable changes in stimulation current requirements. Furthermore, the electrodes must be positioned in such a way to avoid direct stimulation of the muscle.**
- **The electrodes should be applied properly to the patient skin. It has been found that slight pressure on the electrodes may improve the stimulation considerably. Therefore, taping the electrodes to the skin may be advisable.**
- **The more distal the sensor is placed on the thumb, the stronger the acceleration signal. This effect can be used to adjust the signal strength.**

25.5 Accessing the NMT Setup Menu

You can access the [**NMT Setup**] menu by selecting the NMT area.

The [**NMT Setup**] menu enables you to perform calibration, and provides quick start to NMT measurements. You can also access the following menu by selecting [**Setup >>**].

25.6 Calibrating the NMT Measurement

The size of the sensor signal varies from patient to patient. NMT calibration determines supramaximal stimulation current and the reference response amplitude. The reference response amplitude is the twitch at the supramaximal stimulation current when the patient is not paralyzed. The calibration must be done prior to administration of a muscle relaxant drug.

If [**Stimulation Current**] is set to [**Supra (60 mA)**], the module automatically searches for supramaximal current to determine the reference response amplitude. If a value between 0 and 60 mA is selected, the reference response amplitude is determined using the selected stimulation current. For adults, the supramaximal current is usually between 35 and 55 mA.

To starting calibration,

1. Check that settings of [**Stimulation Current**] and [**Pulse Width**] are correct from the [**NMT Setup**] menu.
2. Press the Calibration key on the NMT module, or select [**Calibrate**] from the [**NMT Setup**] menu.

If calibration failed, the NMT module automatically use the default value as the reference amplitude.

NOTE

- **It is recommended that the patient be anesthetized before setting up the calibration twitch as nerve stimulation can be painful.**
- **Changing the stimulation current or pulse width after calibration invalidates the stored reference data, and therefore recalibration is required.**

25.6.1 Starting/Stopping NMT Measurements

To Start NMT measurements,

- Press the Start/stop key on the NMT module, or
- Select the [**Start NMT**] key from the [**NMT Setup**] menu, or
- Select the shortcut key of desired stimulation mode, [**ST 0.1HZ**], [**ST 1HZ**], [**TOF**], [**ST**], [**DBS**], or [**PTC**], from the left side of the [**NMT Setup**] menu.

To Stop NMT measurements, press the Start/stop key on the NMT module, or select [**Stop all NMT**] in the [**NMT Setup**] menu. The measurement is interrupted immediately.

If you need to change the NMT settings after startup, stop the measurements, change the settings, and then restart the measurements.

NOTE

- **Take care when removing the sensor from the patient. Do not pull on the cable.**

25.7 Change NMT Measurement Settings

From the [**NMT Setup**] menu, you can change stimulation related settings.

25.7.1 Changing Stimulation Mode

The module provides four stimulation modes: TOF, ST, DBS, and PTC, see ***25.3 Stimulation Modes*** for detail.

In the [**NMT Setup**] menu, set [**Stimulation Mode**] to [**TOF**], [**ST**], or [**DBS**]. To perform tetanic stimulation, directly select the [**PTC**] button.

25.7.2 Changing Stimulation Current

Before calibration and monitoring, confirm that the desired stimulus current is selected.

The current is either supramaximal or manually selected between 0 and 60 mA. For adults, the supramaximal current is usually between 35 and 55 mA. Smaller currents may be desirable for children.

25.7.3 Changing Pulse Width

You can increase the pulse width to increase the effect of the stimulation to help finding the supramaximal current.

Changing pulse width after calibration invalidates the stored reference amplitude.

25.7.4 Changing Measurement Interval

Measurement interval is the time interval between NMT measurements.

This function is not available in the PTC mode.

25.8 Enabling Block Recovery Note

The block recovery note alerts you when the set limit is reached. This indicates that the patient is responding more clearly to the stimuli and the neuromuscular block is decreasing. The note can be used, for example, to help maintain a certain relaxation level.

To enable the note and set the limit for activate the note, select [**Block Recovery**] and set the limit. If [**Off**] is selected, the monitor will not give a note.

25.9 Adjusting Stimulation Tone Volume

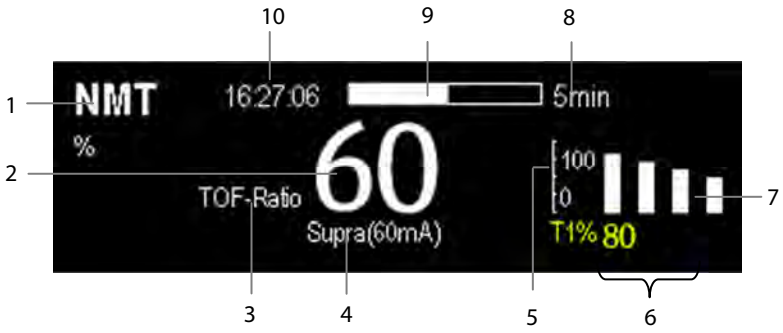
You can adjust the volume of NMT stimulation tone by setting [**Stimulation Beep Vol**] from the [**NMT Setup**] menu. The monitor gives a beep at the selected volume at each stimulation pulse if the setting is not [**0**].

25.10 Understanding NMT Display

Dependent on the selected stimulation mode, the following parameters are provided:

Stimulation mode	Parameter label	Unit	Maximum bars
TOF	TOF-Ratio	%	4
	TOF-Count	/	4
ST	ST-Ratio	%	1
	ST-Count	/	1
PTC	PTC	/	/
DBS	DBS-Ratio	%	2
	DBS-Count	/	2

The follow picture is an example of NMT display of TOF mode:



1. Parameter unit
2. Parameter value
3. Parameter label
4. Stimulation Current
5. Scale: indicates the amplitude of response to stimulation. Bar graph is not shown if calibration is not completed successfully.
6. T1%: response to first stimulus as percentage of the reference amplitude in TOF mode. This value is not shown if calibration is not completed successfully.
7. Bar graph: amplitude of response to the stimulation. The maximum height of the bar graphs displayed is 120%.
8. Measurement interval: The monitor displays “Manual” here if [**Interval**] is set to [**Manual**].
9. Measurement countdown: time to the next measurement. The measurement countdown is not shown if [**Interval**] is set to [**Manual**].
10. Time of last measurement

NOTE

- **The NMT parameter values darken 15 minutes after the NMT measurement is taken.**
- **The PTC value is shown on the display for 20 seconds after which the NMT module returns to the preset stimulation mode.**

25.11 Recalling Calibration Information

In the situation that the NMT module is power down, or you want move the NMT module to another monitor along with the patient and you want to continue with the already determined calibration information, including stimulation current, pulse width, and reference response amplitude, you can use the recall function.

To recall the calibration information, select the [**Restore Calibration Information**] button from the [**NMT Setup**] menu.

FOR YOUR NOTES

26 Monitoring NMT(from TOF-Watch® SX Monitor)

26.1 Introduction

This patient monitor can connect a Organon TOF-Watch® SX monitor for NMT(neuromuscular transmission) monitoring . This patient monitor can display, store and review measurements from TOF-Watch® SX monitor, as well as present related alarms. On this patient monitor, you can separately set the level of NMT related alarms and switch on or off alarm recording; you can also view TOF-Watch® SX monitor settings of alarm limits and alarm switch.

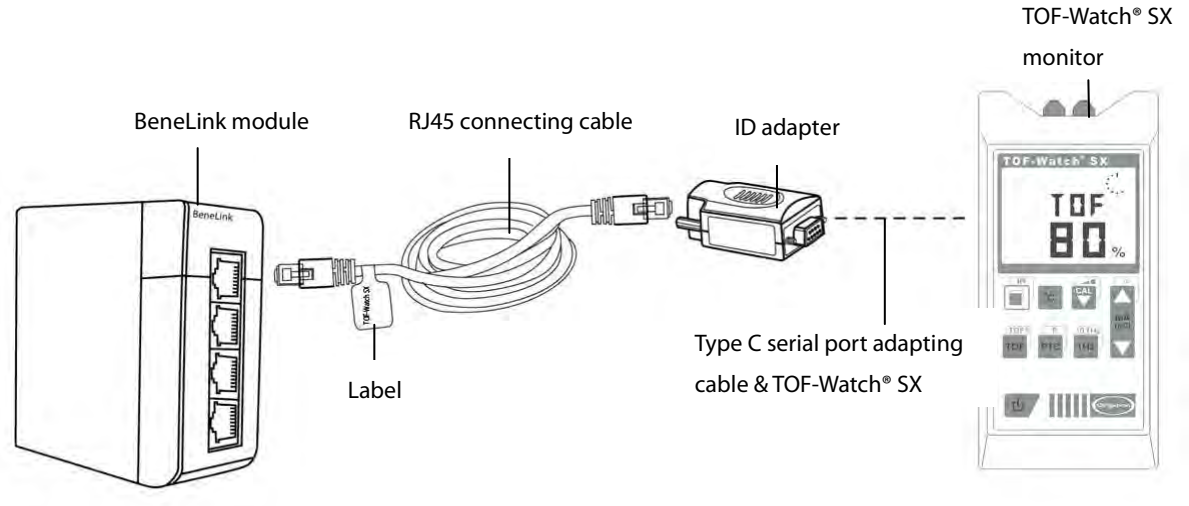
26.2 Safety

⚠WARNING

- **TOF-Watch® SX monitor is manufacutred by Organon. This company provides the technology for measuring NMT parameters. We only provide the connection between this patient monitor and TOF-Watch® SX monitor.**
- **If you have any doubts about the operation and maintenance of the TOF-Watch® SX monitor, please refer to TOF-Watch® SX monitor operator's manual or directly contact Organon.**
- **Fully observe TOF-Watch® SX monitor operator's manual to make settings and to connect the monitor with a patient.**

26.3 Connecting a TOF-Watch® SX monitor

The TOF-Watch® SX monitor connects with BeneLink module through an ID adapter, see the picture below.



Please refer to the following procedure to connect the TOF-Watch® SX monitor:

1. Insert a BeneLink module into a BeneView patient monitor module rack.
2. Connect the ID adapter that matches the TOF-Watch® SX monitor to the BeneLink module with an RJ45 connecting cable.
3. Connect the ID adapter to the TOF-Watch® SX interface with Mindray type C serial port adapting cable (PN: 009-001769-00).
4. Connect the TOF-Watch® SX interface to the TOF-Watch® SX monitor.
5. Stick a label indicating device name to the RJ45 connecting cable at the end nearby the BeneLink module. When the BeneLink module is connected to several external devices, you can tell the devices easily with these labels.
6. Turn on both monitors.

NOTE

- **For the ID adapter setup of the TOF-Watch® SX monitor, refer to section*30.5Connecting an External Device*.**

26.4 NMT Parameters

TOF-Watch® SX monitor provides the following measurements:

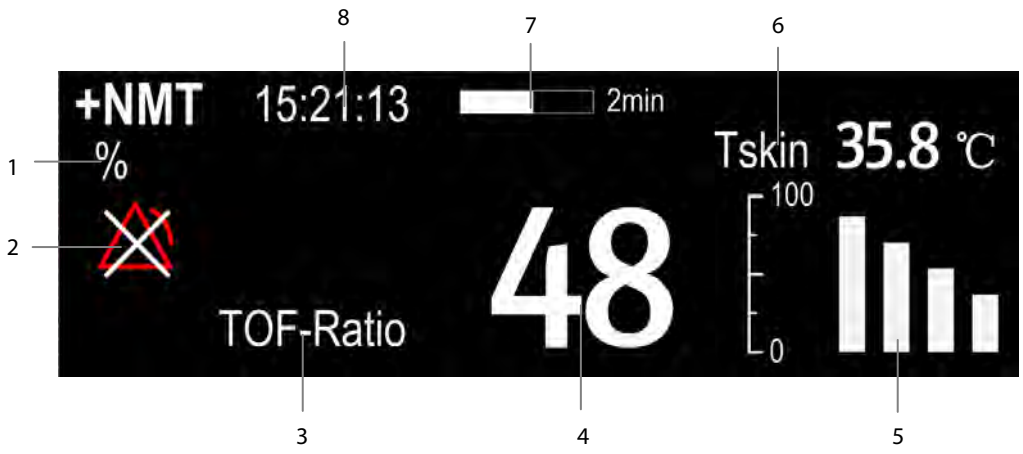
- TOF-Ratio
- TOF-Count
- PTC
- Single
- Tskin

26.5 Accessing the NMT Setup menu

You can access the [**+NMT Setup**] menu by selecting the NMT area or selecting [**Main Menu**] →[**Parameters >>**]→ [**+NMT Setup>>**]. In the [**+NMT Setup**] menu, you can

- Toggle [**Alarm Sound**] between [**On**] and [**Off**] to switch on or off NMT alarms on this patient monitor.
- View the setup as follows:
  - Stimulation Current
  - Stimulation Charge
  - Pulse Width
  - TOFs Interval
  - Transducer Sensitivity
- Set alarm level for TOF-Ratio and TOF-Count, switch on or off alarm record.

26.6 NMT Display



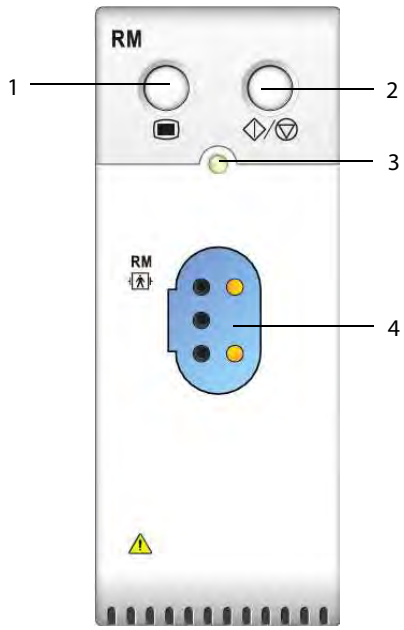
1. Parameter unit
2. Alarm status
3. Parameter label
4. Parameter measurement
5. Response amplitude of stimulation
6. Skin temperature
7. Measurement countdown
8. Time of last measurement

In the case that you take a measurement in TET50Hz mode, TET100Hz mode, DBS3.3 mode or DBS3.2 mode, only mode label is displayed in the NMT parameter area, which is shown as follows:

27 Monitoring RM

27.1 Introduction

The RM monitoring enables clinicians to understand the ventilator/anesthesia machine operation and patient respiratory status. In the respiratory mechanics (RM) monitoring, the airway pressures are measured, from the part between the patient circuit and intubation tube, using a flow sensor between the Y-piece of patient circuit and the patient connection. The pressure is transferred to the monitor through the tube and measured by a pressure transducer in the RM module. The pressure difference together with the gas concentration information is used to calculate flow. The volume information is obtained by integrating the flow signal. From these three parameters, other parameters such as RR, I:E, Compl, etc. are derived.



1. Open/Close the [**RM Setup**] Menu
2. Open/Close the Respiratory Loops
3. Indicator
4. Flow sensor connector

27.2 Safety Information

WARNING

- **RM monitoring is not intended for neonatal patients.**
- **RM monitoring is for mechanically ventilated patients only.**
- **The RM module is not intended to be used with high frequency ventilators.**

27.3 RM Parameters

RM monitoring displays the following waveforms and loops:

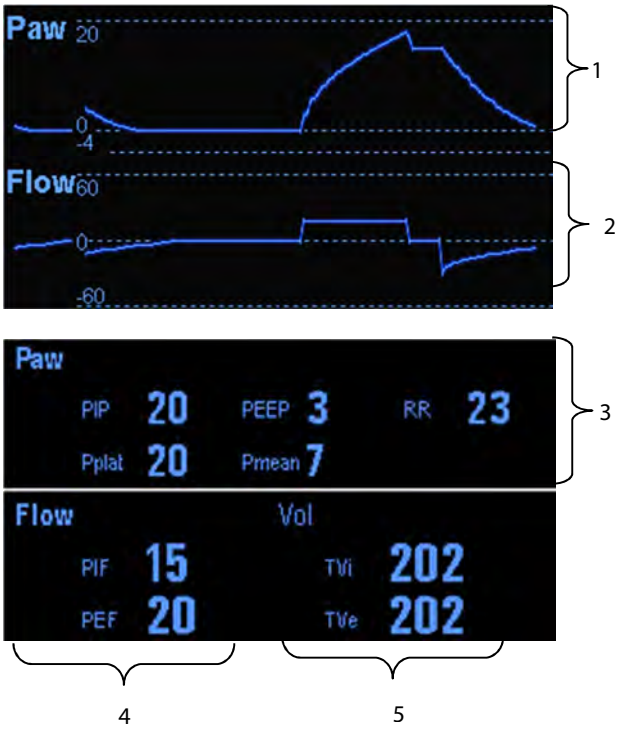
- Flow waveform
- Paw waveform
- Vol waveform
- FV (flow-volume) loop
- PV (paw-volume) loop

RM monitoring provides values for 18 parameters. The 18 parameters can be classified into 4 categories:

Parameter Label	Description	Unit
Paw parameters		
PIP	peak inspiratory pressure	cmH_2O
Pplat	pressure	cmH_2O
PEEP	positive end expiratory pressure	cmH_2O
Pmean	mean pressure	cmH_2O
Flow parameters		
PIF	peak inspiratory flow	L/min
PEF	peak expiratory flow	L/min
Vol parameters		
TVi	inspiratory tidal volume	ml
TVe	expiratory tidal volume	ml
MVi	inspiratory minute volume	L/min
MVe	expiratory minute volume	L/min
Other parameters		
RR	respiratory rate	rpm
I : E	ratio of the inspiratory and expiratory time	/
Compl	compliance	ml/cmH_2O
FEV1.0	first second forced expiratory volume ratio	%
RSBI	rapid shallow breathing index	rpm/L
WOB	work of breathing	J/L
NIP	negative inspiratory force	cmH_2O
RAW	airway resistance	$cmH_2O/L/s$

27.4 RM Display

The RM display shows either the Paw and Flow waveforms, or the Paw and Vol waveforms in the waveform area.

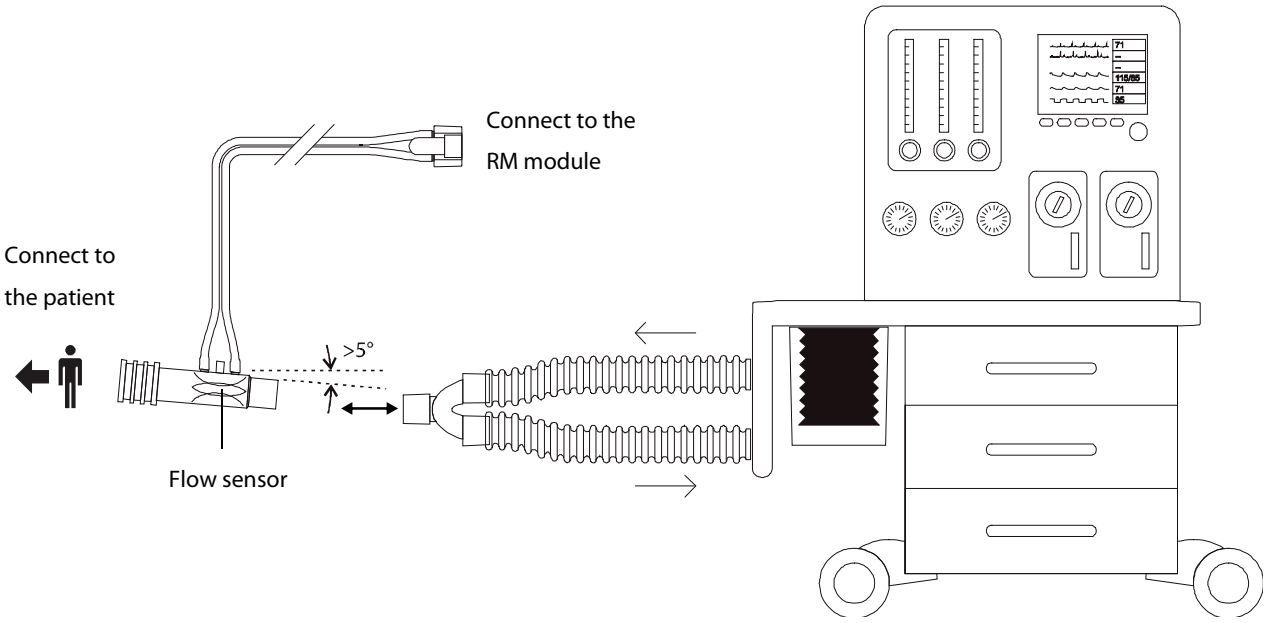


1. Paw waveform
2. Flow waveform
3. Paw parameter window
4. Flow parameter window
5. Vol parameter window

27.5 Preparing to Monitor RM

To prepare to monitor RM, follow this procedure:

1. Select an appropriate flow sensor in accordance with the patient category.
2. Connect the thin tubes of the flow sensor to the flow sensor connector of the RM module.
3. Connect the end of the flow sensor marked with the symbol to the patient tracheal tube.
4. Connect the other end of the flow sensor to the Y-tube of a ventilator or anesthesia machine.
5. Make sure that the connections are tight.



CAUTION

- **Be sure to set the barometric pressure properly before using the RM module. Improper settings will result in erroneous RM reading.**
- **A system leak may significantly affect readings of flow, volume, pressure and other respiratory mechanics parameters./ Check for leaks in the breathing circuit system, as they may significantly affect respiratory mechanics readings.**
- **Match the airway adapter you select to the appropriate patient category. Improper sensor selection may produce excessive ventilation resistance or introduce excessive airway dead space.**
- **To prevent stress on the endotracheal tube, support the sensor and airway adapter.**
- **Position sensor tubing carefully to avoid entanglement or potential strangulation.**

NOTE

- **To avoid the effect of excessive moisture in the measurement circuit, insert the flow sensor in the breathing circuit with the tubes upright, and make sure that the flow sensor is always positioned a few degrees off the horizontal level towards the ventilator side. (Spirit OEM Developer's Manual—P17)**
- **Do not place the flow sensor between the endotracheal tube and an elbow as this may allow patient secretions to block the flow sensor window.**
- **Measurement values provided by a ventilator or an anesthesia machine may differ significantly from the values provided by the RM module, due to different locations of the flow sensor.**
- **For best measurement performance, a heat moisture exchanger (HME) should always be put between the tracheal tube andthe flow sensor. Periodically check the flow sensor and tubing for excessive moisture or secretion build-up and purge if necessary.**
- **During RM monitoring, the RM module automatically performs zero calibration periodically or when the temperature changes. Zero calibration affects RM waveforms.**
- **Keep the respiration loop away from condensing equipment.**

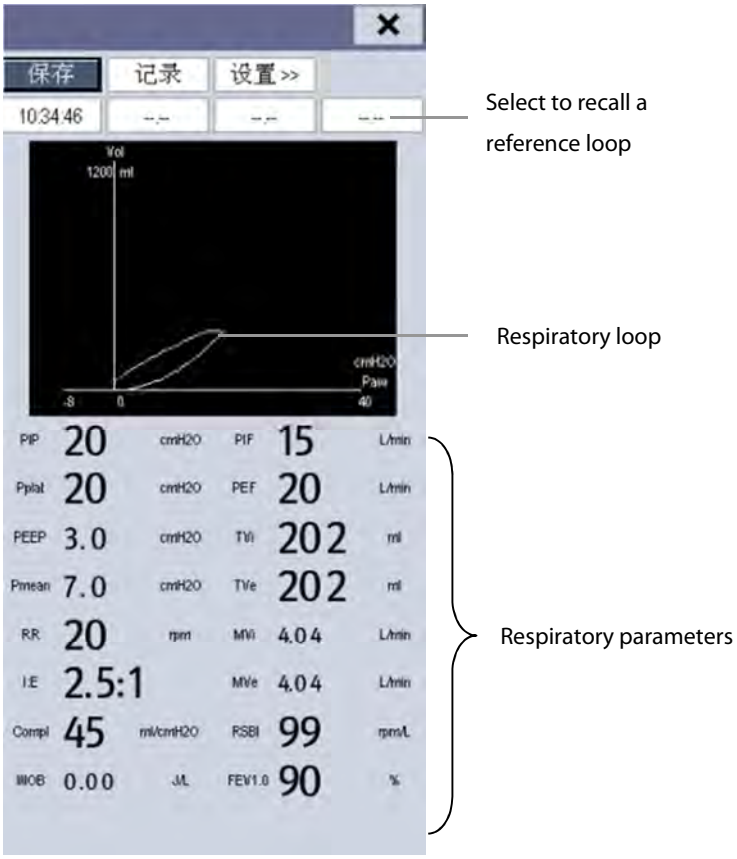
27.6 Understanding the Respiratory Loops

Respiratory loops reflect patient lungs function and ventilation condition, such as the patient's lungs compliance, over-inflation, breathing system leakage and airway blockage.

The monitor provides two types of respiratory loops: P-V (pressure-volume) loop and F-V (flow-volume) loop. The two types of loops come from pressure, flow, and volume waveforms data.

To open the respiratory loops, follow this procedure:

1. Select the RM parameter area or waveform area to enter the [**RM Setup**] menu.
2. From the [**RM Setup**] menu, select [**Respiratory Loop**].



In this window, you can:

- Select [**Save**] to save the respiratory loops in the current respiratory cycle as the reference loops. Up to 4 groups of respiratory loops can be saved, and the saving time is displayed above the respiratory loops.
- Change the respiratory loops displayed on the screen: select [**Setup >>**]→[**Display Loop**] and then select [**PV Loop**] or [**FV Loop**].
- Turn on/off reference loop: select [**Setup >>**]→[**Reference Loop**], and then select [**On**] or [**Off**].
- Change the size of the PV and FV loops: select [**Setup >>**], and then adjust the [**Paw Scale**], [**Vol Scale**] or [**Flow Scale**].
- Select parameters for display: select [**Setup >>**]→[**Select RM Parameters >>**], and then select [**All RM Parameters**] or [**Select Desired RM Parameters**]. When you select [**Select Desired RM Parameters**], 6 parameters at maximum can be selected.
- Print out all parameters for a reference loop by selecting your desired reference loop and then selecting [**Record**].

27.7 Changing RM Settings

27.7.1 Changing the RM Alarm Settings

To change the RM alarm settings, follow this procedure:

1. Select the RM parameter window or waveform area to access the [**RM Setup**] menu.
2. Select [**Alarm Setup >>**].
3. Set the alarm properties of PEEP, PIP and MVe.

27.7.2 Setting the Apnea Alarm Delay

The monitor will alarm if the patient has stopped breathing for longer than the previously set apnea time. To change the delay time of the apnea alarm, follow this procedure:

1. Select the RM parameter window or waveform area to access the [**RM Setup**] menu.
2. Set [**Apnea Delay**].

WARNING

- **The respiration monitoring does not recognize the cause of apneas. It only indicates an alarm if no breath is detected when a preadjusted time has elapsed since the last detected breath. Therefore, it cannot be used for diagnostic purposes.**

27.7.3 Selecting TV or MV for Display

To select tidal volume (TV) or minute volume (MV) for display in the Vol parameter window, follow this procedure:

1. Select the RM parameter window or waveform area to access the [**RM Setup**] menu.
2. Set [**TV/MV**].

By default, the Vol parameter window displays TV values.

27.7.4 Selecting Flow or Vol Waveform for Display

To select Flow or Vol waveform for display, follow this procedure:

1. Select the RM parameter window or waveform area to access the [**RM Setup**] menu.
2. Set [**Flow/Vol**].

27.7.5 Setting RR Source

To set the RR (respiration rate) source, follow this procedure:

1. Select the RM parameter window or waveform area to access the [**RM Setup**] menu.
2. Set [**RR Source**].

When the current RR source does not have valid measurement, the system will automatically switch the [**RR Source**] to [**Auto**].

27.7.6 Changing the Wave Sweep Speed

To set the sweep speed of Paw, Flow, and Vol waveforms, follow this procedure:

1. Select the RM parameter window or waveform area to access the [**RM Setup**] menu.
2. Set [**Sweep**].

27.7.7 Changing the Wave Scale

To set the scale of Paw, Flow, and Vol waveforms, follow this procedure:

1. Select the RM parameter window or waveform area to access the [**RM Setup**] menu.
2. Select [**Wave Scale >>**].
3. Set [**Paw Scale**], [**Flow Scale**], and [**Vol Scale**]

27.7.8 Setting the Ambient Humidity

To set the ambient humidity, follow this procedure:

1. Select the RM parameter window or waveform area to access the [**RM Setup**] menu.
2. Set [**Ambient Humidity**].

27.7.9 Setting the Ambient Temperature

To set the ambient temperature, follow this procedure:

1. Select the RM parameter window or waveform area to access the [**RM Setup**] menu.
2. Set [**Ambient Temp**].

27.7.10 Accessing the Intubation Mode

When performing intubation during general anesthesia, you can enter the intubation mode in order to reduce unnecessary alarms. To enter the intubation mode, follow this procedure:

1. Select the RM parameter window or waveform area to access the [**RM Setup**] menu.
2. Select [**Intubation**].

For the details of the intubation mode, refer to the section ***8.6 Intubation Mode***.

27.7.11 Setting the Barometric Pressure

To set the barometric pressure, follow this procedure:

1. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password→ [**Module Maintenance >>**]→[**Maintain RM >>**].
2. Select [**Barometric Pressure**] and then enter the value of barometric pressure to which the patient monitor is exposed to.

WARNING

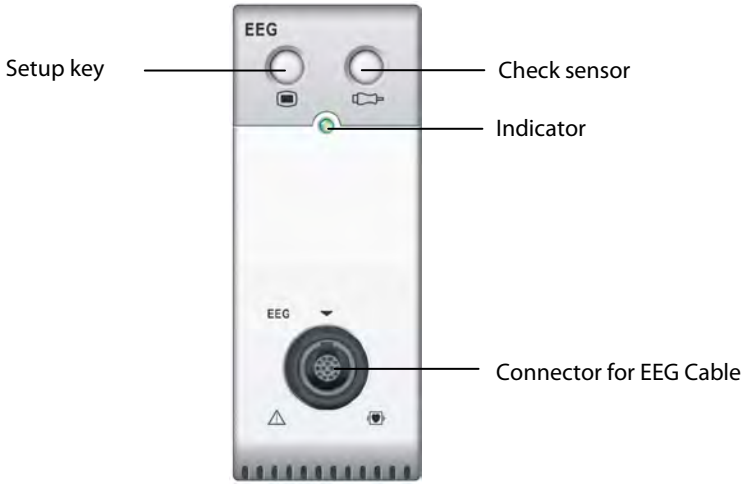
- **Be sure to set the barometric pressure properly before using the RM module. Improper settings will result in erroneous RM reading.**

28 Monitoring EEG

28.1 Introduction

Electroencephalograph (EEG) module is to measure the spontaneous, rhythmic electrical activity of the brain to monitor patient's cerebral function.

It provides up to four channel EEG measurement, display and trend. Each channel can display one real-time EEG wave, and measure the following 10 parameters: SEF, MF, PPF, TP, SR, EMG, Delta, Theta, Alpha and Beta. It supports Density Spectral Arrays (DSA) and Compressed Spectral Arrays (CSA).



28.2 Safety Information

⚠WARNING

- **The conductive parts of electrodes and connectors should not contact other conductive parts, including earth.**
- **To reduce the hazard of burns in the high-frequency surgical neutral electrode connection, the EEG sensor should not be located between the surgical site and the electro-surgical unit return electrode.**
- **The EEG electrode must not be located between defibrillator pads when a defibrillator is used on a patient under monitoring.**
- **Do not come into contact with patients during defibrillation. Otherwise serious injury or death could result.**
- **The Electroencephalograph is a complex technology, intended for use only as an adjunct to clinical judgment and training.**
- **When a defibrillator is used, it is required to only use the specified patient cable.**
- **In case of electrode off, the patient monitor can provide the error indication only when it performs auto sensor check according to the interval time (which is set by user). Therefore, immediately start manual sensor check if abnormal waveform and/or high noise is found.**

NOTE

- **The EEG accessories using on our monitor is purchased from EB Neuro S.p.A. Please contact EB Neuro or visit its website (www.ebneuro.com) for more information.**
- **Make sure to place ground electrode on patient during monitoring.**
- **EEG signals are of very low amplitude, and it is likely there may be some remaining unavoidable electromagnetic interference.**

28.3 Understanding the EEG Display

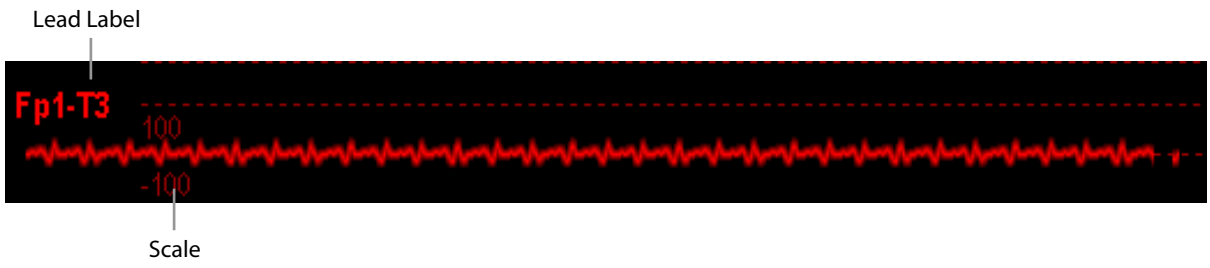
28.3.1 EEG Parameter Area

The parameter area of each EEG channel can display up to five parameters (one primary parameter and four secondary parameters) from the following ten parameters: SR, SEF, MF, PPF, TP, EMG, Delta, Theta, Alpha and Beta. Except for EMG, all parameters display numeric value.

Electromyograph (EMG) bar reflects the electrical power of muscle activity and high frequency artifacts. The power range is 30-55 dB. When the EMG indicator is low, it indicates that EMG activity is low. EEG monitoring conditions are optimal when the bar is empty.

Status	Power (dB)	Meaning
empty	less than 30	optimal
1 bar	30 to 36	acceptable
2 bars	37 to 43	
3 bars	44 to 50	
4 bars	51 to 55	
5 bars	greater than 55	unacceptable

28.3.2 EEG Waveform Area

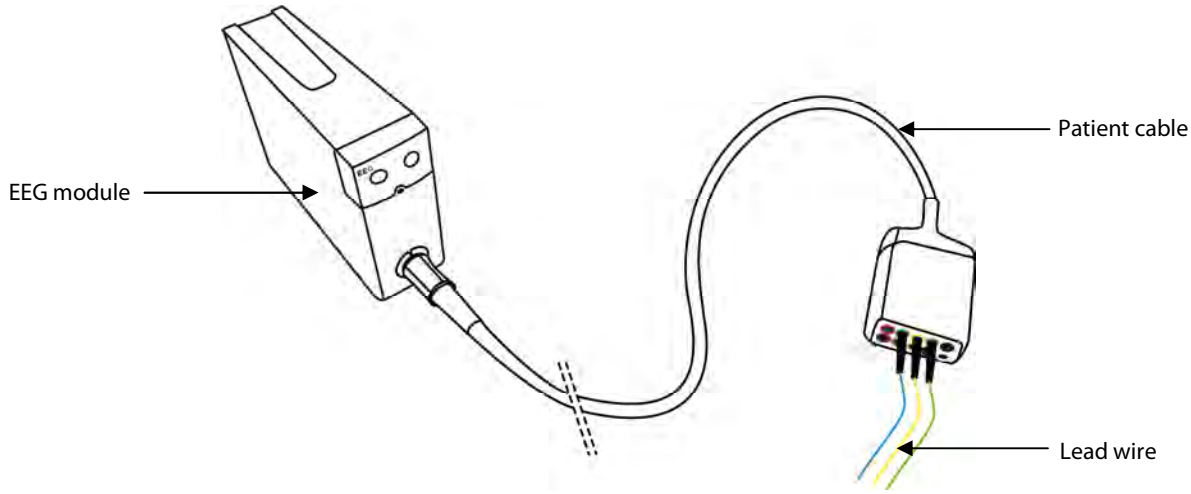


28.4 Preparing to Monitor EEG

1. Insert EEG module into the module rack of the patient monitor, and attach one end of patient cable to EEG module.
2. Press the setup key on the module, and then [**EEG Setup**] menu will pop up. Choose [**Montage Setup>>**] button, and then select a desired montage from the pop-up menu.
3. Prepare the skin where the EEG electrodes will apply according to the montage you have chosen. Refer to section ***28.4.2*** for skin preparation.
4. Attach the electrodes on the patient's head according to the montage you have chosen.
5. Connect the leadset to the sockets on patient cable according to the color.
6. Perform sensor check and observe the results. Check lead connection if the impedance is too high. Refer section ***28.6*** for sensor check.

28.4.1 Connecting EEG Equipment

The following picture **illustrates** the connection between EEG module and accessories.



28.4.2 Attaching Electrodes to Patient

Attaching Cup Electrode

1. Comb or cut the hair away from the spot where you will place the electrode.
2. Use abrasive paste on the spot and rub the skin to remove oil and grease.
3. Apply the conductive paste on the inside of electrode and then press the electrode on the spot.

Attaching Needle Electrode

1. Clean the skin with alcohol.
2. Get the needle into the subcutaneous area.
3. Fix the needle to prevent getting out from the head.

⚠WARNING

- **Needle electrode is disposable. Never reuse it.**
- **Use one type of electrode in the whole montage.**
- **Replace the needle electrode whenever it is found bended. Do not manually straighten it and then reuse it.**

28.5 Changing EEG Settings

28.5.1 Accessing EEG Setup menu

To access the [**EEG Setup**] menu:

- Select the EEG parameter area, or
- Select the EEG waveform area.

28.5.2 Changing the EEG Scale

1. Enter the [**EEG Setup**] menu.
2. Select an appropriate setting from [**Scale**] list.

28.5.3 Changing the EEG Sweep Speed

1. Enter the [**EEG Setup**] menu.
2. Select an appropriate setting from [**Sweep**] list. The faster the wave sweeps, the wider the wave is.

28.5.4 Changing the High/Low Filter

The low and high filters can screen out undesirable interference which may come from respiration, movement, etc. The current EEG high and low filter settings are shown at the top of DSA and CSA view.

To change the filter settings:

1. Enter the [**EEG Setup**] menu.
2. Select an appropriate setting from [**Low Filter**] or [**High Filter**] list.

28.5.5 Switching Notch Filter On or Off

The notch filter can screen out 50Hz/60Hz noise.

1. Enter the [**EEG Setup**] menu.
2. Select [**Notch Filter**] and then toggle between [**On**] and [**Off**]. The default is [**On**].

28.5.6 Choosing Numeric Parameters

You can choose the desired primary and secondary parameters for display on the screen.

1. Enter the [**EEG Setup**] menu.
2. Select [**Select Parameter>>**] and then select one primary parameter and at most four secondary parameters from the pop-up menu.

28.5.7 Choosing a Montage

To choose a montage:

1. Select the EEG parameter window to enter [**EEG Setup**] menu.
2. Select [**Montage Setup>>**] button. The [**Montage Setup**] menu will pop up.
3. Select one desired montage from [**Montage**] list.

There are four pre-defined montages and up to three customized montages in [**Montage**] list. The electrodes and montage type under the four pre-defined montages, as shown in below tables, can not be modified.

Montage Name	EEG 1	EEG 2	EEG 3	EEG 4	PGND	NE
Montage 1	Fp1-T3	Fp2-T4	C3-O1	C4-O2	Fpz	Cz
Montage 2	F3-C3	C3-P3	F4-C4	C4-P4	Fpz	Cz
Montage 3	F3-Cz	F4-Cz	P3-Cz	P4-Cz	Fpz	Cz
Montage 4	Fp1-Cz	Fp2-Cz	O1-Cz	O2-Cz	Fpz	Cz

Montage Name	Montage Type
Montage 1	Bipolar Mode
Montage 2	
Montage 3	Referential Mode
Montage 4	

Bipolar Mode vs. Referential Mode

In bipolar mode, each channel (EEG1, EEG2, EEG3 and EE4) uses two electrodes, a positive and a negative, to measure the potential difference between each pair. In referential mode, all channels use the same referential electrode (negative), and only use one electrode (positive) to measure the difference.

28.5.8 Adding a Montage

To add your own montage, take the following steps:

1. Enter [**EEG Setup**] menu.
2. Select [**Montage Setup>>**] button. The [**Montage Setup**] menu will pop up.
3. Choose a pre-defined montage, and then select [**Edit**].
4. Make modification on the electrode map. Refer to section ***28.5.10***.
5. Select [**Save as**], and then type the name of your own montage in the popup.
6. Select [**OK**].

NOTE

- **The maximum number of customized montages is three. When the number has reached the maximum, the [Save as] button is disabled and grayed out.**
- **The name of customized montage can contain 12 characters at most.**

28.5.9 Deleting a Customized Montage

To delete a customized montage, take the following steps:

1. Enter [**EEG Setup**] menu.
2. Select [**Montage Setup>>**] button. The [**Montage Setup**] menu will pop up.
3. Select one customized montage, and then select [**Delete**].
4. Select [**OK**] in the pop-up menu.

NOTE

- **The pre-defined montages and the montage in use can not be deleted.**

28.5.10 Modifying a Customized Montage

To modify a customized montage, take the following steps:

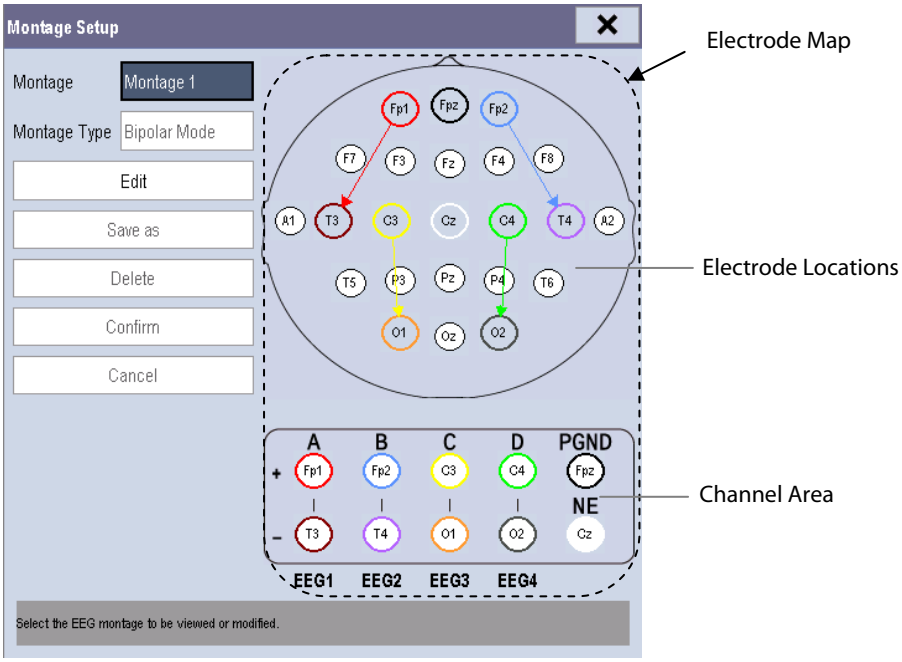
1. Enter [**EEG Setup**] menu.
2. Select [**Montage Setup>>**] button. The [**Montage Setup**] menu will pop up.
3. Select the customized montage you want to modify, and then select [**Edit**].
4. Make modification on the electrode map. Refer to section ***28.5.12***.
5. Select [**Confirm**].

28.5.11 Rename a Customized Montage

To rename the customized montage, take the following steps:

1. Enter [**EEG Setup**] menu.
2. Select [**Montage Setup>>**] button. The [**Montage Setup**] menu will pop up.
3. Select the customized montage you want to modify, and then select [**Edit**].
4. Select [**Confirm**], and then input the new name in the pop-up window.

28.5.12 Making Modifications on Electrode Map



The electrode locations in the map are labelled according to international 10-20 system. In editing state, you can make modification on electrode map.

1. Select one pole of a channel in Channel Area.

   The selected pole in Channel Area will become empty, and the electrode previously in the circle will display in Electrode Locations with gray background.

2. Select one electrode in Electrode Locations.

   The selected electrode in Electrode Locations will appear in the empty circle in Channel Area with gray background.

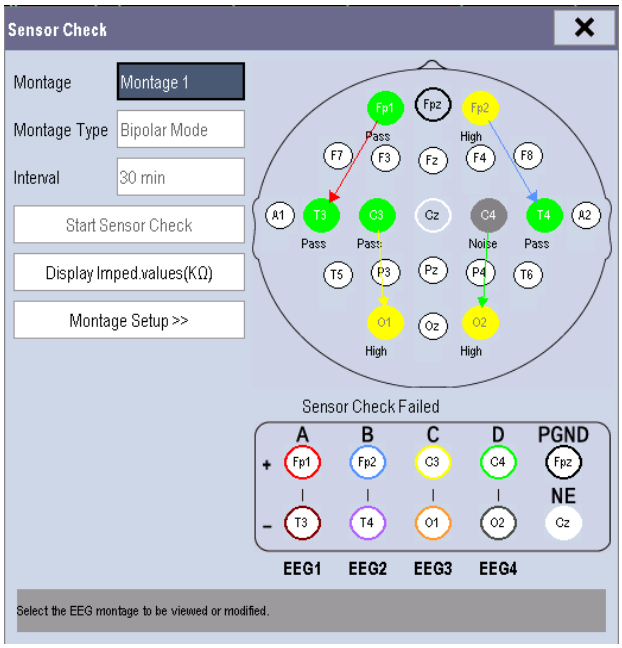
3. If necessary, repeat step 1 to 2 to modify other electrode.

28.6 EEG Sensor Check

This measures the exact impedance of each electrode. During sensor check, EEG waveform changes to a straight line, the parameter value disappears, and a prompt message displays above EEG waveform and in the technical alarm area.

- The sensor check is automatically initiated when:
  - Change the montage;
  - Open EEG [**Sensor Check**] menu;
  - Power on EEG module;
  - Connect the sensor.
- The sensor check automatically stops when:
  - The impedance of all sensors is in the valid range.
- To manually start a sensor check, you can either:
  - Press the hardkey on the EEG module, or
  - Select [**Start Sensor Check**] in [**Sensor Check**] window.
- To manually stop a sensor check, you can either:
  - Press the hardkey on the EEG module.
  - Select [**Stop Sensor Check**] in [**Sensor Check**] window.

When a sensor check finishes, a graphic map will show the impedance status of selected electrodes.



Each color corresponds to one status of the electrode in sensor check:

Color	Status	Description	Impedance Value	Action
Red	[**Off**]	Electrode falls off and has no skin contact.	>=40 kΩ	■ Reconnect electrodes: ◆ In Bipolar mode, reconnect the electrode indicated as red, and PGND electrode. ◆ In Referential mode, reconnect the electrode indicated as red, NE and PGND electrode. ■ Check the sensor-to-skin contact. If necessary, clean and dry skin.
Grey	[**Noise**]	The EEG signal is too noisy. Impedance cannot be measured.	20 kΩ ~ 40 kΩ	Check the sensor-to-skin contact. If necessary, clean and dry skin.
Yellow	[**High**]	The impedance is above the limit	10 kΩ ~ 20 kΩ	
Green	[**Pass**]	The impedance is within valid range	<= 10 kΩ	No action necessary.

Although EEG may still be measured when the electrode status is [**Noise**] or [**High**], all electrodes should be in [**Pass**] status for best performance.

28.6.1 Setting the Interval of Auto Sensor Check

You can set the interval of performing an auto sensor check, or switch off auto sensor check:

1. Enter [**EEG Setup**] menu.
2. Select [**Sensor Check >>**] in [**EEG Setup**] menu.
3. Select an appropriate setting from [**Interval**] list. The options are [**5 min**], [**15 min**], [**30 min**], [**60 min**] and [**Off**].

28.6.2 Displaying / Hiding Impedance Value

You can display the impedance value on the electrode map of [**Sensor Check**] menu by clicking [**Display Imped. Values (KΩ)**] key, or hide the value by clicking [**Hide Imped. Values (KΩ)**] key.

28.6.3 Setting Up a Montage

In the [**Sensor Check**] menu, you can select [**Montage Setup>>**] key to enter the [**Montage Setup**] screen and edit the montage. Refer to sections ***28.5.8, 28.5.9, 28.5.10, 28.5.11, 28.5.12*** for the additional information.

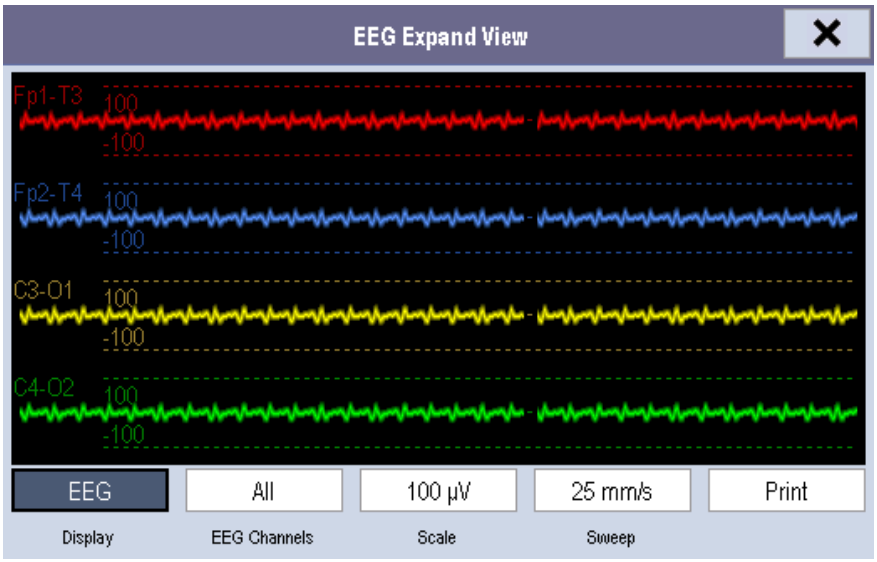
28.7 Understanding EEG Expand View

To display the EEG expand view:

1. Enter [**EEG Setup**] menu.
2. Select [**EEG Expand View >>**] in [**EEG Setup**] menu.
3. Select [**EEG**], [**EEG Para.**], [**EEG Trend**], [**DSA**] or [**CSA**] from [**Display**] list to enter corresponding view.

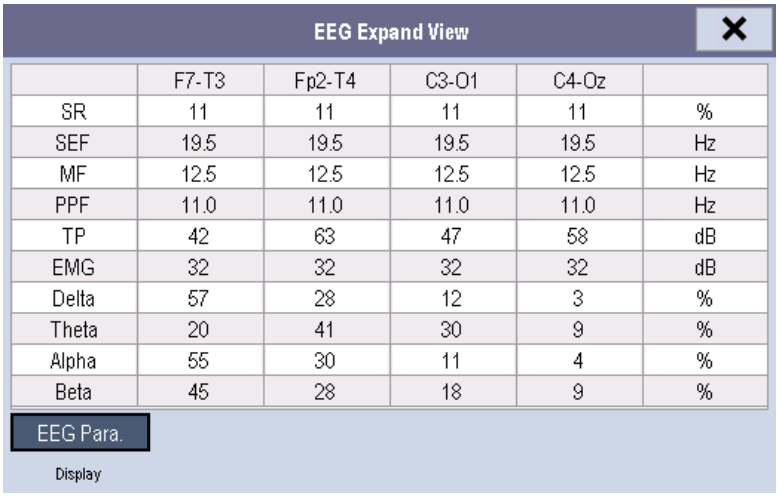
28.7.1 About EEG Waveform Trend

In [**EEG**] view, you can select the EEG channels, scale and sweep speed.



28.7.2 About EEG Parameter Trend

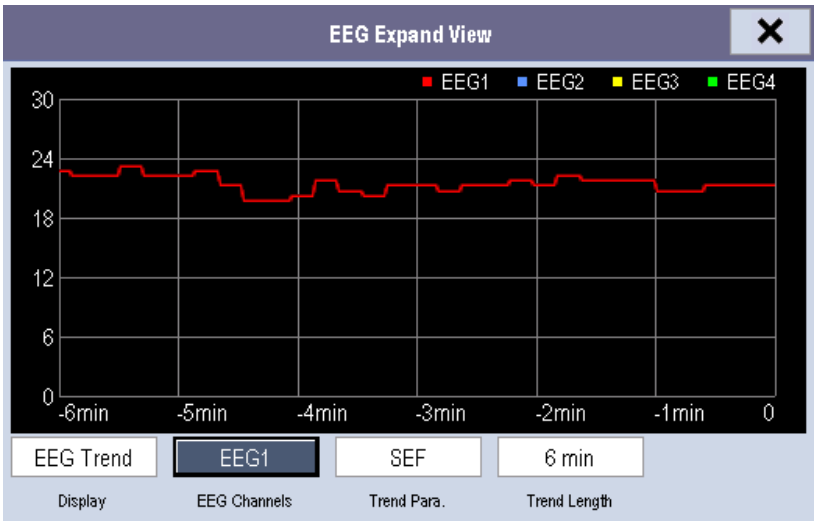
In [**EEG Para.**] view, all the parameter values of the four channels are displayed.



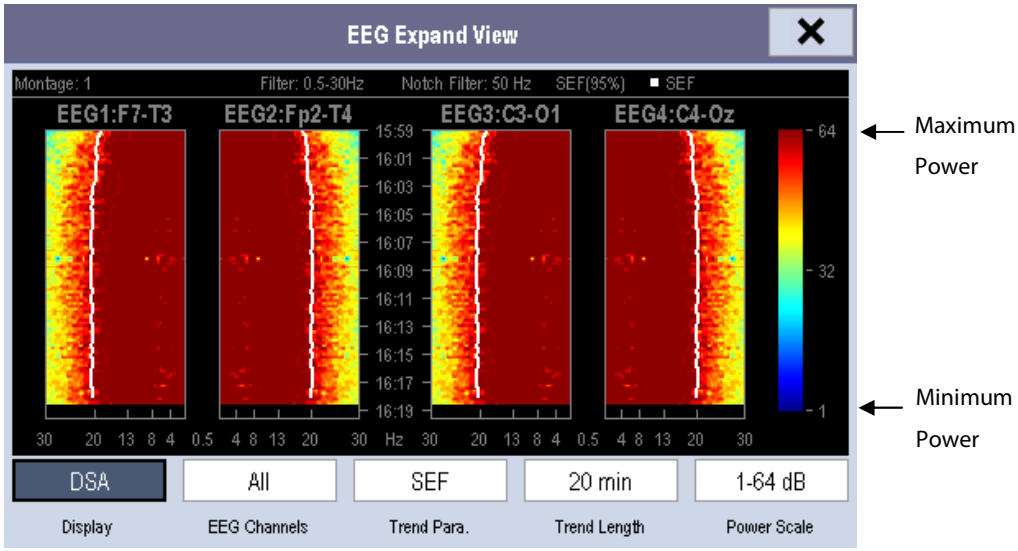
	F7-T3	Fp2-T4	C3-O1	C4-Oz	
SR	11	11	11	11	%
SEF	19.5	19.5	19.5	19.5	Hz
MF	12.5	12.5	12.5	12.5	Hz
PPF	11.0	11.0	11.0	11.0	Hz
TP	42	63	47	58	dB
EMG	32	32	32	32	dB
Delta	57	28	12	3	%
Theta	20	41	30	9	%
Alpha	55	30	11	4	%
Beta	45	28	18	9	%

28.7.3 About EEG Trend

In [**EEG Trend**] view, you can select the EEG channel(s) of a parameter to be displayed on the screen, and set the trend length.



28.7.4 About DSA



The Density Spectral Array (DSA) is to show changes in the power spectrum distribution over time. You can set EEG channels, parameter trend length and power scale in DSA view.

The DSA view has:

- A status bar on the top of DSA view, which displays current montage, filter settings, notch frequency, SEF percentile (95%), and trendline label.
- A color bar on the right side of DSA view, which displays a range of colors representing power level from minimum to maximum. Red represents a higher power level, and blue for a low power level.
- A frequency scale on the horizontal axis. The scale range is dependant to the settings in [**Low Filter**] and [**High Filter**] in the [**EEG Setup**] menu.

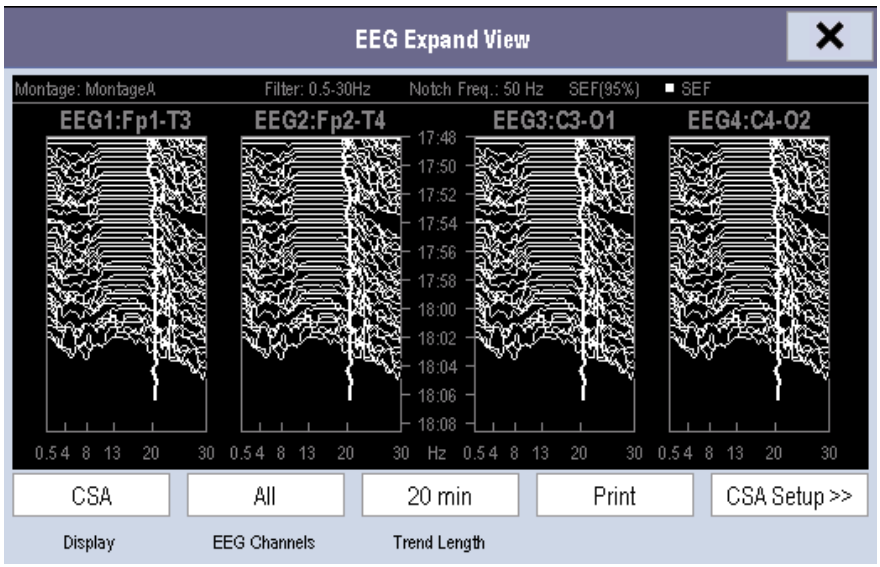
- Up to three colored trendlines of SEF, MF and PPF on DSA graph. The displaying of trendline is dependant to the setting in [**Trend Para.**] of DSA view.
- The marker "?" beside DSA graph, which appears when an artifact found, sensor off or disconnected, or montage changed.

In DSA view, you can select an appropriate power scale to adjust color display.

NOTE

- **The settings of parameter trend length and power scale are changed together in DSA and CSA.**
- **If the measured EEG value amount reaches the maximum display of DSA or CSA window, the earliest data will be cleared.**
- **All the measured data in DSA and CSA will be cleared after power-off.**

28.7.5 About CSA



The continuous EEG signal is sampled periodically and this value is stored in a frame. After processing, each frame is to provide a frequency spectrum displayed as a Compressed Spectral Array (CSA). You can set EEG channels, trend length, and parameter power scale and CSA clipping in CSA view.

The CSA view shows the patient's EEG value change over time. The latest EEG spectral line appears at the bottom of CSA graph. The CSA view has:

- A status bar on the top of CSA view, which displays current montage, filter settings, notch frequency, SEF percentile (95%), and trendline label.
- A frequency scale on the horizontal axis. The scale range is dependant to the settings in [**Low Filter**] and [High **Filter**] in the [**EEG Setup**] menu.
- The marker "?" beside CSA graph, which appears when an artifact found, sensor off or disconnected, or montage changed.
- Up to three colored trendlines of SEF, MF and PPF on CSA graph. The displaying of trendline is dependant to the setting in [**CSA Setup>>**]→[**Trend Para.**].

In CSA view, you can select an appropriate power scale to adjust spectral line's amplitude. The wider scale range, the greater amplitude of the spectral lines is.

You can switch on/off CSA clipping:

- [**On**]: The spectral line clipping is turned on. The latest spectral line will display in a normal shape, in which area other go-through spectral lines will be cut out.
- [**Off**]: The spectral line clipping is turned off. All the spectral lines display normally.

NOTE

- **The settings of paramete trend length and power scale are changed together in DSA and CSA.**
- **If the measured EEG value amount reaches the maximum display of DSA or CSA window, the earliest data will be cleared.**
- **All the measured data in DSA and CSA will be cleared after power-off.**

28.8 Printing EEG Reports

You can print real-time EEG report and CSA report in EEG Expand View.

1. Select the EEG parameter area to enter [**EEG Setup**] menu.
2. Select [**EEG Expand View >>**] in [**EEG Setup**] menu.
3. Select [**EEG**] or [**CSA**] in [**Display**] list.
4. Select [**Print**] to print corresponding report.

FOR YOUR NOTES

29 Clinical Score

29.1 Overview

The Clinical Score facilitates a clinician to quickly determine the severity of illness of a patient based on a calculated score, so that the clinician can take necessary measure according to the indication provided by the Clinical Score.

The monitor supports the following scores:

- MEWS (Modified Early Warning Score)
- NEWS (National Early Warning Score)
- Customizable Score

⚠WARNING

- **The Clinical Score is intended to be used only by healthcare professionals and to be serviced by trained personnel.**
- **The scores and clinical responses in the clinical scores are for reference only and cannot be directly used for diagnostic interpretation.**
- **Both MEWS and NEWS are not applicable to pregnant woman, COPD (Chronic Obstructive Pulmonary Disease) patients and those under 16 years old.**

29.1.1 MEWS (Modified Early Warning Score)

The MEWS calculates a total score and provides a clinical response based on the following five parameters:

- Pulse Rate
- Systolic NIBP
- Respiration Rate
- Temperature
- AVPU (Alert, Reacting to Voice, Reacting to Pain, and Unresponsive)

This score is only applicable to adult.

29.1.2 NEWS (National Early Warning Score)

The NEWS calculates a total score and provides a clinical response based on the following seven parameters:

- Respiration Rate
- SpO_2
- Supplemental Oxygen
- Temperature
- Systolic NIBP
- Pulse Rate
- AVPU

This score is only applicable to adult.

29.1.3 Customizable Score

The customizable score can react based on the selected multiple parameters or single parameter.

- Multiple parameter score: calculate a total score and provide a clinical response based on the multiple parameters which are defined.
- Individual parameter score (IPS): indicate the clinical response whenever any individual parameter value is out of range.

The available parameters in customizable score include:

- Respiration Rate
- SpO_2
- Supplemental Oxygen
- Temperature
- Systolic NIBP
- Pulse Rate
- Level of Consiousness (support AVPU and GCS)
- Blood Sugar
- Urine Output
- Catheter
- Pain Score
- Pain
- Inspired O_2%
- Airway
- Three customizable parameters

You can define the applicable patient category with Mindray Clinical Score Config Tool. Refer to ***Clinical Score Config Instruction for Use*** (P/N: 046-007126-00) for customizable scores.

29.2 Entering Score

To enter the score, follow this procedure:

1. Configure to display the clinical score tile in the parameter area (area C). Refer to ***3.10 Setting the Screen*** to display the tile.
2. Select the tile to display the score screen.

29.3 Calculating a Score

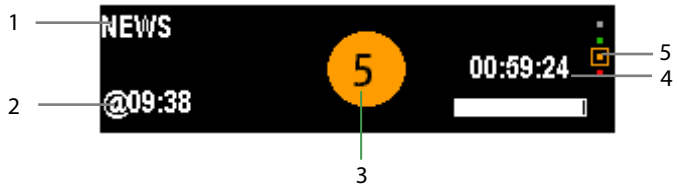
To calculate a score, follow this procedure:

1. Select the default score or load a score for the applicable patient category. Refer to ***29.7.2 Selecting Default Score*** or ***29.7.4 Loading a Score.***
2. Select an operator ID. Refer to ***29.8.1 Selecting an Operator ID***.
3. Obtain the value of all parameters, and then calculate the score. Refer to ***29.5 Obtaining the Total Score***.
4. If necessary, record the score data. Refer to ***29.4 Clinical Score*** Screen.

29.4 Clinical Score Screen

29.4.1 Score Tile in the Main Screen

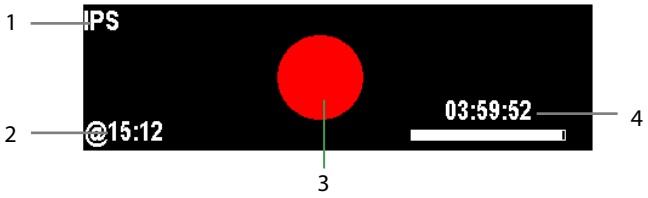
The MEWS, NEWS and multi-parameter score tile display as following:



1. Clinical score name
2. Last measurement time
3. Total score: the background color indicates the current score level.
4. Countdown to the next calculation
5. Score level indicator

It indicates that the warning level increases from top to bottom. The current level is enclosed in the square frame.

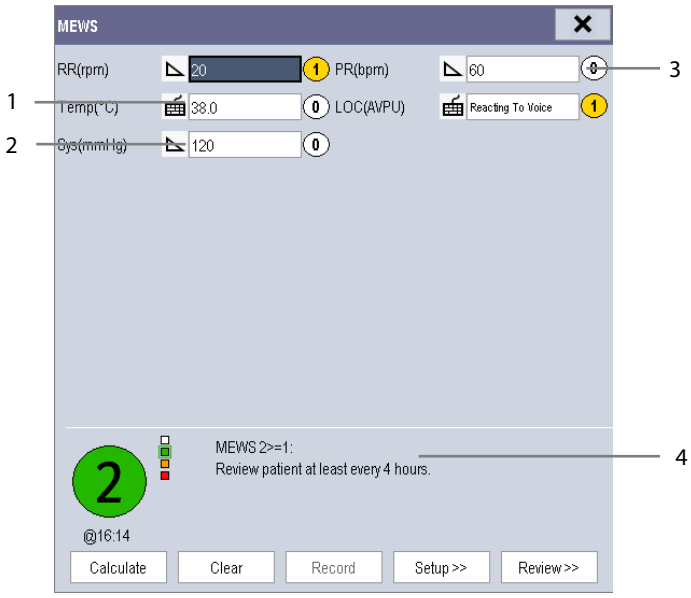
The IPS score tile displays as following:



1. Name for clinical score
2. Last measurement time
3. Score Status
   - Red: indicates that at at least one parameter is out of the defined range.
   - White: indicates that all the parameters are whitin the normal range.
4. Countdown to the next calculation

29.4.2 Score Screen

The MEWS, NEWS or multi-parameter score screen display as following:

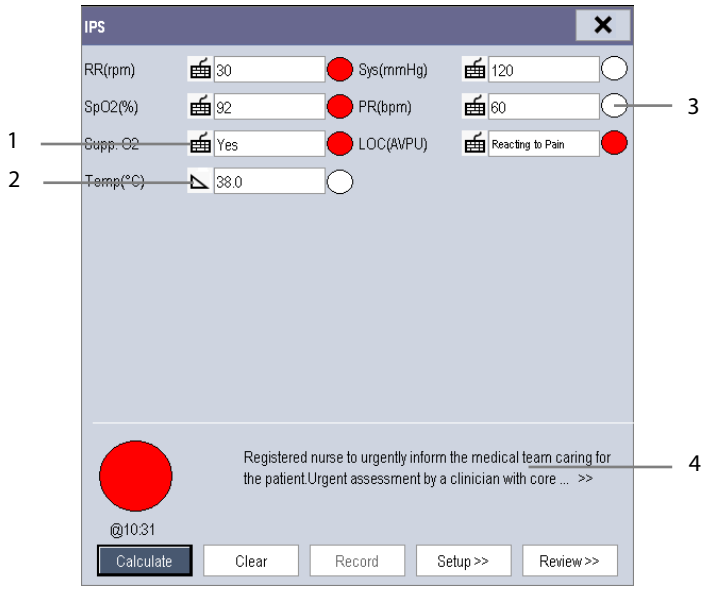


1. Manual input icon

   You need to manually input the parameter
2. Monitoring icon

   The parameter value is from the monitor.
3. Score for single parameter
4. Recommended clinical response

IPS score screen displays as following:



1. Manual input icon

   The parameter value is entered by manual input.

2. Monitoring icon

   The parameter value is from monitor.

3. Score status for single parameter

   - Red: indicates that the parameter is out of the defined range.
   - White: indicates that the parameter is within the normal range.

4. Recommended clinical response

In the above screens, you can:

- Select [**Clear**] to clear the parameter area, total score and clinical response.
- Select [**Review>>**] to open the score review screen. Refer to ***29.9 Reviewing*** for details.
- Select [**Record**] to print the current patient score data with a recorder.

29.5 Obtaining the Total Score

The IPS only calculates the parameter status. The IPS does not have total score.

For other scores, when each parameter tile has a value, the total score can be calculated. To calculate a score, follow this procedure:

1. Select [**Clear**]. The parameters in monitoring will obtain the value automatically.
2. Manually input the value for the parameter not in monitoring.
3. Select [**Calculate**].

The parameter input range is shown in following:

Parameter	Range
Pulse Rate	20 bpm -350 bpm
Systolic NIBP	-50 mmHg -360 mmHg
Respiration Rate	0-200 rpm
Temperature	0.1°C – 50.0°C (32.1°F – 122.0°F)
Level of Consciousness	AVPU: Alert, Reacting to Voice, Reacting to Pain, Unresponsive GCS: 1-15
Supplemental Oxygen	Yes, No
SpO_2	0% – 100%
Urine Output	0 -300 mml/h (0 – 10 ml/h/kg)
Catheter	Yes, No
Blood Sugar	1.0 mg/dl -720.0 mg/dl (0.06 mmol/L -40.00 mmol/L)
Pain Score	0-10
Pain	None, Mild, Moderate, Severe
Inspired O_2%	21% -100%
Airway	Clear, Obstruction
Customizable parameter	The input range depends on the decimal point. The decimal point is customizable in Mindray Clinical Score Config Tool. 0 – 9999 (decimal point as 1) 0.0 – 999.9 (decimal point as 0.1) 0.00 – 99.99 (decimal point as 0.01)

29.6 Setting the Interval of Calculating a Score

You can set up the interval between two calculations. To set up the interval, follow this procedure:

1. Enter the score.
2. Select [**Setup>>**].
3. Select [**Interval**] and set the interval.

29.7 Managing Scores

29.7.1 Importing the Score

You can import MEWS, NEWS and customized scores into the monitor. Up to five scores can be imported into the monitor.

1. Connect the USB drive to the USB connector on the monitor.
2. Select [**Main Menu**]→[**Maintenance>>**] →[**User Maintenance>>**]→Enter the required password→[**EWS Setup>>**]→[**Import Score>>**].
3. In the [**Import Score**] menu, select the scores to be imported. Then select [**Import**].

29.7.2 Selecting Default Score

The monitor does not provide default score. To select a default score:

1. Select [**Main Menu**]→[**Maintenance>>**] →[**User Maintenance>>**] →Enter the required password→[**EWS Setup>>**]→[**Select Default Score>>**].
2. Set the default score for the patient category.

After the default score is set, when a patient category is changed, the monitor will automatically use the default score.

29.7.3 Deleting the Score

To delete the score, follow this procedure:

1. Select [**Main Menu**]→[**Maintenance>>**] →[**User Maintenance>>**] →Enter the required password→[**EWS Setup>>**]→[**Delete Score**].
2. In the [**Delete Score**] menu, select the score to be deleted.
3. Select [**Delete**].

29.7.4 Loading a Score

The default score may not be appropriate for the new patient. You can load a score so as to ensure that the score is appropriate for your patient.

To load a score, follow this procedure:

1. Enter the score.
2. Select [**Setup>>**]→[**Load Score>>**].
3. Select the desired score to be loaded.
4. Select [**Load**].

29.8 Setting Operator ID

NOTE

- **The operator ID settings are available only when it is enabled in the [User Maintenance>>]→ [EWS Setup>>]→ [Operator ID].**

29.8.1 Selecting an Operator ID

To select an operator ID, follow this procedure:

1. Enter the score.
2. Select [**Setup>>**], and then the [**Score Setup**] menu pops up.
3. Select an operator ID in the [**Operator ID**] field.

29.8.2 Adding an Operator ID

You can add the operator ID through manually input operation or a bar scanner. The score system can store a maximum of 20 operator IDs.

To add an operator ID by manual input:

1. Enter the score.
2. Select [**Setup>>**]→ [**Manage Operator ID>>**].
4. Select [**Add ID**].
3. Input a new ID, and then select [**Ok**].

29.8.3 Deleting Operator ID

If the operator ID number reaches the maximum, you need to delete the existing IDs to save a new one.

To delete the operator ID:

1. Enter the score.
2. Select [**Setup>>**]→[**Manage Operator ID>>**].
3. Select the check box before the operator ID to be deleted.
4. Select [**Delete**]. A prompt message will pop up for your confirmation.
5. Select [**Yes**].

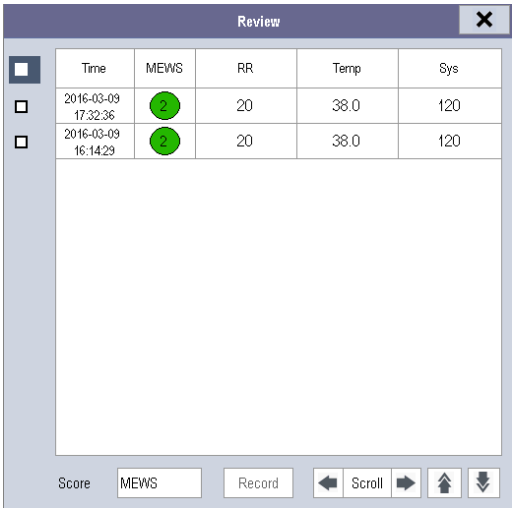
29.8.4 Setting Operator ID Timeout

The operator ID can be valid for a period of time. To set the retention time:

1. Select [**Main Menu**] →[**Maintenance>>**] →[**User Maintenance>>**] →Enter the required password→[**EWS Setup>>**]→[**Operator ID Timeout**].
2. Set the time to [**10 min**], [**15 min**], [**30 min**], [**1 h**], [**2 h**] or [**Off**].

29.9 Reviewing

Enter the score, and then select [**Review**] to access the Review screen



In the [**Review**] screen, you can:

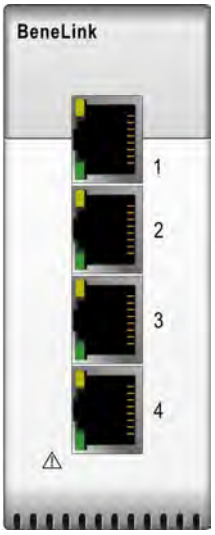
- Select [**Score**] to select the score you want to review.
- Select or to turn the page.
- Select or beside [**Scroll**] to browse the parameter data.
- Select [**Print**] to print the historic score data of the selected patient with the recorder.

FOR YOUR NOTES

30 Device Integration

30.1 Introduction

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



30.2 Safety Information

⚠WARNING

- **Devices of the same category cannot be connected to the BeneLink module simultaneously.**
- **A patient moniotr supports one BeneLink module only.**
- **The signal labels used on the BeneView patient monitor may be different from those given on the external device. For details please see the description of parameters and alarms in corresponding sections of this chapter.**
- **The alarms from the external device may be advanced or delayed before transmission to the BeneView patient monitor.**
- **There can be differences between the alarm priorities displayed on your BeneView patient monitors and the priorities displayed on the external devices interfaced through BeneLink. Please see the list of Output Signals corresponding with each external device for the alarm priorities used by your patient monitor.**

NOTE

- **The above alarm messages are derived from the open protocol of corresponding external device. For more information about these alarms, please see the Instructions for Use matching the device.**

30.3 Supported Devices

Category	Model
Anesthesia Machine	Mindray Wato 20/30/55/65
	Mindray A3/A5/A7
	Maquet Flow-i
	Draeger Fabius GS/Fabius Tiro/Fabius Plus/Primus
	GE Aestiva 7900/Aestiva 7100/Avance/Aisys
	HUL Leon
	HUL Leon Plus
	Draeger Perseus A500
	Draeger ZeusIE
	Draeger Apollo
Ventilator	Mindray E3/E5
	Mindray SV300
	Newport E360
	Puritan Bennett 840
	Maquet SERVO-I/SERVO-S
	Draeger Evita 2
	Draeger Evita 4/ Evita2 dura/Evita XL
	Draeger Evita Infinity V500
	Hamilton G5/C2/Galileo
	Carefusion Vela
	Draeger Savina 300
	Draeger Babylog 8000 plus/Babylog 8000
	Philips Respironics V60
	Resmed VSIII
	Maquet SERVO-U
	ALMS Monnal T75
	GE CARESCAPE R860
	GE Engstrom Carestation
	HUL Leoni Plus
	Draeger Evita V300
	Hamilton S1
Neuromuscular transmission monitor	Organon TOF-Watch® SX
Transcutaneous monitor	TCM CombiM
	TCM TOSCA
	SenTec Digital Monitor (SDM)

NOTE

- **BeneLink module may support more devices than those listed in the above table. Please contact us or our service personnel for the most recent information on the supported devices.**
- **This chapter only focuses on anesthesia and ventilator external devices and excludes neuromuscular transmission devices such as TOF-Watch® SX and transcutaneous devices such as the TCM CombiM, TCM TOSCA, and SenTec Digital Monitor (SDM). For information on how to connect the TOF-Watch® SX to the monitor, please refer to chapter 26 Monitoring NMT(from TOF-Watch SX Monitor) . For information on how to connect he TCM CombiM,TCM TOSCA, and SenTec Digital Monitor (SDM) to the monitor , please refer to chapter 21 Monitoring tcGas.**

30.4 Differences in Displayed Values

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

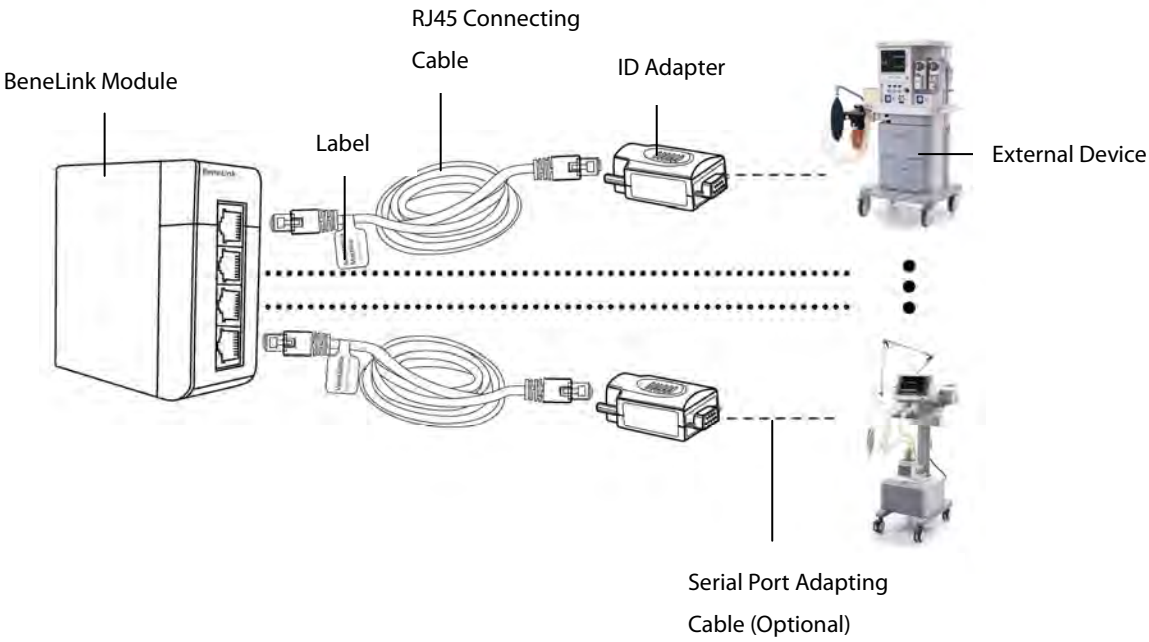
Situation	Possible Reasons
Some parameter values are displayed as invalid values on the BeneView patient monitor.	The patient monitor and the external device may have different parameter configuration or displaying range of values. If the patient monitor displays a parameter that is not configured in the external device or a parameter value from the external device exceeds the displaying range of the patient monitor, the corresponding parameter value is displayed on the patient monitor as an invalid value.
The patient monitor and the external device may display the parameter values with different numbers of places of decimals.	The patient monitor displays the parameter values from the external device based on its own display rules. Same parameter value is displayed differently when the patient monitor and external device adopt different numbers of places of decimals of the value for display.
Non-continuously measured values and continuously measured values have the same displaying mode in the BeneView patient monitor.	Non-continuously measured values are displayed on the patient monitor as latest measured values until a new measurement is performed on the external device.
Differences between the parameter values displayed on the BeneView patient monitor and those displayed on the external device.	Some parameter values are converted to different units during transmission to the patient monitor so that they can be used for calculations. Sometimes, values from the external device may be advanced or delayed before transmission to the BeneView patient monitor.

NOTE

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

30.5 Connecting an External Device

The external device connects with the BeneLink module through an ID adapter, which supports only its matching device. Please refer to the following procedure to connect an external device:



1. Insert the BeneLink module into the module slot on the BeneView patient monitor.
2. Connect the ID adapter that matches the external device to the BeneLink module with an RJ45 connecting cable.
3. Plug the ID adapter into the RS232 port on the external device. Some external devices may have ports incompatible with the ID adapter. In this case, a serial port adapting cable is required. Please see the following table for the required adapting cable.
4. Stick a label indicating device name to the RJ45 connecting cable at the end nearby the BeneLink module. When the BeneLink module is connected to several external devices, you can tell the devices apart easily with these labels.
5. Switch the external device on.

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

The ID adapter has already been correctly configured before leaving the factory. If you want to re-configure the ID adapter, please select [**Main Menu**] → [**Maintenance>>**] → [**Factory Maintenance>>**] →enter the required password →[**Upgrade ID module>>**], and follow this procedure:

1. Set [**Benelink Module Port**] to select which port the RJ45 connecting cable is connected to. You must connect the RJ45 connecting cable to the selected port when re-configuring the ID adapter. Otherwise, ID adapter re-configuration will fail.
2. Set [**ID**] to configure a new ID to the ID adapter.

External Device	ID for ID adapter	Type of serial port adapting cable
Anesthesia Machine		
Mindray Wato 20/30/55/65	4D52B2AE	No need to use the adapting cable: the ID adapter can be plugged into the serial port of the external device directly.
Mindray A3/A5/A7		
Maquet Flow-i	4D46B2BA	Type B
Draeger Fabius GS/ Fabius Plus/ Fabius Tiro	4446BBBA	Fabius GS: No need to use the adapting cable.The ID adapter can be plugged into the serial port of the external device directly. Fabius Plus: Type C Fabius Tiro: Type C
Draeger Primus	4450BBB0	Type C
GE Aestiva 7100/7900	4F37B0C9	Type D
GE Avance Carestation/Aisys	4F41B0BF	Type D
HUL Leon	484CB7B4	Type C
HUL Leon Plus	4850B7B0	Type C
Draeger Perseus A500	4435bbcb	No need to use the adapting cable.The ID adapter can be plugged into the serial port of the external device directly.
Draeger ZeusIE	445abba6	No need to use the adapting cable.The ID adapter can be plugged into the serial port of the external device directly.
Draeger Apollo	444fbbb1	Type C
Ventilator		
Mindray E3/E5	4D56B2AA	No need to use the adapting cable: the ID adapter can be plugged into the serial port of the external device directly.
Mindray SV300		
Newport E360	4E50B1B0	Type B
Puritan Bennett 840	SNDF: 5042AFBE(recommanded) SNDA: 5031AFCF(support less parameters than protocol SNDF)	No need to use the adapting cable. The ID adapter can be plugged into the serial port of the external device directly.
Maquet SERVO-I/SERVO-S	4D53B2AD	Type B
Maquet SERVO-U	4d55B2AB	Type B
Draeger Evita 2/Evita 2 dura/Evita 4/Evita XL	4434BBCC	Type B
Hamilton G5	protocol Block: 3542CABE protocol Polling: 3550CAB0	Type B
Hamilton C2	3270CD90	Type B
Hamilton Galileo	4750B8B0	Type B

External Device	ID for ID adapter	Type of serial port adapting cable
Carefusion Vela	564ca9b4	Type E
Draeger Evita Infinity V500	4456bbaa	No need to use the adapting cable. The ID adapter can be plugged into the serial port of the external device directly.
Draeger Savina 300	4441bbbf	Type B
Draeger Babylog 8000 plus/Babylog 8000	4442bbbe	Type B
Philips Respironics V60	VPRT: 5637A9C9 SDNA: 5636A9CA	Type B
Resmed VSIII	5653a9ad	Type C
ALMS Monnal T75	4154BEAC	No need to use the adapting cable. The ID adapter can be plugged into the serial port of the external device directly.
GE CARESCAPE R860	4F52B0AE	Type B
GE Engstrom Carestation	4F45B0BB	Type B
HUL Leoni Plus	4849B7B7	Type C
Draeger Evita V300	4433bbcd	No need to use the adapting cable. The ID adapter can be plugged into the serial port of the external device directly.
Hamilton S1	protocol Block: 5331accf protocol Polling: 3550cab0	Type B
Other devices		
TOF-Watch® SX	5457ABA9	Type C
TCM CombiM/TCM TOSCA	5443ABBD	Type C
senTec Digital Monitor	5354ACAC	Type C

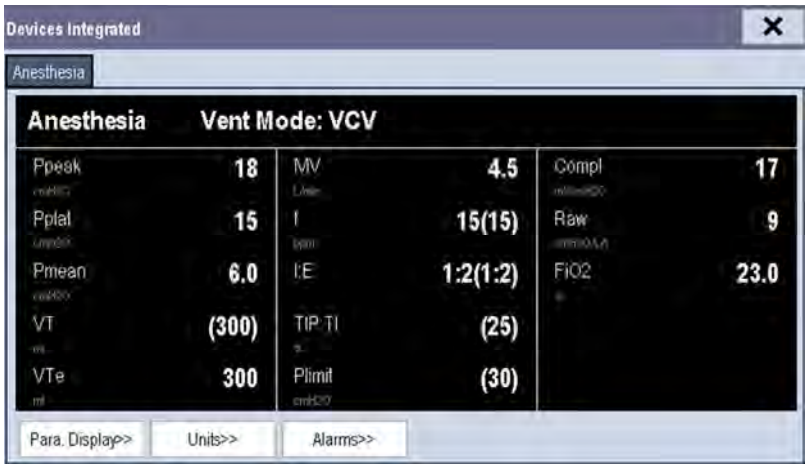
Serial port adapting cable	PN	Remark
Type A	009-001767-00	Male to female
Type B	009-001768-00	Male to male
Type C	009-001769-00	Male to male
Type D	009-002943-00	9-pin to 15-pin
Type E	009-004613-00	9-pin to RJ45 connector

⚠WARNING

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

30.6 Devices Integrated Window

You can view the information of the external device in the [**Devices Integrated**] window, which provides the information of both individual devices and multi devices. In the individual device menu, you can select [**Para. Display>>**], [**Units>>**] or [**Alarms>>**] to set the parameters to be displayed or the parameter units, or view the alarm list.



The parameters in the [**Devices Integrated**] window are displayed in the order of priorities. In the case that the window can not display all the selected parameters, only parameters with higher priorities are displayed. Please refer to the following sections for parameter priorities.

For the parameter that is measured by the external device, the measurement displays directly after the parameter label. For the parameter that is controlled by the external device, its setting is enclosed in a parenthesis after the parameter label. For the parameter that can both be measured and controlled by the external device, both its measurement and setting are displayed after the parameter label, and the setting is also enclosed in a parenthesis. For example, PEEP 18 (20), in which PEEP is parameter label, 18 is the measurement, and (20) is the setting.

In the [**Devices Integrated**] window, you can select [**Multi Devices**] tab to view the parameter information of all the external devices interfaced currently. The displayed parameters are those selected in [**Para. Display**] menu of the individual device window. In the case that the patient monitor can not display all the selected parameters, only parameters of higher priorities are displayed.

30.7 System Functions of Patient Monitor

30.7.1 Alarms

The patient monitor does not display the realtime alarms from the external device. However, you can view current alarm list of the corresponding device by selecting [**Alarms>>**] in the individual device window. The alarm priority is defined by "*" before each alarm message. An alarm list can display up to 100 alarm messages.

30.7.2 Data Storage

The patient monitor can save and review the graphic trends, tabular trends, and alarm events of parameters from the external device. In [**Graphic Trends**] menu and [**Events**] menu, parameter from the external device is displayed in white. In [**Review**] menu, [**Trend Group**] menu, and [**Print Setup**] menu, a mark "+" is shown before each label of parameters from the external device. Please refer to the parameter list to see which parameters can be saved.

NOTE

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

30.7.3 Recording and Printing

Information from the external device can be recorded and printed both in realtime and in graphic and tabular trends with BeneView patient monitor. Besides, the monitor can also record the frozen parameters of the external device.

30.8 Integrating the Anesthesia Machine

30.8.1 Wato 20/30/55/65

30.8.1.1 Output Signals—Parameters

BeneView		Unit	Is it saved in the trends?
Label	Description		
O_2%	Oxygen concentration	%	Yes
PEEP	Positive end-expiratory pressure	cmH_2O hPa mbar	No
Ppeak	Peak pressure	cmH_2O hPa mbar	Yes
Pplat	Plateau pressure	cmH_2O hPa mbar	Yes
Pmean	Mean pressure	cmH_2O hPa mbar	Yes
VT	Tidal volume	ml	No
VTe	Expiratory tidal volume	ml	Yes
MV	Minute volume	L/min	Yes
ftot	Total breath rate	bpm	Yes
f	Breath rate	bpm	No
fSIMV	Frequency of SIMV	bpm	No
FreqMIN	Minimum breath frequency	bpm	No
I:E	Inspiratory time:Expiratory time ratio	/	No
TIP:TI	Percentage of inspiratory plateau time in inspiratory time	%	No
Tslope	Time for the pressure to rise to target pressure	s	No
Tinsp	Time of inspiration	s	No
Trig Window	Trigger Window	%	No
Plimit	Pressure limit level	cmH_2O hPa mbar	No
Pinsp	Pressure control level of inspiration	cmH_2O hPa mbar	No
Psupp	Pressure support level	cmH_2O hPa mbar	No
P-Trigger	Inspiratory trigger level (pressure trigger)	cmH_2O hPa mbar	No
F-Trigger	Inspiratory trigger level (flow trigger)	L/min	No

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
Exp%	Inspiration termination level	%	No
Compl	Compliance	ml/cmH_2O ml/hPa ml/mbar	Yes
RAW	Airway resistance	cmH_2O/L/s hPa/L/s mbar/L/s	Yes
$EtCO_2$	End-tidal carbon dioxide	% mmHg kPa	Yes
$FiCO_2$	Fraction of inspired carbon dioxide	% mmHg kPa	Yes
FiO_2	Fractional concentration of O_2 in inspired gas	% mmHg kPa	Yes
EtO_2	End-tidal O_2	% mmHg kPa	Yes
FiN_2O	Fraction of inspired nitrous oxide	%	Yes
EtN_2O	End-tidal N_2O	%	Yes
FiDes	Inspired anesthetic agent	%	Yes
FiSev		%	Yes
FiEnf		%	Yes
FiIso		%	Yes
FiHal		%	Yes
EtDes	End-tidal anesthetic agent	%	Yes
EtSev		%	Yes
EtEnf		%	Yes
EtIso		%	Yes
EtHal		%	Yes
MAC	Minimum alveolar concentration	/	Yes
N_2O Flow	N_2O flow	L/min	No
Air Flow	Air flow	L/min	No
O_2 Flow	O_2 flow	L/min	No
BIS	Bispectral index	/	Yes
SQI	Signal quality index	/	Yes
SR	Suppression ratio	/	Yes
EMG	Electromyograph	dB	Yes
SEF	Spectral edge frequency	Hz	Yes
TP	Total power	dB	Yes
BC	Burst count	/min	Yes

30.8.1.2 Output Signals—Alarms

BeneView		Wato
Priority	**Label**	**Label**
Physiological alarms		
High	Apnea	Apnea Alarm
	Volume Apnea > 2 min	Volume Apnea>2min
	Paw Too High	Paw Too High
	Paw Too Low	Paw Too Low
	EtO_2 Too High	EtO_2 Too High
	EtO_2 Too Low	EtO_2 Too Low
	FiO_2 Too High	FiO_2 Too High
	FiO_2 Too Low	FiO_2 Too Low
Mediate	VTe Too High	TVe Too High
	VTe Too Low	TVe Too Low
	MV Too High	MV Too High
	MV Too Low	MV Too Low
	$EtCO_2$ Too High	$EtCO_2$ Too High
	$EtCO_2$ Too Low	$EtCO_2$ Too Low
	$FiCO_2$ Too High	$FiCO_2$ Too High
	$FiCO_2$ Too Low	$FiCO_2$ Too Low
	EtN_2O Too High	EtN_2O Too High
	EtN_2O Too Low	EtN_2O Too Low
	FiN_2O Too High	FiN_2O Too High
	FiN_2O Too Low	FiN_2O Too Low
	EtHal Too High	EtHal Too High
	EtHal Too Low	EtHal Too Low
	FiHal Too High	FiHal Too High
	FiHal Too Low	FiHal Too Low
	EtEnf Too High	EtEnf Too High
	EtEnf Too Low	EtEnf Too Low
	FiEnf Too High	FiEnf Too High
	FiEnf Too Low	FiEnf Too Low
	EtIso Too High	EtIso Too High
	EtIso Too Low	EtIso Too Low
	FiIso Too High	FiIso Too High
	FiIso Too Low	FiIso Too Low
	EtSev Too High	EtSev Too High
	EtSev Too Low	EtSev Too Low
	FiSev Too High	FiSev Too High
	FiSev Too Low	FiSev Too Low
	EtDes Too High	EtDes Too High
	EtDes Too Low	EtDes Too Low
	FiDes Too High	FiDes Too High
	FiDes Too Low	FiDes Too Low

BeneView		Wato
Priority	**Label**	**Label**
	BIS Too High	BIS Too High
	BIS Too Low	BIS Too Low
Low	RR Too High	Rate Too High
	RR Too Low	Rate Too Low
	Pressure Limiting	Pressure Limiting
Technical alarms		
High	Drive Gas Pressure Low	Drive Gas Pressure Low
	O_2 Supply Failure	O_2 Supply Failure
	High Technical Alarm	Mechanical Ventilation Failure
		RT Clock Need Reset
		RT Clock Not Exist
		Keyboard Init Error
		Power System Comm Error
		Power System Comm Stop
		Power Supply Voltage Error
		Power Board High Temp
		Low Battery Voltage!
		System DOWN for battery depletion!
		Breathing Circuit Not Mounted
		Check Flow Sensors
		Ventilator Comm Error
		Ventilator Selftest Error
		Ventilator Hardware Error 01/02/03/04/05/06/07/08/09/10/11/12
		Auxi Ctrl Module Hardware Error 01/02/03/04/05
		Auxi Ctrl Module Comm Error
		Auxi Ctrl Module Comm Stop
		Flowmeter Hardware Error 01/02/03/04/05/06/07
		Flowmeter Cal. Data Error 01/02
		O_2-N_2O Ratio Error
		Flowmeter Comm Error
		Flowmeter Comm Stop
		Device Fault, Ventilate Manually
		Paw < -10cmH_2O
Mediate	Patient Circuit Leak	Patient Circuit Leak
	Mediate Technical Alarm	Key Error
		IP Address Conflict
		Battery Undetected
		ACGO On
		O_2 Flush Failure
		PEEP Valve Failure
		Insp Valve Failure

BeneView		Wato
Priority	**Label**	**Label**
		PEEP Safety Valve Failure
		Replace O_2 sensor
		Pressure Monitoring Channel Failure
		Insp Reverse Flow
		Exp Reverse Flow
		TVe Below Control Range
		Ventilator Comm Stop
		Pressure Monitoring Channel Failure
		Volume Monitoring Disabled
		CO_2 Canister Not Mounted
Mediate	CO_2 Module abnormal	CO_2 Comm Stop
		CO_2 Comm Error
		CO_2 Sensor High Temp
		CO_2 Sensor Low Temp
		CO_2 High Airway Press.
		CO_2 Low Airway Press.
		CO_2 High Barometric
		CO_2 Low Barometric
		CO_2 Hardware Error
		CO_2 Sampleline Occluded
		CO_2 System Error
		CO_2 No Watertrap
		$EtCO_2$ Overrange
		$FiCO_2$ Overrange
		CO_2 Zero Failed
		CO_2 Cal. Failed
		CO_2 Factory Cal. Invalid
		CO_2 Check Airway
		CO_2 No Sampleline
		CO_2 Main Board Error
		CO_2 Check Sensor or Main Board
		CO_2 Replace Scrubber&Pump
		CO_2 Replace Sensor
		CO_2 15V Overrange
		CO_2 Init Error
		CO_2 Selftest Error
		CO_2 Temp Overrange
		CO_2 Overrange
		CO_2 Check Cal.
		CO_2 Zero Error
		CO_2 Sensor Error
		CO_2 No Sensor

BeneView		Wato
Priority	**Label**	**Label**
Mediate	AG Module abnormal	AG Hardware Error
		O_2 Sensor Error
		AG Selftest Error
		AG Hardware Malfunction
		AG Init Error
		AG No Watertrap
		AG Change Watertrap
		AG Comm Stop
		AG Airway Occluded
		AG Comm Error
		AG Data Limit Error
		AG Zero Failed
		AG Cal. Failed
		AG Accuracy Error
		O_2 Accuracy Unspecified
		N_2O Accuracy Unspecified
		CO_2 Accuracy Unspecified
		Enf Accuracy Unspecified
		Iso Accuracy Unspecified
		Sev Accuracy Unspecified
		Hal Accuracy Unspecified
		Des Accuracy Unspecified
		Mixed anesthetic gas and MAC < 3
		Mixed anesthetic gas and MAC >= 3
		$EtCO_2$ Overrange
		$FiCO_2$ Overrange
		EtN_2O Overrange
		FiN_2O Overrange
		EtHal Overrange
		FiHal Overrange
		EtEnf Overrange
		FiEnf Overrange
		EtIso Overrange
		FiIso Overrange
		EtSev Overrange
		FiSev Overrange
		EtDes Overrange
		FiDes Overrange
Mediate	BIS Module abnormal	BIS Init Error
		BISx Disconnected
		BIS Comm Error
		BIS Overrange

BeneView		Wato
Priority	**Label**	**Label**
		SQI Overrange
		SR Overrange
		BIS High Imped.
		BIS Sensor Off
		BIS DSC Error
		BIS DSC Malf
		BIS No Cable
		BIS No Sensor
		BIS Wrong Sensor Type
		SQI<50%
		SQI<15%
		BIS Sensor Expired
		BIS Sensor Failure
		BIS Sensor Too Many Uses
		Disconnect/Reconnect BIS
		BIS Selftest Error
Low	O_2 Sensor Unconnected	O_2 Sensor Unconnected
	Battery in Use	Battery in Use
	Low Technical Alarm	Heating Module Failure
		3-way Valve Failure
		Flow Sensor Failure
		Calibrate Flow Sensor
		Calibrate O_2 Sensor
		Calibrate PEEP Valve
		TV Comp Disabled
		TV Not Achieved
		Flowmeter Zero Failed
		N_2O Flow Too High
		O_2 Flow Too High
		Air Flow Too High
		Pinsp Not Achieved
		TVe > TVi
		TV Delivery Too High
		Sensor Zero Failed
		Ventilator Init Error

30.8.2 Mindray A3/A5/A7

30.8.2.1 Output Signals—Parameters

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
I:E	Inspiratory time:Expiratory time ratio	/	No
F-Trigger	Inspiratory trigger level (flow trigger)	L/min	No
P-Trigger	Inspiratory trigger level (pressure trigger)	cmH_2O mbar hPa	No
VT	Tidal volume	ml	No
f	Breath rate	bpm	No
PEEP	Positive end-expiratory pressure	cmH_2O hPa mbar	No
Plimit	Pressure limit level	cmH_2O hPa mbar	No
Pinsp	Pressure control level of inspiration	cmH_2O hPa mbar	No
Psupp	Pressure support level	cmH_2O hPa mbar	No
Tinsp	Time of inspiration	s	No
Tslope	Time for the pressure to rise to target pressure	s	No
Tpause	Apnea Time	s or %	No
FreqMin	Minimum breath frequency	bpm	No
Ppeak	Peak pressure	cmH_2O hPa mbar	Yes
Pplat	Plateau pressure	cmH_2O hPa mbar	Yes
Pmean	Mean pressure	cmH_2O hPa mbar	Yes
MV	Minute volume	L/min	Yes
VTe	Expiratory tidal volume	ml	Yes
RAW	Airway resistance	cmH_2O/L/s hPa/L/s mbar/L/s	Yes
Compl	Compliance	ml/cmH_2O ml/hPa ml/mbar	Yes

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
FiO_2	Fractional concentration of O_2 in inspired gas	% mmHg kPa	Yes
EtO_2	End-tidal O_2	% mmHg kPa	Yes
N_2O Flow	N_2O flow	L/min	No
Air Flow	Air flow	L/min	No
O_2 Flow	O_2 flow	L/min	No
$EtCO_2$	End-tidal carbon dioxide	% mmHg kPa	Yes
$FiCO_2$	Fraction of inspired carbon dioxide	% mmHg kPa	Yes
FiN_2O	Fraction of inspired nitrous oxide	%	Yes
EtN_2O	End-tidal N_2O	%	Yes
EtDes	End-tidal anesthetic agent	%	Yes
EtSev		%	Yes
EtEnf		%	Yes
EtIso		%	Yes
EtHal		%	Yes
FiDes	Inspired anesthetic agent	%	Yes
FiSev		%	Yes
FiEnf		%	Yes
FiIso		%	Yes
FiHal		%	Yes
FiAA	Inspired anesthetic agent	%	Yes
EtAA	End-tidal anesthetic agent	%	Yes
MAC	Minimum alveolar concentration	/	Yes
BIS	Bispectral index	/	Yes
SQI	Signal quality index	/	Yes
SR	Suppression ratio	/	Yes
EMG	Electromyograph	dB	Yes
SEF	Spectral edge frequency	Hz	Yes
TP	Total power	dB	Yes
BC	Burst count	/min	Yes
HALLev	Anesthetic agent consupmtion	ml	No
ENFLev			
ISOLev			
DESLev			
SEVLev			

30.8.2.2 Output Signals—Alarms

BeneView		Mindray A3/A5/A7
Priority	**Label**	**Label**
Physiological alarms		
High	Apnea	Apnea CO_2/Apnea
	Volume Apnea>2min	Volume Apnea > 2 min
	Paw Too High	Paw Too High
	Paw Too Low	Paw Too Low
	FiO_2 Too High	FiO_2 Too High
	FiO_2 Too Low	FiO_2 Too Low
Mediate	MV Too High	MV Too High
	MV Too Low	MV Too Low
	$EtCO_2$ Too High	$EtCO_2$ Too High
	$EtCO_2$ Too Low	$EtCO_2$ Too Low
	$FiCO_2$ Too High	$FiCO_2$ Too High
	EtN_2O Too Low	EtN_2O Too Low
	EtN_2O Too High	EtN_2O Too High
	FiN_2O Too Low	FiN_2O Too Low
	FiN_2O Too High	FiN_2O Too High
	EtHal Too Low	EtHal Too Low
	EtHal Too High	EtHal Too High
	FiHal Too Low	FiHal Too Low
	FiHal Too High	FiHal Too High
	EtEnf Too Low	EtEnf Too Low
	EtEnf Too High	EtEnf Too High
	FiEnf Too Low	FiEnf Too Low
	FiEnf Too High	FiEnf Too High
	EtIso Too Low	EtIso Too Low
	EtIso Too High	EtIso Too High
	FiIso Too Low	FiIso Too Low
	FiIso Too High	FiIso Too High
	EtSev Too Low	EtSev Too Low
	EtSev Too High	EtSev Too High
	FiSev Too Low	FiSev Too Low
	FiSev Too High	FiSev Too High
	EtDes Too Low	EtDes Too Low
	EtDes Too High	EtDes Too High
	FiDes Too Low	FiDes Too Low
	FiDes Too High	FiDes Too High
Low	Pressure Limiting	Pressure Limiting
Technical alarms		
High	Drive Gas Pressure Low	Drive Gas Pressure Low
	O_2 Supply Failure	O_2 Supply Failure

BeneView		Mindray A3/A5/A7
Priority	**Label**	**Label**
	No Fresh Gas	No Fresh Gas
	High Technical Alarm	Negative Pressure
		Safety Valve Failure
		Check Flow Sensors
		O_2-N_2O Ratio Error
		Flowmeter Comm Stop
		Aux Control Module Comm Stop
		Power System Comm Stop
		Low Battery Voltage
		System going DOWN, Battery depleted!
		Power Board High Temp
		Breathing System Not Mounted
Mediate	O_2 Sensor Unconnected	O_2 Sensor Disconnected
	Patient Circuit Leak	Patient Circuit Leak
	Mediate Technical Alarm	PEEP Valve Failure
		Insp Valve Failure
		CO_2 Absorber Canister Not Locked
		ACGO 3-way Valve Failure
		Replace O_2 Sensor
		Ventilator Comm Stop
		Battery Undetected
		IP Address Conflict
		Fan Failure
Mediate	AG Module Abnormal	AG Hardware Error
		O_2 Sensor Error
		External AG Self Test Error
		AG Hardware Malfunction
		AG Init Error
		AG No Watertrap
		AG Watertrap Type Wrong
		AG Change Watertrap
		AG Comm Stop
		AG Airway Occluded
		AG Comm Error
		AG Data Limit Error
		AG Zero Failed
		AG Cal. Failed
		AG Accuracy Error
		CO_2 Accuracy Unspecified
		N_2O Accuracy Unspecified
		CO_2 Accuracy Unspecified
		Enf Accuracy Unspecified
		Iso Accuracy Unspecified

BeneView		Mindray A3/A5/A7
Priority	**Label**	**Label**
		Sev Accuracy Unspecified
		Hal Accuracy Unspecified
		Des Accuracy Unspecified
		Mixed anesthetic gas and MAC < 3
		Mixed anesthetic gas and MAC >= 3
		$EtCO_2$ Over Range
		$FiCO_2$ Over Range
		EtN_2O Over Range
		FiN_2O Over Range
		EtHal Over Range
		FiHal Over Range
		EtEnf Over Range
		FiEnf Over Range
		EtIso Over Range
		FiIso Over Range
		EtSev Over Range
		FiSev Over Range
		EtDes Over Range
		FiDes Over Range
		EtO_2 Over Range
		FiO_2 Over Range
		Internal AG Error 01 02 03 04 05 06 07 08 09 10 11 12
Mediate	BIS Module abnormal	BIS Init Error
		BISx Disconnected
		BIS Comm Error
		BIS Over Range
		SQI Over Range
		SR Over Range
		BIS High Imped.
		BIS Sensor Off
		BIS DSC Error
		BIS DSC Malf
		BIS No Cable
		BIS No Sensor
		BIS Wrong Sensor Type
		BIS Sensor Checking
		BIS Sensor Check Failed
		BIS Ground Checking
		BIS Electrode 1 Lead Off
		BIS Electrode 1 High Imped.
		BIS Electrode 2 Lead Off
		BIS Electrode 2 High Imped.

BeneView		Mindray A3/A5/A7
Priority	**Label**	**Label**
		BIS Electrode 3 Lead Off
		BIS Electrode 3 High Imped.
		BIS Electrode 4 Lead Off
		BIS Electrode 4 High Imped.
		BIS Electrode Unconnected
		BIS SQI<50%
		BIS SQI<15%
		BIS Sensor Expired
		BIS Sensor Fault
		BIS Sensor Too Many Uses
		Disconnect/Reconnect BIS
		BIS Self Test Error
		BIS Interference
		BIS Comm Abnormal
		BIS in Demo
Low	Battery in Use	Battery in Use
	Low Technical Alarm	Flow Sensor Failure
		Pinsp Not Achieved
		Vt Not Achieved
		Calibrate O_2 Sensor
		N_2O Flow Too High
		O_2 Flow Too High
		Air Flow Too High
		Internal N_2O Flow Failure
		Internal O_2 Flow Failure
		Internal Air Flow Failure
		Heating Module Failure
		Automatic Ventilation Disabled

30.8.3 Maquet Flow-i

30.8.3.1 Output Signals—Parameters

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
PEEP	Positive end-expiratory pressure	cmH_2O hPa mbar	No
Ppeak	Peak pressure	cmH_2O hPa mbar	Yes
Pplat	Plateau pressure	cmH_2O hPa mbar	Yes
Pmean	Mean pressure	cmH_2O hPa mbar	Yes
VT	Tidal volume	ml	No
VTi	Inspired tidal volume	ml	Yes
MV	Minute volume	L/min	Yes
MVe	Expiratory minute volume	L/min	Yes
MVi	Inspiratory mimute volume	L/min	Yes
ftot	Total respiratory rate	bpm	Yes
f	Breath rate	bpm	No
I:E	Inspiratory time:Expiratory time ratio	/	No
TIP:TI	Percentage of inspiratory plateau time in inspiratory time	%	No
Rise Time%	rise time%	%	No
Tslope	Time for the pressure to rise to target pressure	s	No
Tinsp	Time of inspiration	s or %	No
Tapnea	Apnea time	s	No
PC above PEEP	PC above PEEP	cmH_2O hPa mbar	No
PS above PEEP	PS above PEEP	cmH_2O hPa mbar	No
P-Trigger	Inspiratory trigger level(pressure trigger)	cmH_2O hPa mbar	No
F-Trigger	Inspiratory trigger level (flow trigger)	L/min	No
Insp Flow	Inspiratory flow	L/min	No
Exp Flow	Expiratory flow	L/min	No

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
Compl	Compliance	ml/cmH_2O ml/hPa ml/mbar	Yes
$EtCO_2$	End-tidal carbon dioxide	% mmHg kPa	Yes
$FiCO_2$	Fraction of inspired carbon dioxide	% mmHg kPa	Yes
FiO_2	Fractional concentration of O_2 in inspired gas	% mmHg kPa	Yes
EtO_2	End-tidal O_2	% mmHg kPa	Yes
FiN_2O	Fraction of inspired nitrous oxide	%	Yes
EtN_2O	End-tidal N_2O	%	Yes
FiAA	Inspired anesthetic agent	%	Yes
EtAA	End-tidal anesthetic agent	%	Yes
FiAA 2nd	2nd Insp. Agent	%	Yes
EtAA 2nd	2nd Exp. Agent	%	Yes
MAC	Minimum alveolar concentration	/	Yes
PO_2	Oxygen supply pressure	kPa	No
PN_2O	N_2O supply pressure	kPa	No
Pair	Air supply pressure	kPa	No
FG	Fresh gas flow	ml/min	No
Ti/Ttot	Duty cycle or ratio of inspiration time to total breathing cycle time (only during spontaneous breathing)	/	No

30.8.3.2 Output Signals—Alarms

BeneView		Maquet Flow-i
Priority	**Label**	**Label**
Physiological alarms		
High	Apnea	Apnea
	Paw Too High	Paw High
	High Paw Sustained	High continuous pressure
Mediate	MV Too High	MV too high
	MV Too Low	MV too Low
	PEEP Too High	PEEP High
	PEEP Too Low	PEEP Low

BeneView		Maquet Flow-i
Priority	**Label**	**Label**
	$EtCO_2$ Too High	$EtCO_2$ High
	$EtCO_2$ Too Low	$EtCO_2$ Low
	$FiCO_2$ Too High	$FiCO_2$ High
	FiN_2O Too High	FiN_2O High
	EtIso Too High	EtISO High
	FiIso Too High	FiISO High
	FiIso Too Low	FiISO Low
	EtSev Too High	EtSEV High
	EtSev Too Low	EtSEV Low
	FiSev Too High	FiSEV High
	EtDes Too High	EtDES High
	EtDes Too Low	EtDES Low
	EtO_2 Too High	EtO_2 High
	EtO_2 Too Low	EtO_2 Low
	FiO_2 Too High	FiO_2 High
	FiO_2 Too Low	FiO_2 Low
Low	RR Too High	frequency high
	RR Too Low	frequency low
Technical alarms		
High	Circuit Occluded	Gas sampling tube Occlusion
	High Technical Alarm	Mixture of Anesthesia agents
		Gas Supply
		Cross contamination of anesthesic Agents
		Vaporizer liquid level
		battery alarm
		patient Cassette remove
		patient Cassette exchange
Mediate	Mediate Technical Alarm	Gas Analyzer water trap
		Gas Analyzer water trap missing
		internal communicaiton failture
Low	Battery in Use	Battery operation

30.8.4 Draeger Fabius GS/Fabius Tiro/Fabius Plus

30.8.4.1 Output Signals—Parameters

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
PEEP	Positive end-expiratory pressure	cmH_2O hPa mbar	No
Ppeak	Peak pressure	cmH_2O hPa mbar	Yes
Pplat	Plateau pressure	cmH_2O hPa mbar	Yes
Pmean	Mean pressure	cmH_2O hPa mbar	Yes
Paw	Airway pressure	cmH_2O hPa mbar	Yes
VT	Tidal volume	ml	No
VTe	Expiratory tidal volume	ml	Yes
MV	Minute volume	L/min	Yes
f	Breath rate	bpm	No
fspn	Spontaneous respiratory rate	bpm	Yes
I:E	Inspiratory time:Expiratory time ratio	/	No
TIP:TI	Percentage of inspiratory plateau time in inspiratory time	%	No
Tinsp	Time of inspiration	s	No
Pinsp	Pressure control level of inspiration	cmH_2O hPa mbar	No
Psupp	Pressure support level	cmH_2O hPa mbar	No
Pmax	Maximal breathing pressure	cmH_2O Mbar hPa	No
F-Trigger	Inspiratory trigger level (flow trigger)	L/min	No
Insp Flow	Inspiration flow	L/min	No
Exp Flow	Expiratory flow	L/min	No
$RRCO_2$	Respiratory rate of CO_2	bpm	Yes
$EtCO_2$	End-tidal carbon dioxide	% mmHg kPa	Yes

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
$FiCO_2$	Fraction of inspired carbon dioxide	% mmHg kPa	Yes
FiO_2	Fractional concentration of O_2 in inspired gas	% mmHg kPa	Yes
FiN_2O	Fraction of inspired nitrous oxide	%	Yes
EtN_2O	End-tidal N_2O	%	Yes
FiDes	Inspired anesthetic agent	%	Yes
FiSev		%	Yes
FiEnf		%	Yes
FiIso		%	Yes
FiHal		%	Yes
EtEnf	End-tidal anesthetic agent	%	Yes
EtDes		%	Yes
EtIso		%	Yes
EtSev		%	Yes
EtHal		%	Yes
FiAA	Inspired anesthetic agent	%	Yes
EtAA	End-tidal anesthetic agent	%	Yes
FiAA 2nd	2nd Insp. Agent	%	Yes
EtAA 2nd	2nd Exp. Agent	%	Yes
Insp. MAC	Inspired minimum alveolar concentration	/	No
Exp. MAC	Expired minimum alveolar concentration	/	No
MAC	Minimum alveolar concentration	/	Yes
ATMP	Barometric pressure	mmHg	No
HALLev	Anesthetic agent consupmtion	ml	No
ENFLev			
ISOLev			
DESLev			
SEVLev			
VO_2	Oxygen consumption	ml/min	Yes
VO_2/m^2	Oxygen consumption per body surface area	$ml/min/m^2$	No
VO_2/kg	Oxygen consumption per body weight	ml/min/kg	No
VCO_2	CO_2 production	ml/min	No
EE	Energy expenditure	kcal/day	No
RQ	Respiratory quotient	/	No
PO_2	Oxygen supply pressure	kPa	No
PN_2O	N_2O supply pressure	kPa	No
Pair	Air supply pressure	kPa	No
O_2 cyl.	Oxygen cylinder pressure	kPa	No
O_2 cyl.2nd	Secondary oxygen cylinder pressure	kPa	No
N_2O cyl.	N_2O cylinder pressure	kPa	No

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
air cyl.	Air cylinder pressure	kPa	No
FG	Fresh gas flow	ml/min	No
N_2O Flow	N_2O flow	L/min	No
Air Flow	Air flow	L/min	No
O_2 Flow	O_2 flow	L/min	No
Des flow	Anesthetic agent flow	ml/h	No
Enf flow			
Iso flow			
Hal flow			
Sev flow			
IBW	Ideal body weight	kg	No
BSA	Body surface area	m^2	No
BIS	Bispectral index	/	Yes
SQI	Signal quality index	/	Yes
SR	Suppression ratio	/	Yes
EMG	Electromyograph	dB	Yes
SEF	Spectral edge frequency	Hz	Yes
TP	Total power	dB	Yes
BC	Burst count	/min	Yes
SpO_2	Arterial oxygen saturation from pulse oximetry	%	Yes
PR	Pulse rate	bpm	Yes

30.8.4.2 Output Signals—Alarms

BeneView		Fabius GS/Fabius Tiro/Fabius Plus
Priority	**Label**	**Label**
Physiological alarms		
High	Apnea	APNEA VENT
	Volume Apnea > 2 min	APNEA VOL
	Pressure Apnea	APNEA PRES
	Paw Too High	PAW HIGH
	Paw Too Low	PAW NEGATIVE
	FiO_2 Too Low	% O_2 LOW
	CONT PRES	CONT PRES
Mediate	FiO_2 Too High	% O_2 HIGH
	MV Too High	MIN VOL HIGH
	MV Too Low	MIN VOL LOW
	PEEP Too High	PEEP HIGH
	PRESS EXP High	PRESS EXP HI
Low	PRESSURE LIM	PRESSURE LIM
Technical alarms		

BeneView		Fabius GS/Fabius Tiro/Fabius Plus
Priority	**Label**	**Label**
High	O_2 Supply Failure	LO O_2 SUPPLY
	Check APL Valve	APL VALVE ?
	No Fresh Gas	NO FRESHGAS
	High Technical Alarm	VENT ERR
Mediate	Check Expiration-Valve	EXP-VALVE ?
	Check Fresh Gas Supply	FRESH GAS ?
	Mediate Technical Alarm	BATTERY LOW
		PRESS ERR
		VOL ERR
Low	Low Technical Alarm	SPEAKER FAIL
		POWER FAIL
		CAL % O_2 ?
		% O_2 ERR
		TIME LIMITED
		RS232COM ERR
		PORT 1 ERROR
		PORT 2 ERROR
		THRESHOLD LO

30.8.5 Draeger Primus

30.8.5.1 Output Signals—Parameters

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
O_2%	Oxygen concentration	%	Yes
PEEP	Positive end-expiratory pressure	cmH_2O hPa mbar	Yes
Ppeak	Peak pressure	cmH_2O hPa mbar	Yes
Pplat	Plateau pressure	cmH_2O hPa mbar	Yes
Pmean	Mean pressure	cmH_2O hPa mbar	Yes
Paw	Airway pressure	cmH_2O hPa mbar	Yes
VT	Tidal volume	ml	No
VTi	Inspired tidal volume	ml	Yes

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
MV	Minute volume	L/min	Yes
MVe	Expiratory minute volume	L/min	Yes
MVLEAK	Leakage minute volume	L/min	No
ftot	Total respiratory rate	bpm	Yes
f	Breath rate	bpm	No
fmand	Mandatory breathing frequency	bpm	No
fspn	Spontaneous respiratory rate	bpm	Yes
FreqMIN	Minimum breath frequency	bpm	No
I:E	Inspiratory time:Expiratory time ratio	/	No
TIP:TI	Percentage of inspiratory plateau time in inspiratory time	%	No
Tslope	Time for the pressure to rise to target pressure	s	No
Tinsp	Time of inspiration	s	No
Pinsp	Pressure control level of inspiration	cmH_2O hPa mbar	No
Psupp	Pressure support level	cmH_2O hPa mbar	No
Pmax	Maximal breathing pressure	cmH_2O Mbar hPa	No
F-Trigger	Inspiratory trigger level (flow trigger)	L/min	No
Compl	Compliance	ml/cmH_2O ml/hPa ml/mbar	Yes
$RRCO_2$	Respiratory rate of CO_2	bpm	Yes
$EtCO_2$	End-tidal carbon dioxide	% mmHg kPa	Yes
$FiCO_2$	Fraction of inspired carbon dioxide	% mmHg kPa	Yes
FiO_2	Fractional concentration of O_2 in inspired gas	% mmHg kPa	Yes
EtO_2	End-tidal O_2	% mmHg kPa	Yes
ΔO_2	Difference between inspiratory and expiratory O_2	% mmHg kPa	No
Tapnea	Apnea time	s	No

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
FiN_2O	Inspired anesthetic agent	%	Yes
FiIso		%	Yes
FiDes		%	Yes
FiEnf		%	Yes
FiSev		%	Yes
FiHal		%	Yes
EtN_2O	End-tidal anesthetic agent	%	Yes
EtEnf		%	Yes
EtDes		%	Yes
EtIso		%	Yes
EtSev		%	Yes
EtHal		%	Yes
FiAA	Inspired anesthetic agent	%	Yes
EtAA	End-tidal anesthetic agent	%	Yes
FiAA 2nd	2nd Insp. Agent	%	Yes
EtAA 2nd	2nd Exp. Agent	%	Yes
Insp. MAC	Inspired minimum alveolar concentration	/	No
Exp. MAC	Expired minimum alveolar concentration	/	No
MAC	Minimum alveolar concentration	/	Yes
HALLev	Anesthetic agent consupmtion	ml	No
ENFLev			
ISOLev			
DESLev			
SEVLev			
VO_2	Oxygen consumption	ml/min	Yes
FG	Fresh gas flow	ml/min	No
N_2O Flow	N_2O flow	L/min	No
Air Flow	Air flow	L/min	No
O_2 Flow	O_2 flow	L/min	No
SpO_2	Arterial oxygen saturation from pulse oximetry	%	Yes
PR	Pulse rate	bpm	Yes

30.8.5.2 Output Signals—Alarms

BeneView		Draeger Primus
Priority	**Label**	**Label**
Physiological alarms		
High	Apnea	APNEA/APNEA VENT
	Volume Apnea > 2 min	APNEA VOL
	Pressure Apnea	APNEA PRES
	Paw Too High	PAW HIGH
	Paw Too Low	PAW NEGATIVE
	FiO_2 Too Low	% O_2 LOW
	CONT PRES	CONT PRES
	CO_2 Apnea	APNEA CO_2
	No Pulse	NO SPO_2 PULS
	PR Too Low	SPO_2 PULS LO
	SpO_2 Too Low	SPO_2 LOW
Mediate	FiO_2 Too High	FI O_2 HIGH
	VTe Too Low	TIDAL VOL. ?
	MV Too High	MIN VOL HIGH
	MV Too Low	MIN VOL LOW
	PEEP Too High	PEEP HIGH
	$EtCO_2$ Too High	ET CO_2 HIGH
	$EtCO_2$ Too Low	ET CO_2 Low
	$FiCO_2$ Too High	INSP CO_2 HIGH
	FiN_2O Too High	FI N_2O HIGH
	EtHal Too High	EXP. HAL HIGH
	FiHal Too High	% HAL HIGH
	FiHal Too Low	% HAL LOW
	EtEnf Too High	EXP. ENF HIGH
	FiEnf Too High	% ENF HIGH
	FiEnf Too Low	% ENF LOW
	EtIso Too High	EXP. ISO HIGH
	FiIso Too High	% ISO HIGH
	FiIso Too Low	% ISO LOW
	EtSev Too High	EXP. SEV HIGH
	FiSev Too High	% SEV HIGH
	FiSev Too Low	% SEV LOW
	EtDes Too High	EXP. DES HIGH
	FiDes Too High	% DES HIGH
	FiDes Too Low	% DES LOW
	MAC Too Low	MAC LOW?
	PR Too High	SPO_2 PULS HI
	SpO_2 Too High	SPO_2 HIGH
Technical alarms		

BeneView		Draeger Primus
Priority	**Label**	**Label**
High	O_2 Supply Failure	O_2 SUPPLY ?
	No Fresh Gas	NO FRESHGAS
	Circuit Occluded	CIRCLE OCCL
	VENT DISC	VENT DISC
	High Technical Alarm	VENT ERR
		INT.TMP.HIGH
		O_2CYL.DISCON
		CHK N_2O CYL
		NO N_2O DELIV
		NO O_2 DELIV.
		NO AIR DELIV
		FG X-OVER ?
		VENT.UNLOCKD
		AW-TEMP HIGH
		NO N_2O
Mediate	Patient Circuit Leak	LEAKAGE
	Check Fresh Gas Supply	FRESH GAS ?
	Mediate Technical Alarm	POWER FAIL
		BATTERY LOW
		N_2O SUPPLY ?
		PRESSURE LIM
		MIXER INOP
		P MAX?
		SAFETY O_2 ON
		FG.FLOW LIM.
		LOSS OF DATA
		HOSES MIXED?
		WRONG HOSES?
		% O_2 ERR
		SET.CANCELED
		FG TOO HIGH
		FG ACTIVE
		FG AIR SENS?
		FG O_2 SENS?
		FG N_2O SENS?
		ABS. PRESENT?
Mediate	AG Module abnormal	WATERTR. OLD?
		MIXED AGENT
		CO_2/AGT ERR
		N_2O ERR
		AGT ERR
		2nd AGENT

BeneView		Draeger Primus
Priority	**Label**	**Label**
		$FICO_2$ OFF
		CO_2 LINE BLK
		CO_2 ALRM OFF
Low	NO AIR	NO AIR
	NO O_2 SUPPLY	NO O_2 SUPPLY
	Low Technical Alarm	FAN ERR
		PWR SPLY ERR
		PRESS ERR
		VOL ERR
		LO O_2 SUPPLY
		CHK O_2 CYL
		ID-FUNC-INOP
		HOSE OLD?
		HOSE MISSING
		COM VENT ERR
		APOLLO COM1?
		APOLLO COM2?
		O_2 CYL OPEN
		N_2O CYL OPEN
		AIR CYL OPEN
		N_2OCYL.SENS?
		AIRCYL.SENS?
		O_2 CYL.SENS?
		AIR CYL.?
		PRESS RELIEF
		ABSORB. OLD?
		INSP VOL ERR
Low	SpO_2 Module abnormal	SPO_2SEN DISC
		SPO_2 ALRM OF
		SPO_2 ERR

30.8.6 GE Aestiva 7900/Aestiva 7100

30.8.6.1 Output Signals—Parameters

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
VTe	Expiratory tidal volume	ml	Yes
MVe	Expiratory minute volume	L/min	Yes
O_2%	Oxygen concentration	%	Yes
Ppeak	Peak pressure	cmH_2O hPa mbar	Yes
Pplat	Plateau pressure	cmH_2O hPa mbar	Yes
Pmean	Mean pressure	cmH_2O hPa mbar	Yes
Pmin	Minimum airway pressure	cmH_2O mbar hPa	No
VT	Tidal volume	ml	No
f	Breath rate	bpm	No
I:E	Percentage of inspiratory plateau time in inspiratory time	%	No
TIP:TI	Percentage of inspiratory plateau time in inspiratory time	%	No
PEEP	Positive end-expiratory pressure	cmH_2O hPa mbar	No
Plimit	Pressure limit level	cmH_2O mbar hPa	No
Pinsp	Pressure control level of inspiration	cmH_2O mbar hPa	No

30.8.6.2 Output Signals—Alarms

BeneView		Aestiva 7900/Aestiva 7100
Priority	**Label**	**Label**
Physiological alarms		
High	FiO_2 Too Low	Low O_2
	Paw Too High	High Paw
	Paw Too Low	Low Paw
	High Paw Sustained	Sustained Paw (shutdown)
	Volume Apnea > 2 min	Volume Apnea > 2 min
Mediate	FiO_2 Too High	High O_2
	Sub-Atmospheric Paw	Sub-Atmospheric Paw
	MV Too Low	Low VE
	MV Too High	High VE
	VTe Too Low	Low Vte
	VTe Too High	High Vte
	Volume Apnea	Volume Apnea
Low	Pressure Limiting	Sustained Paw
Technical alarms		
High	O_2 Supply Failure	No O_2 Pressure
	No Fresh Gas	No Fresh Gas Flow
	High Technical Alarm	Pinspired Not Achieved
		Inspiration Stopped
		+15V SIB Out-of-Range
		+15V Manifold Out-of-Range
		Display Voltage Out-of-Range
		Vaux_ref Out-of-Range
		Vext_ref Out-of-Range
		A/D Converter Failure
		CPU Failure
		Memory (EEPROM) Failure
		Memory (flash) Failure
		Memory (RAM) Failure
		Memory (video) Failure
		Bootup Memory Failure
		Software Watchdog Failure
		Hardware Watchdog Failure
		Internal Clock Too Fast
		Internal Clock Too Slow
		CPU Internal Error
		Control Settings Input Has Failed
Mediate	Mediate Technical Alarm	No Pressure Mode/PEEP
		Inspiratory Overshoot
		Manifold Pressure Sensor Failure

BeneView		Aestiva 7900/Aestiva 7100
Priority	**Label**	**Label**
		High Pressure Limit Reached (min sys)
		Inspiratory Reverse Flow
		Expiratory Reverse Flow
		Check Flow Sensors
		Flow Valve Failure
		Gas Inlet Valve Failure
		Bootup Gas Inlet Valve Failure
		Memory (redundant storage) Fail
		No Battery
		Low Battery Charge
		Low VE Limit Set
Low	Battery in Use	On Battery
	Low Technical Alarm	Check O_2 Sensor
		O_2 Calibration Error
		PEEP Not Achieved
		Vt Not Achieved
		No Inspiratory Flow Sensor
		No Expiratory Flow Sensor
		Insp Vt/Vte Mismatch
		Vdel Mismatch
		Bellows Empty
		'+Vanalog Failure
		'-Vanalog Failure
		Flow Sensor Cal Data Corrupt
		Low Battery
		Low Battery (shutdown)
		Battery Voltage Out Of Range
		Battery Current Out Of Range
		Circuit Auxiliary
		Auxiliary Breathing Circuit
		Service Calibrations Due

30.8.7 GE Avance Carestation/Aisys

30.8.7.1 Output Signals—Parameters

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
Vte	Expiratory tidal volume	ml	Yes
MVe	Expiratory minute volume	L/min	Yes
ftot	Total respiratory rate	bpm	Yes
O_2%	Oxygen concentration	%	Yes
Ppeak	Peak pressure	cmH_2O hPa mbar	Yes
Pplat	Plateau pressure	cmH_2O hPa mbar	Yes
Pmean	Mean pressure	cmH_2O hPa mbar	Yes
Pmin	Minimum airway pressure	cmH_2O mbar hPa	No
MVspn	Spontaneous breathed minute volume	L/min	Yes
fspn	Spontaneous respiratory rate	bpm	Yes
PEEPi	Intrinsic positive end-expiratory pressure	cmH_2O hPa mbar	No
Compl	Compliance	ml/cmH_2O ml/hPa ml/mbar	Yes
RAW	Airway resistance	cmH_2O/L/s hPa/L/s mbar/L/s	Yes
VTi	Inspired tidal volume	ml	Yes
MVi	Inspiratory mimute volume	L/min	Yes
Paux Peak	Peak auxiliary pressure	cmH_2O hPa mbar	No
Paux Mean	Mean auxiliary pressure	cmH_2O hPa mbar	No
Paux Min	Minimum auxiliary pressure	cmH_2O hPa mbar	No

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
PEEPe	Extrinsic positive end-expiratory pressure	cmH_2O hPa mbar	No
PEEPtot	Total PEEP	cmH_2O hPa mbar	No
PEEPi time	Intrinsic PEEP age (elapsed time since last maneuver)	min	No
P0.1	100 ms occlusion pressure	cmH_2O hPa mbar	No
P0.1 time	P0.1 age (elapsed time since last maneuver)	min	No
ATMP	Barometric pressure	mmHg	No
FiO_2	Fractional concentration of O_2 in inspired gas	% mmHg kPa	Yes
EtO_2	End-tidal O_2	% mmHg kPa	Yes
ΔO_2	Difference between inspiratory and expiratory O_2	% mmHg kPa	No
$FiCO_2$	Fraction of inspired carbon dioxide	% mmHg kPa	Yes
$EtCO_2$	End-tidal carbon dioxide	% mmHg kPa	Yes
$RRCO_2$	Respiratory rate of CO_2	bpm	Yes
FiAA	Inspired anesthetic agent	%	Yes
EtAA	End-tidal anesthetic agent	%	Yes
FiAA 2nd	2nd Insp. Agent	%	Yes
EtAA 2nd	2nd Exp. Agent	%	Yes
FiN_2O	Fraction of inspired nitrous oxide	%	Yes
EtN_2O	End-tidal N_2O	%	Yes
MAC	Minimum alveolar concentration	/	Yes
VO_2	Oxygen consumption	ml/min	Yes
VO_2/m^2	Oxygen consumption per body surface area	$ml/min/m^2$	No
VO_2/kg	Oxygen consumption per body weight	ml/min/kg	No
VCO_2	CO_2 production	ml/min	No
EE	Energy expenditure	kcal/day	No
RQ	Respiratory quotient	/	No
PO_2	oxygen supply pressure	kPa	No

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
PN_2O	N_2O supply pressure	kPa	No
Pair	air supply pressure	kPa	No
O_2 cyl.	Oxygen cylinder pressure	kPa	No
O_2 cyl.2nd	Secondary oxygen cylinder pressure	kPa	No
N_2O cyl.	N_2O cylinder pressure	kPa	No
air cyl.	Air cylinder pressure	kPa	No
Des flow	Anesthetic agent flow	ml/h	No
Enf flow			
Iso flow			
Hal flow			
Sev flow			
O_2 Flow	O_2 flow	L/min	No
N_2O Flow	N_2O flow	L/min	No
Air Flow	Air flow	L/min	No
Tinsp	Time of inspiration	s	No
Texp	Expiratory time	s	No
I:E	Inspiratory time:Expiratory time ratio	/	No
FRC	Fractional residual capacity	ml	No
VT	Tidal volume	ml	No
f	Breath rate	bpm	No
TIP:TI	Percentage of inspiratory plateau time in inspiratory time	%	No
PEEP	Positive end-expiratory pressure	cmH_2O hPa mbar	No
Plimit	Pressure limit level	cmH_2O hPa mbar	No
Pinsp	Pressure control level of inspiration	cmH_2O hPa mbar	No
Psupp	Pressure support level	cmH_2O hPa mbar	No
Pmax	Maximal breathing pressure	cmH_2O Mbar hPa	No
Tapnea	Apnea time	s	No
IBW	Ideal body weight	Kg	No
BSA	Body surface area	m^2	No
Rise Time%	rise time%	%	No
F-Trigger	Inspiratory trigger level (flow trigger)	L/min	No

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
P-Trigger	Inspiratory trigger level(pressure trigger)	cmH_2O hPa mbar	No
Tinsp	Time of inspiration	s or %	No
Tpause	Apnea Time	s or %	No

30.8.7.2 Output Signals—Alarms

BeneView		GE Avance Carestation/Aisys
Priority	**Label**	**Label**
Physiological alarms		
High	Paw Too High	High Paw
	Paw Too Low	Low Paw
	High Paw Sustained	High Paw Sustained
	Volume Apnea > 2 min	Volume Apnea > 2 min
	EtO_2 Too Low	Low etO_2
	EtO_2 Too High	High etO_2
	FiO_2 Too Low	Low FiO_2
	FiO_2 Too High	High FiO_2
	CO_2 Apnea	CO_2 Apnea
Mediate	Sub-Atmospheric Paw	Sub-Atmospheric Paw
	MV Too Low	Low VE
	MV Too High	High VE
	VTe Too Low	Low Vte
	VTe Too High	High Vte
	Volume Apnea	Volume Apnea
	RR Too High	High RR
	RR Too Low	Low RR
	$EtCO_2$ Too Low	Low $etCO_2$
	$EtCO_2$ Too High	High $etCO_2$
	$FiCO_2$ Too High	High $FiCO_2$
	EtAA Too Low	Low etAA
	EtAA Too High	High et AA
	FiAA Too Low	Low FiAA
	FiAA Too High	High FiAA
Low	Pressure Limiting	Sustained Paw
	PRESSURE LIM	Plimit Reached
Technical alarms		
High	Circuit Occluded	Circuit Occluded
	O_2 Supply Failure	No O_2 Pressure
	No Fresh Gas	No Fresh Gas Flow
	High Technical Alarm	Pmax Reached

BeneView		GE Avance Carestation/Aisys
Priority	**Label**	**Label**
		Pinspired Not Achieved
		Other Priority Alarms (for high priority alarms not assigned a unique bit)
		No VO_2, High FiN_2O
		Low Drive Gas Pressure
		Low Battery Charge
		Low Battery (No AC)
		Control Settings Failure
		Standby ON (set when anesthesia system is not in therapy mode or when respiratory care ventilator is in standby)
		Therapy Computer Failure
		Monitoring Computer Failure
		Display Computer Failure
		System Error
		Mixer Failure
		Mixer Leak
		Mixer Control Failure
		Vent Failure
		Mechanical Ventilation Disabled
		Patient Detected (while in standby)
		High O_2 Supply Pressure
		High Air Supply Pressure
Mediate	Patient Circuit Leak	Patient Circuit Leak
	AG Module abnormal	MGAS ANE_WARMING_UP (5-minute warming up)
		MGAS WARMING_UP (2-minute warming up)
		No VO_2, FiO_2 > 85%
		Alternate O_2 ON
		Air Only Mode
		MGAS Failure
		MGAS Outlet Occluded
		MGAS Filter Blocked
		MGAS Sample Line Blocked
		MGAS No Sample Line
		MGAS Replace Water Trap
		Module Not Compatible
		Vaporizer Cassette Failure
		Vaporizer Cassette Agent Level Low
		No Vaporizer Cassette
		Vaporizer Failure

BeneView		GE Avance Carestation/Aisys
Priority	**Label**	**Label**
		Vaporizer Leak
		AA Control Failure
		AA Delivery Disabled
		Nebulizer Failure
		No Nebulizer
Mediate	Mediate Technical Alarm	High Circuit O_2
		Low Circuit O_2
		No O_2 Cell Sensor
		No Pressure Cntrl/PEEP
		Inspiration Stopped
		Inspiratory Reverse Flow
		Expiratory Reverse Flow
		Check Flow Sensors
		No Air Pressure
		No VO_2, Artifact
		No VO_2, High Bypass Flow
		No Battery
		Battery Failure
		Battery Charger Failure
		Non Circle Circuit Selected
		Expiratory Flow Sensed with Non Circle Circuit
		Verify Low VE Limit
		Fan Failure
		Heater Failure
		Power Supply Failure
		Display Failure
		Breathing System Failure
		Sensor Interface Board Failure
		ACGO Failure
		SCGO Failure
		Primary Audio Failure
		Backup Audio Failure
Low	Battery in Use	Running On Battery (No AC)
	Low Technical Alarm	ASR on
		Replace O_2 Cell
		O_2 Cell Calibration Error
		PEEP Not Achieved
		Vt Not Achieved
		No Inspiratory Flow Sensor
		No Expiratory Flow Sensor
		Insp Vt/Vte Mismatch (VTE > Insp VT)

BeneView		GE Avance Carestation/Aisys
Priority	**Label**	**Label**
		Vdel Mismatch (System Leak)
		Bellows Empty
		No N_2O Pressure
		Memory (EEPROM) Failure
		Flow Sensor Cal Data Corrupt
		Service Calibrations Due

30.8.8 HUL Leon

30.8.8.1 Output Signals—Parameters

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
O_2%	Oxygen concentration	%	Yes
PEEP	Positive end-expiratory pressure	cmH_2O hPa mbar	No
Ppeak	Peak pressure	cmH_2O hPa mbar	Yes
Pplat	Plateau pressure	cmH_2O hPa mbar	Yes
Pmean	Mean pressure	cmH_2O hPa mbar	Yes
VT	Tidal volume	ml	No
VTe	Expiratory tidal volume	ml	Yes
VTi	Inspired tidal volume	ml	Yes
MV	Minute volume	L/min	Yes
f	Breath rate	bpm	No
ftot	Total respiratory rate	bpm	Yes
fspn	Spontaneous respiratory rate	bpm	Yes
I:E	Inspiratory time:Expiratory time ratio	/	No
Insp Flow	Inspiratory flow	L/min	No
Tinsp	Time of inspiration	s	No
Pinsp	Pressure control level of inspiration	cmH_2O mbar hPa	No
F-Trigger	Inspiratory trigger level (flow trigger)	L/min	No
Compl	Compliance	ml/cmH_2O ml/hPa ml/mbar	Yes

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
RAW	Airway resistance	$cmH_2O/L/s$ hPa/L/s mbar/L/s	Yes
Pmax	Maximum airway pressure	cmH_2O mbar hPa	No
$EtCO_2$	End-tidal carbon dioxide	% mmHg kPa	Yes
$FiCO_2$	Fraction of inspired carbon dioxide	% mmHg kPa	Yes
FiO_2	Fractional concentration of O_2 in inspired gas	% mmHg kPa	Yes
EtO_2	End-tidal O_2	% mmHg kPa	Yes
FiN_2O	Inspired anesthetic agent	%	Yes
FiIso			
FiDes			
FiEnf			
FiSev			
FiHal			
EtN_2O	End-tidal anesthetic agent	%	Yes
EtEnf			
EtDes			
EtIso			
EtSev			
EtHal			
MAC	Minimum alveolar concentration	/	Yes
Tpause	Apnea Time	s or %	No

30.8.8.2 Output Signals—Alarms

BeneView		HUL Leon
Priority	**Label**	**Label**
Physiological alarms		
High	Apnea	Apnea: Backup Breath was triggered /Apnea
	CO_2 Apnea	Apnea CO_2
	High Paw Sustained	Patient pressure continuously too high
	Paw Too High	Ppeak high
Mediate	$EtCO_2$ Too High	Expiratory CO_2 high
	$EtCO_2$ Too Low	Expiratory CO_2 low
	EtEnf Too High	ENF insp. too high
	$FiCO_2$ Too High	Inspiratory CO_2 high
	FiDes Too High	DES insp. too high
	FiDes Too Low	DES insp. too low
	FiEnf Too High	ENF insp. too low
	FiHal Too High	HAL insp. too high
	FiHal Too Low	HAL insp. too low
	FiIso Too High	ISO insp. too high
	FiIso Too Low	ISO insp. too low
	FiO_2 Too High	Inspiratory O_2 high
	FiO_2 Too Low	Inspiratory O_2 low
	FiSev Too High	SEVO insp. too high
	FiSev Too Low	SEVO insp. too low
	MV Too High	MV high
	MV Too Low	MV low
	PRESS EXP High	No release of pressure during expiration
	RR Too Low	$FreqCO_2$ low
	RR Too High	$FreqCO_2$ high
	VTe Too Low	Vte low
Low	PRESSURE LIM	PMax setting reached too early
Technical alarms		
High	Check APL Valve	Ambient Air Valve open
	Circuit Occluded	Gasmeasurement Occlusion (Artema AION)
	Drive Gas Pressure Low	No driving gas. Mechanical ventilation stopped. Only Man/Spont possible.
	High Technical Alarm	Battery empty. Mechanical ventilation stopped. Only Man/Spont possib
		Battery empty. Supply voltage too low
		Broken microphone. No checking of audible alarming
		Calib. needed: Remove O_2-Cell short-time.
		Checksum Error
		Checksum Fail PIC Conductor
		CFB Timeout

BeneView		HUL Leon
Priority	**Label**	**Label**
		Checksum Fail PIC Monitor
		CO_2 absorber removed. Circle system short-circuited
		Communication Fail CFB
		Communication Fail Conductor PIC
		Communication Fail Power PIC
		Communication Fail Monitor PIC (Busy Timeout)
		Communication Fail Monitor PIC (Read Timeout)
		Communication Fail Monitor PIC (Write Timeout)
		Controllerboard EEPROM checksum failed
		Controllerboard EEPROM not write protected
		Driving gas blender failed.
		Encoder without function
		Ext. fresh gas outlet active
		Expiratory flow measurement failed. No expiratory volume measurement.
		Failsafe
High	High Technical Alarm	Failure O_2 Measurement. Please calibrate O_2 Cell
		FiO_2 Cell badly calibrated
		Flowsensor contaminated. No measurement of expiratory flow.
		Flowsensor contaminated. No measurement of inspiratory flow.
		Flowsensor disconnected. No volume measurement.
		Fresh gas blender failed (flow too high). Turn on emergency dosing
		Fresh gas blender failed (flow too low). Turn on emergency dosing!
		Fresh gas blender failed (N_2O). Turn on emergency dosing!
		Fresh gas blender failed (no flow measurement) Turn on emergency dosing!
		Fresh gas blender failed (O_2). Turn on emergency dosing!
		Fresh gas blender failed (valves). Fresh gas is 100% O_2
		Gas Measurement failed (Artema AION)
		Inspiratory flow measurement failed. No

BeneView		HUL Leon
Priority	**Label**	**Label**
		inspiratory volume measurement.
High	High Technical Alarm	Mains Fail Conductor PIC
		Mains Fail Monitor PIC
		No water trap
		Read settings differ from written setting
		Security relay broken
		Sensor fail O_2 measuremnet fresh gas. Switched to 100% O_2 fresh gas flow
		Sensor Fail Patient Pressure
		System Fail Monitor Artema AION
		Systemtest skipped too many times
		Technical Failure CFB (see error log)
		Technical Failure NetDCU (see error log)
		Technical failure. Only Man/Spont possible
		Versions not compatible
		Zero flow. Flow sensor not calibrated
	No Fresh Gas	O_2 and Air supply failed. Dosing fresh gas stopped
	O_2 Supply Failure	O_2 cell fresh gas failed. Please change. Fresh gas is 100% O_2
	VENT DISC	Patient module unlocked. Ventilation stopped /Disconnection
Mediate	Mediate Technical Alarm	Battery almost empty
		Battery Check/Charge Fail
		Batteries deep discharged. Please calibrate
		Battery Fail
		Battery falsely connected or damaged
		Change Water Trap (Artema AION)
		Gas Measurement unreliable (Artema AION)
		Set pressure not reachable
		Set volume not reachable
	Patient Circuit Leak	Leak high
Low	Battery in Use	Device running on batteries
	NO AIR	Air supply failed, Fresh gas with 100% O_2 / Air supply failed
	NO O_2 SUPPLY	O_2 supply failed. Dosing fresh gas with air (=21% O_2). O_2 supply failed /Piped O_2 supply too low
	O_2 Sensor Unconnected	FiO_2 cell failed. Please change.
	Low Technical Alarm	Air and N_2O supply failed, Fresh gas with 100% O_2
		Air supply failed. Driving gas is O_2

BeneView		HUL Leon
Priority	**Label**	**Label**
		Air supply pressure too high
		Check external O_2 measurement
		CO_2 absorber removed. Circle system short-circuited
		Emergency dosing active
		Emergency dosing still active. Please turn off emergency dosing
		Exhalation Condition not reached
		Ext. fresh gas outlet active
		Failure during communication with VueLink
		Fan Fail
		HL7 server not available
		MemoryStick Fail
		No Primary Agent detected
		N_2O supply failed
		N_2O supply failed, Fresh gas with 100% O_2
		N_2O supply from reserve
		O_2 ZGA supply failed. Driving gas is air
		Patient module open
		Piped N_2O supply pressure too high
		Piped N_2O supply too low
		Piped O_2 supply pressure too high
		VueLink not connected

30.8.9 HUL Leon Plus

30.8.9.1 Output Signals—Parameters

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
O_2%	Oxygen concentration	%	No
PEEP	Positive end-expiratory pressure	cmH_2O hPa mbar	No
Ppeak	Peak pressure	cmH_2O hPa mbar	Yes
Pplat	Plateau pressure	cmH_2O hPa mbar	Yes

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
Pmean	Mean pressure	cmH_2O hPa mbar	Yes
VT	Tidal volume	ml	No
VTe	Expiratory tidal volume	ml	Yes
VTi	Inspired tidal volume	ml	Yes
MV	Minute volume	L/min	Yes
f	Breath rate	bpm	No
ftot	Total respiratory rate	bpm	Yes
fspn	Spontaneous respiratory rate	bpm	Yes
I:E	Inspiratory time:Expiratory time ratio	/	No
Insp Flow	Inspiratory flow	L/min	No
Tinsp	Time of inspiration	s	No
Pinsp	Pressure control level of inspiration	cmH_2O hPa mbar	No
Pmax	Maximum airway pressure	cmH_2O mbar hPa	No
F-Trigger	Inspiratory trigger level (flow trigger)	L/min	No
Compl	Compliance	ml/cmH_2O ml/hPa ml/mbar	Yes
RAW	Airway resistance	cmH_2O/L/s hPa/L/s mbar/L/s	Yes
$FiCO_2$	Fraction of inspired carbon dioxide	% mmHg kPa	Yes
$EtCO_2$	End-tidal carbon dioxide	% mmHg kPa	Yes
FiO_2	Fractional concentration of O_2 in inspired gas	% mmHg kPa	Yes
EtO_2	End-tidal O_2	% mmHg kPa	Yes
FiN_2O	Inspired anesthetic agent	%	Yes
FiIso			
FiDes			
FiEnf			
FiSev			

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
FiHal			
EtN_2O	End-tidal anesthetic agent	%	Yes
EtEnf			
EtDes			
EtIso			
EtSev			
EtHal			
MAC	Minimum alveolar concentration	/	Yes
Tpause	Apnea Time	s or %	No

30.8.9.2 Output Signals—Alarms

BeneView		HUL Leon Plus
Priority	**Label**	**Label**
Physiological alarms		
High	Apnea	Apnea: Backup Breath was triggered /Apnea
	CO_2 Apnea	Apnea CO_2
	FiO_2 Too Low	Inspiratory O_2 low
	Paw Too High	Ppeak high
	High Paw Sustained	Patient pressure continuously too high
Mediate	$EtCO_2$ Too High	Expiratory CO_2 high
	$EtCO_2$ Too Low	Expiratory CO_2 low
	$FiCO_2$ Too High	Inspiratory CO_2 high
	FiDES Too Low	DES insp. too high
	FiDES Too High	DES insp. too low
	FiEnf Too Low	ENF insp. too high
	FiEnf Too High	ENF insp. too low
	FiHal Too High	HAL insp. too high
	FiHAL Too Low	HAL insp. too low
	FiIso Too High	ISO insp. too high
	FiIso Too Low	ISO insp. too low
	FiO_2 Too High	Inspiratory O_2 high
	FiSev Too High	SEVO insp. too high
	FiSev Too Low	SEVO insp. too low
	MV Too High	MV high
	MV Too Low	MV low
	PRESS EXP High	No release of pressure during expiration
	RR Too Low	$FreqCO_2$ low
	RR Too High	$FreqCO_2$ high
	VTe Too Low	Vte low
Low	PRESSURE LIM	PMax setting reached too early
Technical alarms		

BeneView		HUL Leon Plus
Priority	**Label**	**Label**
High	Check APL Valve	Ambient Air Valve open
	Circuit Occluded	Gasmeasurement Occlusion (Artema AION)
	Drive Gas Pressure Low	No driving gas. Mechanical ventilation stopped. Only Man/Spont possible.
	No Fresh Gas	O_2 and Air supply failed. Dosing fresh gas stopped.
	O_2 Supply Failure	O_2 cell fresh gas failed. Please change. Fresh gas is 100% O_2
	VENT DISC	Patient module unlocked. Ventilation stopped /Disconnection
	High Technical Alarm	Battery empty. Mechanical ventilation stopped. Only Man/Spont possib
		Battery empty. Supply voltage too low
		Broken microphone. No checking of audible alarming
		Calib. needed: Remove O_2-Cell short-time.
		CFB Timeout
		Checksum Error
		Checksum Fail PIC Conductor
		Checksum Fail PIC Monitor
		Communication Fail CFB
		Communication Fail Conductor PIC
		Communication Fail Monitor PIC (Busy Timeout)
		Communication Fail Monitor PIC (Read Timeout)
		Communication Fail Monitor PIC (Write Timeout)
		Communication Fail Power PIC
		Controllerboard EEPROM checksum failed
		Controllerboard EEPROM not write protected
		CO_2 absorber removed. Circle system short-circuited
		Driving gas blender failed.
		Encoder without function
		Ext. fresh gas outlet active
		Expiratory flow measurement failed. No expiratory volume measurement.
		Failsafe
		Failure O_2 Measurement. Please calibrate O_2 Cell
High	High Technical Alarm	FiO_2 Cell badly calibrated

BeneView		HUL Leon Plus
Priority	**Label**	**Label**
		Flowsensor contaminated. No measurement of expiratory flow.
		Flowsensor contaminated. No measurement of inspiratory flow.
		Flowsensor disconnected. No volume measurement.
		Fresh gas blender failed (flow too high). Turn on emergency dosing
		Fresh gas blender failed (flow too low). Turn on emergency dosing!
		Fresh gas blender failed (N_2O). Turn on emergency dosing!
		Fresh gas blender failed (no flow measurement) Turn on emergency dosing!
		Fresh gas blender failed (O_2). Turn on emergency dosing!
		Fresh gas blender failed (valves). Fresh gas is 100% O_2
		Gas Measurement failed (Artema AION)
		Inspiratory flow measurement failed. No inspiratory volume measurement.
		Mains Fail Conductor PIC
		Mains Fail Monitor PIC
		No water trap
		Read settings differ from written setting
		Security relay broken
		Sensor fail O_2 measuremnet fresh gas. Switched to 100% O_2 fresh gas flow
		Sensor Fail Patient Pressure
		System Fail Monitor Artema AION
		Systemtest skipped too many times
		Technical Failure CFB (see error log)
		Technical Failure NetDCU (see error log)
		Technical failure. Only Man/Spont possible
		Versions not compatible
		Zero flow. Flow sensor not calibrated
Mediate	Patient Circuit Leak	Leak high
	Mediate Technical Alarm	Battery almost empty
		Battery Check/Charge Fail
		Batteries deep discharged. Please calibrate
		Battery Fail
		Battery falsely connected or damaged
		Broken loudspeaker. Audible alarming not

BeneView		HUL Leon Plus
Priority	**Label**	**Label**
		possible
		Change Water Trap (Artema AION)
		Gas Measurement unreliable (Artema AION)
		Set pressure not reachable
		Set volume not reachable
Low	Battery in Use	Device running on batteries
	NO AIR	Air supply failed, Fresh gas with 100% O_2 /Air supply failed
	NO O_2 SUPPLY	O_2 supply failed. Dosing fresh gas with air (=21% O_2). O_2 supply failed /Piped O_2 supply too low
	O_2 Sensor Unconnected	FiO_2 cell failed. Please change.
	Low Technical Alarm	Air and N_2O supply failed, Fresh gas with 100% O_2
		Air supply failed. Driving gas is O_2
		Air supply pressure too high
		Check external O_2 measurement
		CO_2 absorber removed. Circle system short-circuited
		Emergency dosing active
		Emergency dosing still active. Please turn off emergency dosing
		Exhalation Condition not reached
		Ext. fresh gas outlet active
		Failure during communication with VueLink
		Fan Fail
		HL7 server not available
		MemoryStick Fail
		N_2O supply failed
		N_2O supply failed, Fresh gas with 100% O_2
		N_2O supply from reserve
		No Primary Agent detected
		Patient module open
		Piped N_2O supply pressure too high
		Piped N_2O supply too low
		Piped O_2 supply pressure too high
		O_2 ZGA supply failed. Driving gas is air
		VueLink not connected

30.8.10 Draeger Perseus A500

30.8.10.1 Output Signals—Parameters

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
ftot	Total respiratory rate	bpm	Yes
fspn	Spontaneous respiratory rate	bpm	Yes
RAW	Airway resistance	$cmH_2O/L/s$ hPa/L/s mbar/L/s	Yes
VCO_2	CO_2 production	ml/min	No
HALLev	Anesthetic agent consupmtion	ml	No
ENFLev			
ISOLev			
DESLev			
SEVLev			
VO_2	Oxygen consumption	ml/min	Yes
Pmean	Mean pressure	cmH_2O hPa mbar	Yes
Pplat	Plateau pressure	cmH_2O hPa mbar	Yes
PEEP	Positive end-expiratory pressure	cmH_2O hPa mbar	No
Ppeak	Peak pressure	cmH_2O hPa mbar	Yes
Insp. MAC	Inspired minimum alveolar concentration	/	No
Exp. MAC	Expired minimum alveolar concentration	/	No
FiN_2O	Inspired anesthetic agent	%	Yes
FiIso			
FiDes			
FiEnf			
FiSev			
FiHal			
EtN_2O	End-tidal anesthetic agent	%	Yes
EtEnf			

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
EtDes			
EtIso			
EtSev			
EtHal			
MVspn	Spontaneous breathed minute volume	L/min	Yes
MV	Minute volume	L/min	Yes
Tapnea	Apnea time	s	No
ΔO_2	Difference between inspiratory and expiratory O_2	% mmHg kPa	No
$RRCO_2$	Respiratory rate of CO_2	bpm	Yes
$FiCO_2$	Fraction of inspired carbon dioxide	% mmHg kPa	Yes
$EtCO_2$	End-tidal carbon dioxide	% mmHg kPa	Yes
N_2O Flow	N_2O flow	L/min	No
Air Flow	Air flow	L/min	No
O_2 Flow	O_2 flow	L/min	No
FiAA	Inspired anesthetic agent	%	Yes
EtAA	End-tidal anesthetic agent	%	Yes
FiAA 2nd	2nd Insp. Agent	%	Yes
EtAA 2nd	2nd Exp. Agent	%	Yes
FiO_2	Fractional concentration of O_2 in inspired gas	% mmHg kPa	Yes
EtO_2	End-tidal O_2	% mmHg kPa	Yes
VTi	Inspired tidal volume	ml	Yes
Tinsp	Time of inspiration	s	No
f	Breath rate	bpm	No
PS above PEEP	PS above PEEP	cmH_2O mbar hPa	No

BeneView		Unit	Is it saved in the trends?
Label	Description		
Pmax	Maximum airway pressure	cmH_2O mbar hPa	No
F-Trigger	Inspiratory trigger level (flow trigger)	L/min	No
TIP:TI	Percentage of inspiratory plateau time in inspiratory time	%	No
Tslope	Time for the pressure to rise to target pressure	s	No
FG	Fresh gas flow	ml/min	No
Pinsp	Pressure control level of inspiration	cmH_2O hPa mbar	No

30.8.10.2 Output Signals—Alarms

BeneView		Draeger Perseus A500
Priority	Label	Label
Physiological alarms		
High	Apnea	APNEA or APNEA VOL
	FiO_2 Too Low	$\%O_2$ LOW
	CO_2 Apnea	APNEA CO_2
	Pressure Apnea	APNEA PRES
	Paw Too High	PAW HIGH
	Paw Too Low	PAW LOW or PAW NEGATIVE
	CONT PRES	CONT PRES
Mediate	FiHal Too High	% HAL HIGH
	FiEnf Too High	% ENF HIGH
	FiIso Too High	% ISO HIGH
	Check fresh Gas Supply	FRESH GAS?
	MV Too Low	MIN VOL LOW
	FiSev Too High	% SEV HIGH
	FiDes Too High	% DES HIGH
	$EtCO_2$ Too Low	ET CO_2 LOW
	$EtCO_2$ Too High	ET CO_2 HIGH
	FiHal Too Low	% HAL LOW
	FiEnf Too Low	% ENF LOW
	FiIso Too Low	% ISO LOW

BeneView		Draeger Perseus A500
Priority	**Label**	**Label**
	FiDes Too Low	% DES LOW
	FiSev Too Low	% SEV LOW
	$FiCO_2$ Too High	INSP CO_2 HI
	MV Too High	MIN VOL HIGH
	EXP-VALVE?	EXP-VALVE?
	PEEP Too High	PEEP HIGH
	VTe Too High	TIDAL VOL HI
	MAC Too Low	MAC LOW?
	FiN_2O Too High	% N_2O HIGH
Technical alarms		
	O_2 Supply Failure	O_2 SUPPLY?
	NO Fresh Gas	NO FRESHGAS
	VENT DISC	VENT ASSEMBL
		VENT ERR
		MIXER INOP
		INT.TMP.HIGH
		AIR PRESS HI
High		HI O_2 SUPPLY
	High Technical Alarm	SYSTEM FAULT
		N_2O CYL.?
		NO N_2O
		NO OXYGEN
		NO AIR
		FG EXTERN?
		BATTERY LOW
		% O_2 ERR
		N_2O SUPPLY ?
		POWER FAIL
		SAFETY O_2 ON
		FG LIMITED
Mediate	Mediate Technical Alarm	LOSS OF DATA
		SET.CANCELED
		FG TOO HIGH
		FG ACTIVE
		ABS.PRESENT?
		HOSES MIXED?

BeneView		Draeger Perseus A500
Priority	**Label**	**Label**
		WRONG HOSES?
		AIR ENTRAIN
		VENT PAUSE?
	CO_2 Module abnormal	CO_2 LINE BLK
	AG Module abnormal	MIXED AGENT
		GAS MON ERR
		2nd AGENT
		WATERTR.OLD?
Low	Low Technical Alarm	RS232COM ERR
		PRESS ERR
		WATER TRAP ?
		VENT TEMP HI
		VOL ERR
		FAN ERR
		N_2O PRESS HI
		O_2 CYL. ?
		VOLAT SUPPLY
		CO_2-LINE ?
		PWR SPLY ERR
		TIDAL VOL.?
		INSP VOL ERR
		N_2OCYL.SENS?
		AIRCYL.SENS?
		O_2 CYL.SENS?
		AIR CYL.?
		PMIN REACHED
		PRESS RELIEF
		ABSORB. OLD?
		ID-FUNC-INOP
		HOSE OLD?

30.8.11 Draeger ZeusIE

30.8.11.1 Output Signals—Parameters

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
FiO_2	Fractional concentration of O_2 in inspired gas	% mmHg kPa	Yes
EtO_2	End-tidal O_2	% mmHg kPa	Yes
FiN_2O	Inspired anesthetic agent	%	Yes
FiIso			
FiDes			
FiEnf			
FiSev			
FiHal			
EtN_2O	End-tidal anesthetic agent	%	Yes
EtEnf			
EtDes			
EtIso			
EtSev			
EtHal			
FiAA	Inspired anesthetic agent	%	Yes
EtAA	End-tidal anesthetic agent	%	Yes
FiAA 2nd	2nd Insp. Agent	%	Yes
EtAA 2nd	2nd Exp. Agent	%	Yes
Exp. MAC	Expired minimum alveolar concentration	/	No
Pmean	Mean pressure	cmH_2O hPa mbar	Yes
Pplat	Plateau pressure	cmH_2O hPa mbar	Yes
PEEP	Positive end-expiratory pressure	cmH_2O hPa mbar	No
MVspn	Spontaneous breathed minute volume	L/min	Yes

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
Ppeak	Peak pressure	cmH_2O hPa mbar	Yes
VTe	Expiratory tidal volume	ml	Yes
VTi	Inspired tidal volume	ml	Yes
MVLEAK	Leakage minute volume	L/min	No
MV	Minute volume	L/min	Yes
$RRCO_2$	Respiratory rate of CO_2	bpm	Yes
fspn	Spontaneous respiratory rate	bpm	Yes
$EtCO_2$	End-tidal carbon dioxide	% mmHg kPa	Yes
$FiCO_2$	Fraction of inspired carbon dioxide	% mmHg kPa	Yes
RAW	Airway resistance	cmH_2O/L/s hPa/L/s mbar/L/s	Yes
HALLev	Anesthetic agent consupmtion	ml	No
ENFLev			
ISOLev			
DESLev			
SEVLev			
SpO_2	Arterial oxygen saturation from pulse oximetry	%	Yes
BIS	Bispectral index	/	Yes
EMG	Electromyograph	dB	Yes
SQI	Signal quality index	/	Yes
SR	Suppression ratio	/	Yes
SEF	Spectral edge frequency	Hz	Yes
TP	Total power	dB	Yes
BC	Burst count	/min	Yes
Tinsp	Time of inspiration	s	No
Texp	Expiratory time	s	No
Pmax	Maximal breathing pressure	cmH_2O Mbar hPa	No

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
F-Trigger	Inspiratory trigger level (flow trigger)	L/min	No
TIP:TI	Percentage of inspiratory plateau time in inspiratory time	%	No
Pinsp	Pressure control level of inspiration	cmH_2O hPa mbar	No
f	Breath rate	bpm	No
FG	Fresh gas flow	ml/min	No
Tslope	Time for the pressure to rise to target pressure	s	No
Psupp	Pressure support level	cmH_2O hPa mbar	No

30.8.11.2 Output Signals—Alarms

BeneView		Draeger ZeusIE
Priority	**Label**	**Label**
Physiological alarms		
High	Apnea	APNEA or APNEA VOL
	Pressure Apnea	APNEA PRES
	Paw Too Low	PAW LOW or PAW NEGATIVE
	CONT PRES	CONT PRES
	CO_2 Apnea	APNEA CO_2
Mediate	FiHal Too High	% HAL HIGH
	FiEnf Too High	% ENF HIGH
	FiIso Too High	% ISO HIGH
	FiSev Too High	% FiSEV HIGH
	FiDes Too High	% FiDES HIGH
	FiHal Too Low	% FiHAL LOW
	FiEnf Too Low	%FiENF LOW
	FiIso Too Low	%FiISO LOW
	FiSev Too Low	% FiSEV LOW
	FiDes Too Low	% FiDES LOW
	FiN_2O Too High	% N_2O HIGH
	FiN_2O Too Low	% N_2O LOW
	FiAA Too High	INSP AGT.HI.

BeneView		Draeger ZeusIE
Priority	**Label**	**Label**
	Paw Too High	PAW HIGH
	MV Too Low	MIN VOL LOW
	MV Too High	MIN VOL HIGH
	PEEP Too High	PEEP HIGH
	VTe Too High	TIDAL VOL HI
	$EtCO_2$ Too High	ET CO_2 HIGH
	$EtCO_2$ Too Low	ET CO_2 LOW
	$FiCO_2$ Too High	INSP CO_2 HI
Technical alarms		
High	High Technical Alarm	INT COM ER
		COM VENT ERR
		INT.TMP.HIGH
		POWER FAIL
		VENT ERR
		VA+MIX ERR
		MIXER ERR
		O_2 CYL. ?
		N_2O CYL.?
Mediate	Mediate Technical Alarm	WRONG AGENT
		FLOW SENSOR?
		PRESS ERR
		VOL ERR
		BATTERY LOW
		% O_2 ERR
		PS LIMITED
		MIXER INOP
		N_2O SUPPLY?
		SAFETY O_2 ON
		NO AIR
		FG-FLOW HIGH
	CO_2 Module abnormal	CO_2 LINE BLK
	AG Module abnormal	MIX AGENT
		N_2O ERR
		AGT ERR
		TOW AGENT

BeneView		Draeger ZeusIE
Priority	**Label**	**Label**
Low	Low Technical Alarm	AIR TRAPPING
		CO_2-LINE?
		NO N_2O
		PBAG INOP
		BIS INOP
		BIS SENS?

30.8.12 Draeger Apollo

30.8.12.1 Output Signals—Parameters

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
PEEP	Positive end-expiratory pressure	cmH_2O hPa mbar	No
Ppeak	Peak pressure	cmH_2O hPa mbar	Yes
Pplat	Plateau pressure	cmH_2O hPa mbar	Yes
Pmean	Mean pressure	cmH_2O hPa mbar	Yes
VTi	Inspired tidal volume	ml	Yes
MV	Minute volume	L/min	Yes
f	Breath rate	bpm	No
fspn	Spontaneous respiratory rate	bpm	Yes
FreqMIN	Minimum breath frequency	bpm	No
TIP:TI	Percentage of inspiratory plateau time in inspiratory time	%	No
Tslope	Time for the pressure to rise to target pressure	s	No
Tinsp	Time of inspiration	s	No
Pinsp	Pressure control level of inspiration	cmH_2O hPa mbar	No

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
Psupp	Pressure support level	cmH_2O hPa mbar	No
Pmax	Maximal breathing pressure	cmH_2O Mbar hPa	No
F-Trigger	Inspiratory trigger level (flow trigger)	L/min	No
Compl	Compliance	ml/cmH_2O ml/hPa ml/mbar	Yes
$RRCO_2$	Respiratory rate of CO_2	bpm	Yes
$EtCO_2$	End-tidal carbon dioxide	% mmHg kPa	Yes
$FiCO_2$	Fraction of inspired carbon dioxide	% mmHg kPa	Yes
FiO_2	Fractional concentration of O_2 in inspired gas	% mmHg kPa	Yes
EtO_2	End-tidal O_2	% mmHg kPa	Yes
ΔO_2	Difference between inspiratory and expiratory O_2	% mmHg kPa	No
Tapnea	Apnea time	s	No
FiN_2O	Inspired anesthetic agent	%	Yes
FiIso			
FiDes			
FiEnf			
FiSev			
FiHal			
EtN_2O	End-tidal anesthetic agent	%	Yes
EtEnf			
EtDes			
EtIso			

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
EtSev			
EtHal			
FiAA	Inspired anesthetic agent	%	Yes
EtAA	End-tidal anesthetic agent	%	Yes
FiAA 2nd	2nd Insp. Agent	%	Yes
EtAA 2nd	2nd Exp. Agent	%	Yes
Insp. MAC	Inspired minimum alveolar concentration	/	No
Exp. MAC	Expired minimum alveolar concentration	/	No
HALLev	Anesthetic agent consupmtion	ml	No
ENFLev			
ISOLev			
DESLev			
SEVLev			
N_2O Flow	N_2O flow	L/min	No
Air Flow	Air flow	L/min	No
O_2 Flow	O_2 flow	L/min	No
SpO_2	Arterial oxygen saturation from pulse oximetry	%	Yes
PR	Pulse rate	bpm	Yes

30.8.12.2 Output Signals—Alarms

BeneView		Draeger Apollo
Priority	**Label**	**Label**
Physiological alarms		
High	Apnea	Apnea Vent
	Volume Apnea > 2 min	Apnea Vol
	Pressure Apnea	Apnea Pres
	PAW Too High	Paw High
	PAW Too Low	Paw Negtive
	FiO_2 Too Low	% O_2 LOW
	CONT PRES	CONT PRES
	CO_2 Apnea	APNEA CO_2
	No Pulse	NO SPO_2 PULS
	PR Too Low	SPO_2 PUL LO
	SpO_2 Too Low	SPO_2 LOW
Mediate	FiO_2 Too High	FiO_2 High
	VTe Too Low	TIDAL VOL?
	MV Too High	MIN Vol HIGH
	MV Too Low	MIN Vol Low
	PEEP Too High	Peep High
	$EtCO_2$ Too High	$EtCO_2$ High
	$EtCO_2$ Too Low	$EtCO_2$ Low
	$FiCO_2$ Too High	INSP CO_2 HIGH
	FiN_2O Too High	FI N_2O HIGH
	EtHAL Too High	EXP. HAL HIGH
	FiHAL Too High	%HAL HIGH
	FiHAL Too Low	%HAL Low
	EtENF Too High	EXP. ENF HIGH
	FiENF Too High	%ENF HIGH
	FiENF Too Low	%ENF Low
	EtISO Too High	EXP.ISO HIGH
	FiISO Too High	%ISO HIGH
	FiISO Too Low	%ISO Low
	EtSEV Too High	EXP.SEV HIGH
	FiSEV Too High	%SEV HIGH
	FiSEV Too Low	%SEV Low

BeneView		Draeger Apollo
Priority	**Label**	**Label**
	EtDES Too High	EXP.DES HIGH
	FiDES Too High	%DES HIGH
	FiDES Too Low	%DES Low
	MAC Too Low	MAC Low?
	PR Too High	SPO_2 PUL HI
	SpO_2 Too High	SPO_2 HIGH
Technical alarms		
High	O_2 Supply Failure	O_2 Supply?
	No Fresh Gas	NO Fressh gas
	Circuit Occluded	CIRCLE OCCL
	VENT DISC	VENT DISC
	High Technical Alarm	VENT ERR
		INT.TMP.HIGH
		O_2CYL.DISCON
		CHK N_2O CYL
		NO N_2O DELIV
		NO AIR DELIV
		FG-OVER?
		VENT. UNLOCK
		AW-TEMP HIGH
		NO N_2O
Mediate	Patient Circuit Leak	LEAKAGE
	Check Fresh Gas Supply	FRESH GAS?
	CO_2 Module abnormal	CO_2 LINE BLK
	AG Module abnormal	MIXED AGENT
		CO_2/AGT ERR
		N_2O ERR
		AGT ERR
		2ND AGENT
	Mediate Technical Alarm	POWER FAIL
		BATTERY LOW
		N_2O SUPPLY?
		PRESSURE LIM
		MIXER INOP
		P MAX?

BeneView		Draeger Apollo
Priority	**Label**	**Label**
		SAFETY O_2 ON
		FG FLOW LIM
		LOSS OF DATA
		% O_2 ERR
		SET CANCELED
		FG TOO HIGH
		FG ACTIVE
		FG AIR SENS?
		FG O_2 SENS?
		FG N_2O .SENS?
Low	NO AIR	NO AIR
	NO O_2 SUPPLY	NO O_2 SUPPLY
	SpO_2 Module abnormal	SPO_2SEN DISC
		SPO_2 ALRM OF
		SPO_2 ERR
	Low Technical Alarm	FAN ERR
		PWR SPLY ERR
		PRESS ERR
		VOL ERR
		LO O_2 SUPPLY
		CHK O_2 CYL
		O_2 CYL OPEN
		N_2O CYLOPEN
		AIR CYL OPEN
		COM VENT ERR
		APOLLO COM1?
		APOLLO COM2?
		N_2O CYL .SENS?
		AIR CYL SENS?
		O_2 CYL .SENS?
		AIR CYL?
		PRESS RELIEF

30.9 Integrating Ventilator

30.9.1 Mindray E3/E5

30.9.1.1 Output Signals—Parameters

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
PEEP	Positive end-expiratory pressure	cmH_2O hPa mbar	Yes
Ppeak	Peak pressure	cmH_2O hPa mbar	Yes
Pplat	Plateau pressure	cmH_2O hPa mbar	Yes
O_2%	Oxygen concentration	%	Yes
Pmean	Mean pressure	cmH_2O hPa mbar	Yes
VT	Tidal volume	ml	No
VTe	Expiratory tidal volume	ml	Yes
VTe spn	Spontaneous expiratory tidal volume	ml	Yes
MV	Minute volume	L/min	Yes
MVspn	Spontaneous breathed minute volume	L/min	Yes
ftot	Total respiratory rate	bpm	Yes
fmand	Mandatory breathing frequency	bpm	No
fspn	Spontaneous respiratory rate	bpm	Yes
fapnea	Breath rate for apnea ventilation	bpm	No
fSIMV	Frequency of SIMV	bpm	No
RR	Respiratory rate	bpm	No
I:E	Inspiratory time: Expiratory time ratio	/	No
△int. PEEP	Intermittent PEEP	cmH_2O hPa mbar	No
MVLEAK	Leakage minute volume	L/min	No
FiO_2	Fractional concentration of O_2 in inspired gas	% mmHg kPa	Yes

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
Cstat	Static compliance	ml/cmH_2O ml/hPa ml/mbar	Yes
Cdyn	Dynamic compliance	ml/cmH_2O ml/hPa ml/mbar	Yes
RSBI	Rapid shallow breathing index	1/(min·L)	Yes
WOBimp	Imposed work of breathing	J/min	Yes
F-Trigger	Inspiratory trigger level (flow trigger)	L/min	No
P-Trigger	Inspiratory trigger level (pressure trigger)	cmH_2O Mbar hPa	No
Psupp	Pressure support level	cmH_2O hPa mbar	No
Tinsp	Time of inspiration	s	No
Pinsp	Pressure control level of inspiration	cmH_2O hPa mbar	No
Papnea	Apnea pressure	cmH_2O mbar hPa	No
Trise	Rise time	s	No
Phigh	Upper pressure level	cmH_2O mbar hPa	No
Plow	Lower pressure level	cmH_2O mbar hPa	No
Thigh	Time for the upper pressure level	s	No
Tlow	Time for the lower pressure level	s	No
Exp%	Inspiration termination level	%	No
Pmax	Maximum airway pressure	cmH_2O mbar hPa	No
Ri	Inspiratory resistance	cmH_2O/L/s hPa/L/s mbar/L/s	Yes

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
Re	Expiratory resistance	$cmH_2O/L/s$ hPa/L/s mbar/L/s	Yes
NIF	Negative inspiratory force	cmH_2O hPa mbar	No
$EtCO_2$	End-tidal carbon dioxide	% mmHg kPa	Yes
$FiCO_2$	Fraction of inspired carbon dioxide	% mmHg kPa	Yes
Flow	Flow	L/min	No
IBW	Ideal body weight	kg	No

30.9.1.2 Output Signals—Alarms

BeneView		Mindray E3/E5
Priority	**Label**	**Label**
Physiological alarms		
High	Paw Too High	Paw Too High
	Paw Too Low	Paw Too Low
	MV Too High	MV Too High
	MV Too Low	MV Too Low
	Apnea	Apnea
	Apnea Ventilation	Apnea Ventilation
	FiO_2 Too High	FiO_2 Too High
	FiO_2 Too Low	FiO_2 Too Low
	PEEP Too High	PEEP Too High
Mediate	VTe Too High	TVe Too High
	RR Too High	ftot Too High
	$EtCO_2$ Too High	$EtCO_2$ Too High
	$EtCO_2$ Too Low	$EtCO_2$ Too Low
	$FiCO_2$ Too High	$FiCO_2$ Too High
Low	Plimit Reached	Pressure Limited
Technical alarms		
High	Air Supply Pressure Low	Air Supply Pressure Low
	O_2 Supply Pressure Low	O_2 Supply Pressure Low
	No Gas Supply Pressure	No Gas Supply Pressure

BeneView		Mindray E3/E5
Priority	**Label**	**Label**
	Airway Obstructed?	Airway Obstructed?
	Tube Disconnected?	Tube Disconnected?
	Sustained Airway Pressure	Sustained Airway Pressure
	Insp gas temperature too high	Insp. Gas Temp Too High
	High Technical Alarm	RT Clock Not Exist
		Keyboard Comm Stop
		Keyboard Selftest Error
		Ventilator Reset Error
		Battery Exhaust! Syst. Down!
		Low Battery Voltage
		Ctrl Module Comm Error
		Ctrl Module Comm Stop
		Ctrl Module Selftest Error
		Protection Module Comm Error
		Protection Module Comm Stop
		Protection Module Selftest Err
		Pressure Sensor Failure
		Air Insp. Limb Failure
		Please perform pressure cal.
		Please perform flow cal.
		CO_2 Comm Stop
		CO_2 Comm Error
		CO_2 Hardware Error
		CO_2 Init Error
		CO_2 Selftest Error
Mediate	Mediate Technical Alarm	Key Error
		Battery Undetected
		Fan Failure
		Internal Temperature Too high
		Exp. Flow Sensor Failure
		O_2 Sensor Failure
		O_2 Insp. Limb Failure
Low	Airway Leak?	Airway Leak?
	Battery in Use	Battery in Use
	Tinsp too Long	Tinsp Too Long
	CO_2 No Water trap	CO_2 No Watertrap
	Low Technical Alarm	RT Clock Need Reset

BeneView		Mindray E3/E5
Priority	**Label**	**Label**
		IP Address Conflict
		Loading Default Config. Failed
		Restoring Last Config. Failed
		Insp. Hold Interrupted
		Exp. Hold Interrupted
		Heating Module Failure
		Please calibrate O_2 sensor.
		Buzzer Failure
		CO_2 Sensor High Temp
		CO_2 Sensor Low Temp
		CO_2 High Airway Pressure
		CO_2 Low Airway Pressure
		CO_2 High Barometric
		CO_2 Low Barometric
		CO_2 Sampleline Occluded
		CO_2 System Error
		$EtCO_2$ Overrange
		$FiCO_2$ Overrange
		CO_2 Zero Failed

30.9.2 Mindray SV300

30.9.2.1 Output Signals—Parameters

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
PEEP	Positive end-expiratory pressure	cmH_2O hPa mbar	Yes
Ppeak	Peak pressure	cmH_2O hPa mbar	Yes
Pplat	Plateau pressure	cmH_2O hPa mbar	Yes
O_2%	Oxygen concentration	%	Yes
Pmean	Mean pressure	cmH_2O hPa mbar	Yes
VT	Tidal volume	ml	No

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
VTe	Expiratory tidal volume	ml	Yes
VT/kg	TVe/IBW	ml/kg	No
VTe spn	Spontaneous expiratory tidal volume	ml	Yes
VTapnea	Apnea tidal volume	ml	No
MV	Minute volume	L/min	Yes
MVspn	Spontaneous breathed minute volume	L/min	Yes
ftot	Total respiratory rate	bpm	Yes
fmand	Mandatory breathing frequency	bpm	No
fspn	Spontaneous respiratory rate	bpm	Yes
fapnea	Breath rate for apnea ventilation	bpm	No
fSIMV	Frequency of SIMV	bpm	No
f	Breath rate	bpm	No
I:E	Inspiratory time: Expiratory time ratio	/	No
fsigh	Sigh rate	bpm	No
△int. PEEP	Intermittent PEEP	cmH_2O hPa mbar	No
MVLEAK	Leakage minute volume	L/min	No
FiO_2	Fractional concentration of O_2 in inspired gas	% mmHg kPa	Yes
Cstat	Static compliance	ml/cmH_2O ml/hPa ml/mbar	Yes
Cdyn	Dynamic compliance	ml/cmH_2O ml/hPa ml/mbar	Yes
RSBI	Rapid shallow breathing index	1/(min·L)	Yes
WOBimp	Imposed work of breathing	J/min	Yes
F-Trigger	Inspiratory trigger level (flow trigger)	L/min	No
P-Trigger	Inspiratory trigger level (pressure trigger)	cmH_2O Mbar hPa	No
Psupp	Pressure support level	cmH_2O hPa mbar	No
Tinsp	Time of inspiration	s	No

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
Pinsp	Pressure control level of inspiration	cmH_2O hPa mbar	No
Papnea	Apnea pressure	cmH_2O mbar hPa	No
Tpause	Apnea Time	s or %	No
Trise	Rise time	s	No
Phigh	Upper pressure level	cmH_2O mbar hPa	No
Plow	Lower pressure level	cmH_2O mbar hPa	No
Thigh	Time for the upper pressure level	s	No
Tlow	Time for the lower pressure level	s	No
Exp%	Inspiration termination level	%	No
Pmax	Maximum airway pressure	cmH_2O mbar hPa	No
Ri	Inspiratory resistance	$cmH_2O/L/s$ hPa/L/s mbar/L/s	Yes
Re	Expiratory resistance	$cmH_2O/L/s$ hPa/L/s mbar/L/s	Yes
RCexp	Expiratory time constant	s	No
NIF	Negative inspiratory force	cmH_2O hPa mbar	No
P0.1	100 ms occlusion pressure	cmH_2O hPa mbar	No
PEEPi	Intrinsic positive end-expiratory pressure	cmH_2O hPa mbar	Yes
$EtCO_2$	End-tidal carbon dioxide	% kPa mmHg	Yes

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
$FiCO_2$	Fraction of inspired carbon dioxide	% mmHg kPa	Yes
Flow	Flow	L/min	No
IBW	Ideal body weight	kg	No
VCO_2	CO_2 production	ml/min	No
PR	Pulse rate	bpm	Yes
SpO_2	Arterial oxygen saturation from pulse oximetry	%	Yes

30.9.2.2 Output Signals—Alarms

BeneView		SV300
Priority	**Label**	**Label**
Physiological alarms		
High	Paw Too High	Paw Too High
	Paw Too Low	Paw Too Low
	MV Too High	MV Too High
	MV Too Low	MV Too Low
	FiO_2 Too High	FiO_2 Too High
	FiO_2 Too Low	FiO_2 Too Low
	Apnea Ventilation	Apnea Ventilation
	PEEP Too High	PEEP Too High
	High Circuit O_2	O_2% Too High
	Low Circuit O_2	O_2% Too Low
Mediate	CO_2 Apnea	Apnea CO_2
	PEEP Too Low	PEEP Too Low
	SpO_2 Too High	SpO_2 Too High
	SpO_2 Too Low	SpO_2Too Low
	PR Too High	PR Too High
	PR Too Low	PR Too Low
	VTe Too High	TVe Too High
	fspn Too High	fspn Too High
	$EtCO_2$ Too High	$EtCO_2$ Too High
	$EtCO_2$ Too Low	$EtCO_2$ Too Low
	$FiCO_2$ Too High	$FiCO_2$ Too High
Low	Plimit Reached	Pressure Limited
Technical alarms		
High	O_2 Supply Pressure Low	O_2 Supply Failure
	Air Supply Pressure Low	Air Supply Pressure Low
	O_2 Supply Pressure Low	O_2 Supply Pressure Low
	No Gas Supply Pressure	No Gas Supply Pressure

BeneView		SV300
Priority	**Label**	**Label**
	Airway Obstructed?	Airway Obstructed?
	Tube Disconnected?	Tube Disconnected?
	Sustained Airway Pressure	Sustained Airway Pressure
	Insp gas temperature too high	Insp. Gas Temp Too High
High	High Technical Alarm	RT Clock Not Exist
		Technical Error 01
		Technical Error 01
		Ventilator Reset Error
		Battery Depleted! System Shut Down
		Ctrl Module Comm Error
		Device Failure 05
		Device Failure 06
		Protection Module Comm Error
		Device Failure 22
		Protection Module Selftest Error
		Device Failure 09
		Insp. Limb Failure
		Please perform pressure calibration.
		Please perform flow calibration.
		CO_2 Module Failure 05
		CO_2 Comm Error
		CO_2 Module Failure 04
		CO_2 Module Failure 02
		CO_2 Module Failure 03
		Device Failure 12
		Device Failure 16
		Device Failure 14
		Device Failure 15
		Device Failure 07
		Device Failure 08
		Flow Sensor Type Error
		Device Failure 17
		Device Failure 18
		Blower Temperature High
		Device Failure 21
		Battery 1 Failure 01
		Battery 2 Failure 01
		Battery 1 Failure 02
		Battery 2 Failure 02
		Battery 1 Failure 03
		Battery 2 Failure 03
		Battery 1 Failure 04

BeneView		SV300
Priority	**Label**	**Label**
		Battery 2 Failure 04
		Battery 1 Failure 05
		Battery 2 Failure 05
		Battery Temp High. Syst maybe Down
		Device Failure 03
		Device Failure 19
		Protection Module Init Error
		Device Failure 20
		SpO_2 Desat
		No Pulse
		System DOWN. Connect Ext. Power.
		Battery Undetected
		Device Failure 04
		Device Failure 02
		Device Failure 01
Mediate	Mediate Technical Alarm	Key Error
		Fan Failure
		Internal Temperature Too high
		Please Replace CO_2 Sensor
		Blower Controller Speed Abnormity
		Technical Error 03
		Technical Error 05
		Technical Error 06
		Battery Temp. High. Connect Ext. Pwr.
		Low Battery. Connect Ext. Power.
		Please Replace SpO_2 Sensor
		SpO_2 Module Error
		Insp. Limb Airway Obstructed?
		Technical Error 01
		Technical Error 02
		CO_2 Module Failure 04
		CO_2 Module Failure 02
		CO_2 Module Failure 03
Low	Airway Leak?	Airway Leak?
	Battery in Use	Battery in Use
	CO_2 No Water trap	CO_2 No Watertrap
	Low Technical Alarm	IP Address Conflict. Please Reset IP.
		Restoring Last Config. Failed
		Insp. Hold Interrupted
		Exp. Hold Interrupted
		Heating Module Failure
		Please calibrate O_2 sensor.

BeneView		SV300
Priority	**Label**	**Label**
		Technical Error 04
		CO_2 Sensor High Temp
		CO_2 Sensor Low Temp
		CO_2 High Airway Pressure
		CO_2 Low Airway Pressure
		CO_2 High Barometric
		CO_2 Low Barometric
		CO_2 Sampleline Occluded
		CO_2 System Error
		$EtCO_2$ Overrange
		$FiCO_2$ Overrange
		CO_2 Module Failure 01
		CO_2 No Sensor
		Replace HEPA Filter
		Pressure Limited in Sigh cycle
		SpO_2 Sensor Off
		SpO_2 No Sensor
		SpO_2 Too Much Light
		SpO_2 Non-Pulsatile
		SpO_2 Overrange
		PR Overrange

NOTE

- **Only SV300 with software version 04.00.00 or later can be connected to the BeneLink module.**

30.9.3 Newport E360

30.9.3.1 Output Signals—Parameters

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
PEEP	Positive end-expiratory pressure	cmH_2O hPa mbar	Yes
Ppeak	Peak pressure	cmH_2O hPa mbar	Yes
Pplat	Plateau pressure	cmH_2O hPa mbar	Yes
Pmean	Mean pressure	cmH_2O hPa mbar	Yes

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
VT	Tidal volume	ml	No
VTe	Expiratory tidal volume	ml	Yes
VTi	Inspiratory tidal volume	ml	Yes
MVspn	Spontaneous breathed minute volume	L/min	Yes
MVe	Expiratory minute volume	L/min	Yes
MVi	Inspiratory mimute volume	L/min	Yes
ftot	Total respiratory rate	bpm	Yes
fspn	Spontaneous respiratory rate	bpm	Yes
f	Breath rate	bpm	No
I:E	Inspiratory time: Expiratory time ratio	/	No
Leak Comp	Leak compensation	%	No
FiO_2	Fractional concentration of O_2 in inspired gas	% mmHg kPa	Yes
Rstat	Static lung resistance	$cmH_2O/L/s$ hPa/L/s mbar/L/s	Yes
Rdyn	Dynamic lung resistance	$cmH_2O/L/s$ hPa/L/s mbar/L/s	Yes
Cstat	Static compliance	ml/cmH_2O ml/hPa ml/mbar	Yes
Cdyn	Dynamic compliance	ml/cmH_2O ml/hPa ml/mbar	Yes
RSBI	Rapid shallow breathing index	1/(min·L)	Yes
WOBimp	Imposed work of breathing	J/min	Yes
O_2 Flow	O_2 flow	L/min	No
Air Flow	Air flow	L/min	No
Insp.Flow	Inspiration flow	L/min	No
Exp. Flow	Expiratory flow	L/min	No
F-Trigger	Inspiratory trigger level (flow trigger)	L/min	No
P-Trigger	Inspiratory trigger level (pressure trigger)	cmH_2O Mbar hPa	No
Psupp	Pressure support level	cmH_2O Mbar hPa	No
Plimit	Pressure limit level	cmH_2O mbar hPa	No
Tinsp	Time of inspiration	s	No

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
Pmax	Maximal breathing pressure	cmH_2O Mbar hPa	No
PEEP/CPAP	PEEP/CPAP	cmH_2O mbar hPa	No
PEEPtot	Total PEEP	cmH_2O hPa mbar	No

30.9.3.2 Output Signals—Alarms

BeneView		Newport E360
Priority	**Label**	**Label**
Physiological alarms		
High	Paw Too High	High Paw
	Paw Too Low	Low Paw
	MV Too High	High Exhale MV
	MV Too Low	Low Exhale MV
	Apnea	Apnea Alarm
	FiO_2 Too High	FiO_2 High
	FiO_2 Too Low	FiO_2 Low
	VT Not Achieved	Volume Target Not Met
	Low Baseline	Low Baseline
	High Baseline	High Baseline
	Sustained Hbline	Sustained Hbline
Mediate	RR Too High	Resp. Rate Alarm
Technical alarms		
High	Air Supply Pressure Low	Air Supply Loss
	O_2 Supply Pressure Low	O_2 Supply Loss
	Check Flow Sensors	Flow Sensor Error
	Patient Disconnected	Patient Disconnect
	Power Failure	Power Failure
	Tinsp too Short	Insp Time too Short
	High Technical Alarm	Device Alert
		No O_2 Power-Up
		Control EEPROM Failure
		Low Battery
		Transducer Error
		Control RAM Failed
		Control ROM Failed
		Control CPU Failed

BeneView		Newport E360
Priority	**Label**	**Label**
		Monitor RAM Failed
		Monitor ROM Failed
		Monitor CPU Failed
		Dual RAM Failed
		Monitor Tasks Failed
		Control Processor Failed
		Mon Internal System Failed
		Control Tasks Failed
		Monitor Processor Failed
		Ctrol Internal System Failed
		Fan Failure
		Air Flow Sensor EEPROM Failure
		O_2 Flow Sensor EEPROM Failure
		Air Servo Valve Leak
		O_2 Servo Valve Leak
Mediate	O_2 and air supply	Air & O_2 Supply Loss
	O_2 Sensor Unconnected	FiO_2 Sensor Disconnected
	Mediate Technical Alarm	Flow Sensor Cal Failed
		FiO_2 Sensor Bad
		O_2 Sensor Cal Failed
		External Battery
		Check Flow Sensor Board
		NO TEST
Low	Battery in Use	Battery in Use
	Tinsp too Long	Insp Time too Long
	Low Technical Alarm	I:E Ratio Inverse violation
		Plimit<Pbase
		Psupport+Pbase>60cmH_2O
		Pbase>Low Paw
		Tidal Volume Out of Range
		Flow Out of Range
		Ti Out of Range
		Rate Out of Range
		Psupport Out of Range
		Plimit Out of Range
		PEEP/CPAP Out of Range
		Flow Trigger Out of Range
		CPM Blinking
		EXH. VALVE CAL. Failed: Prox < 1
		EXH. VALVE CAL. Failed: Prox > 0.5
		EXH. VALVE CAL. Failed: Prox Low
		EXH. VALVE CAL. Failed: Flow < 1

BeneView		Newport E360
Priority	**Label**	**Label**
		LEAK TEST Leak Test Failed

30.9.4 Puritan Bennett 840

30.9.4.1 Output Signals—Parameters

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
O_2%	Oxygen concentration	%	Yes
PEEP	Positive end-expiratory pressure	cmH_2O hPa mbar	Yes
Ppeak	Peak pressure	cmH_2O hPa mbar	Yes
Pplat	Plateau pressure	cmH_2O hPa mbar	Yes
Pmean	Mean pressure	cmH_2O hPa mbar	Yes
Paw	Airway pressure	cmH_2O hPa mbar	Yes
VT	Tidal volume	ml	No
VTe	Expiratory tidal volume	ml	Yes
VTi	Inspiratory tidal volume	ml	Yes
VTe spn	Spontaneous expiratory tidal volume	ml	Yes
VTapnea	Apnea tidal volume	ml	No
MVspn	Spontaneous breathed minute volume	L/min	Yes
MVe	Expiratory minute volume	L/min	Yes
ftot	Total respiratory rate	bpm	Yes
fapnea	Breath rate for apnea ventilation	bpm	No
f	Breath rate	bpm	No
I:E	Inspiratory time: Expiratory time ratio	/	No
MVLEAK	Leakage minute volume	L/min	No
Leak Comp	Leak compensation	%	No
Rstat	Static lung resistance	cmH_2O/L/s hPa/L/s mbar/L/s	Yes
Rdyn	Dynamic lung resistance	cmH_2O/L/s hPa/L/s mbar/L/s	Yes

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
Cstat	Static compliance	ml/cmH_2O ml/hPa ml/mbar	Yes
Cdyn	Dynamic compliance	ml/cmH_2O ml/hPa ml/mbar	Yes
RSBI	Rapid shallow breathing index	1/(min·L)	Yes
WOB	Work of breathing	J/L	Yes
Base Flow	Base Flow	L/min	No
F-Trigger	Inspiratory trigger level (flow trigger)	L/min	No
P-Trigger	Inspiratory trigger level (pressure trigger)	cmH_2O Mbar hPa	No
Psupp	Pressure support level	cmH_2O Mbar hPa	No
Tplat	Plateau time	s	No
Rise Time%	Rise time	%	No
PEEP/CPAP	PEEP/CPAP	cmH_2O Mbar hPa	No
NIF	Negative inspiratory force	cmH_2O hPa mbar	No
P0.1	100 ms occlusion pressure	cmH_2O hPa mbar	No
PEEPi	Intrinsic positive end-expiratory pressure	cmH_2O hPa mbar	No
PEEPtot	Total PEEP	cmH_2O hPa mbar	No
Peak Flow	Peak flow	L/min	No
Tapnea	Apnea interval	s	No
IBW	Ideal body weight	kg	No
Ti max	Maximum inspiration time	s	No
Tube ID	Tube ID	mm	No

30.9.4.2 Output Signals—Alarms

BeneView		Puritan Bennett 840
Priority	**Label**	**Label**
Physiological alarms		
High	Paw Too High	High Inspiratory Pressure
	MV Too High	High Exhaled minute Volume
	MV Too Low	low exhaled minute volume
	Apnea	Apnea
	FiO_2 Too Low	Low O_2 %
	Ppeak Too Low	Low Ppeak
Mediate	VTe Too High	High Exhaled Tidal Volume
	RR Too High	High ftot
	VTe Too Low	Low Exhaled Mandatory Tidal Volume Alarm
	EtO_2 Too High	High O_2 Percent
Technical alarms		
High	Air Supply Pressure Low	No Air Supply
	O_2 Supply Pressure Low	No O_2 Supply
	Airway Obstructed?	Severe Occlusion
	Patient Disconnected	Circuit Disconnect
	Power Failure	Loss of Power
	High Technical Alarm	Compressor Inoperative
		Compliance Limited VT
		Procedure Error
		PAV Startup Too Long
		PAV R&C Not Assessed
		Volume Not Delivered
		Volume Not Delivered
Low	Tinsp too Long	Inspiration Too Long
	Low Technical Alarm	Inoperative Battery
		AC Power Loss
		Low Battery

30.9.5 Maquet SERVO-I/SERVO-S

30.9.5.1 Output Signals—Parameters

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
O_2%	Oxygen concentration	%	Yes
PEEP	Positive end-expiratory pressure	cmH_2O hPa mbar	Yes
Ppeak	Peak pressure	cmH_2O hPa mbar	Yes
Pplat	Plateau pressure	cmH_2O hPa mbar	Yes
Pmean	Mean pressure	cmH_2O hPa mbar	Yes
VT	Tidal volume	ml	No
VTe	Expiratory tidal volume	ml	Yes
VTi	Inspired tidal volume	ml	Yes
MV	Minute volume	L/min	Yes
MVspn	Spontaneous breathed minute volume	L/min	Yes
MVe	Expiratory minute volume	L/min	Yes
MVi	Inspiratory mimute volume	L/min	Yes
ftot	Total respiratory rate	bpm	Yes
fspn	Spontaneous respiratory rate	bpm	Yes
fCMV	CMV frequency	bpm	No
fSIMV	Frequency of SIMV	bpm	No
f	Breath rate	bpm	No
I:E	Inspiratory time:Expiratory time ratio	/	No
Leak Comp	Leak compensation	%	No
Cstat	Static compliance	ml/cmH_2O ml/hPa ml/mbar	Yes
Cdyn	Dynamic compliance	ml/cmH_2O ml/hPa ml/mbar	Yes
RSBI	Rapid shallow breathing index	1/(min·L)	Yes
WOB	Work of breathing	J/L	Yes
Exp. Flow	Expiratory flow	L/min	No
F-Trigger	Inspiratory trigger level (flow trigger)	L/min	No

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
P-Trigger	Inspiratory trigger level (pressure trigger)	cmH_2O Mbar hPa	No
Tinsp	Time of inspiration	s	No
Tpause	Apnea Time	s or %	No
Rise Time%	rise time%	%	No
Phigh	Upper pressure level	cmH_2O mbar hPa	No
Plow	Lower pressure level	cmH_2O mbar hPa	No
Thigh	Time for the upper pressure level	s	No
TPEEP	Time at PEEP level in Bi-Vent	s	No
Exp%	Inspiration termination level	%	No
PC above PEEP	PC above PEEP	cmH_2O mbar hPa	No
PS above PEEP	PS above PEEP	cmH_2O mbar hPa	No
PEEP/CPAP	PEEP/CPAP	cmH_2O mbar hPa	No
Ri	Inspiratory resistance	$cmH_2O/L/s$ hPa/L/s mbar/L/s	Yes
Re	Expiratory resistance	$cmH_2O/L/s$ hPa/L/s mbar/L/s	Yes
PO_2	oxygen supply pressure	kPa	No
Pair	air supply pressure	kPa	No
P0.1	100 ms occlusion pressure	cmH_2O hPa mbar	No
PEEPtot	Total PEEP	cmH_2O hPa mbar	No
$EtCO_2$	End-tidal carbon dioxide	% mmHg kPa	Yes
VCO_2	CO_2 production	ml/min	No
$VTCO_2$	CO_2 tidal elimination	ml	No

30.9.5.2 Output Signals—Alarms

BeneView		Maquet SERVO-I/SERVO-S
Priority	**Label**	**Label**
Physiological alarms		
	Paw Too High	Airway pressure alarm Upper pressure limit exceeded
	MV Too High	Exp.Minute volume too high
	MVToo Low	Exp.Minute volume too low
	Apnea	Apnea alarm
	FiO_2 Too High	O_2 conc.too high
	FiO_2 Too Low	O_2 conc.too low
High	PEEPToo Low	PEEP Low
	$EtCO_2$ Too High	$EtCO_2$ conc.too high
	$EtCO_2$ Too Low	$EtCO_2$ conc.too low
Mediate	RR Too Low	Breath frequency Low
	RR Too High	Breath frequency High
	PEEP Too High	PEEP High
Technical alarms		
	No Gas Supply Pressure	Gas supply alarm
	O_2 cell disconnect	O_2 cell disconnect
		Breathing system uP Module error
		Inspiratory control uP Module error
		Monitoring System uP Module error
		Battery alarm
		Power Failure
		Mains Failure
		O_2 potentiometer error
High		CMV potentiometer error
	High Technical Alarm	Range Switch error
		Mode Switch error
		Barometer error
		High continuous pressure
		Overrange
		Computer Interface Emulator hardware error
		NIV,Leakage out of range
		NIV,Time in waiting position exceeds 2 min
		regulation pressure limited
		Panel Interface uP Module error
		Exp.flow &CO_2 linearization uP Module error
		Alarm buff
Mediate	Mediate Technical Alarm	CI Battery Voltage
		Pneumatic-Edi out of synch
		Edi activity low
		No Edi signal detected

BeneView		Maquet SERVO-I/SERVO-S
Priority	**Label**	**Label**
		Unsuccessful manual gas change alarm
Low	Check tubing	Check tubing

30.9.6 Maquet SERVO-U

30.9.6.1 Output Signals—Parameters

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
O_2%	Oxygen concentration	%	Yes
PEEP	Positive end-expiratory pressure	cmH_2O hPa mbar	Yes
Ppeak	Peak pressure	cmH_2O hPa mbar	Yes
Pplat	Plateau pressure	cmH_2O hPa mbar	Yes
Pmean	Mean pressure	cmH_2O hPa mbar	Yes
VT	Tidal volume	ml	No
VTe	Expiratory tidal volume	ml	Yes
VTi	Inspired tidal volume	ml	Yes
VT/kg	TVe/IBW	ml/kg	No
VTapnea	Apnea tidal volume	ml	No
MV	Minute volume	L/min	Yes
MVe	Expiratory minute volume	L/min	Yes
MVi	Inspiratory mimute volume	L/min	Yes
MVspn	Spontaneous breathed minute volume	L/min	Yes
fapnea	Breath rate for apnea ventilation	bpm	No
f	Breath rate	bpm	No
ftot	Total respiratory rate	bpm	Yes
fspn	Spontaneous respiratory rate	bpm	Yes
fSIMV	Frequency of SIMV	bpm	No
I:E	Inspiratory time:Expiratory time ratio	/	No
Ti/Ttot	Duty cycle or ratio of inspiration time to total breathing cycle time (only during spontaneous breathing)	/	No
Leak Comp	Leak compensation	%	No

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
Cstat	Static compliance	ml/cmH_2O ml/hPa ml/mbar	Yes
Cdyn	Dynamic compliance	ml/cmH_2O ml/hPa ml/mbar	Yes
RSBI	Rapid shallow breathing index	1/(min·L)	Yes
WOB	Work of breathing	J/L	Yes
Exp. Flow	Expiratory flow	L/min	No
F-Trigger	Inspiratory trigger level (flow trigger)	L/min	No
P-Trigger	Inspiratory trigger level (pressure trigger)	cmH_2O Mbar hPa	No
Plimit	PRESSURE LIMit level	cmH_2O hPa mbar	No
Tinsp	Time of inspiration	s or %	No
Tpause	Apnea Time	s or %	No
Trise	Rise time	s	No
Rise Time%	rise time%	%	No
Phigh	Upper pressure level	cmH_2O mbar hPa	No
Thigh	Time for the upper pressure level	s	No
TPEEP	Time at PEEP level in Bi-Vent	s	No
PC above PEEP	PC above PEEP	cmH_2O mbar hPa	No
PS above PEEP	PS above PEEP	cmH_2O mbar hPa	No
PEEP/CPAP	PEEP/CPAP	cmH_2O mbar hPa	No
Ri	Inspiratory resistance	cmH_2O/L/s hPa/L/s mbar/L/s	Yes
Re	Expiratory resistance	cmH_2O/L/s hPa/L/s mbar/L/s	Yes
PO_2	oxygen supply pressure	kPa	No
Pair	air supply pressure	kPa	No

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
P0.1	100 ms occlusion pressure	cmH_2O hPa mbar	No
PEEPtot	Total PEEP	cmH_2O hPa mbar	No
$EtCO_2$	End-tidal carbon dioxide	% mmHg kPa	Yes
Flow	Flow	L/min	No
Tapnea	Apnea time	s	No
VCO_2	CO_2 production	ml/min	No
$VTCO_2$	CO_2 tidal elimination	ml	No

30.9.6.2 Output Signals—Alarms

BeneView		Maquet SERVO-U
Priority	**Label**	**Label**
Physiological alarms		
High	Apnea	Apnea
	FiO_2 Too High	O_2 concentration high
	FiO_2 Too Low	O_2 concentration low
	High Paw Sustained	Airway pressure continuously high
	MV Too High	Expiratory minute volume high
	MV Too Low	Expiratory minute volume low
	Paw Too High	Airway pressure high
	PEEP Too High	PEEP high
	PEEP Too Low	PEEP low
Mediate	$EtCO_2$ Too High	$EtCO_2$ high
	$EtCO_2$ Too Low	$EtCO_2$ low
	RR Too High	Respiratory rate High
	RR Too Low	Respiratory rate low
Technical alarms		
High	High Technical Alarm	Battery alarm
		Overrange alarm
		Patient disconnected > 1 min
		Time in waiting position > 2 min
	No Gas Supply Pressure	Gas supply alarm
	O_2 cell disconnect	O_2 cell/sensor failure
	Patient Connection Leak	Patient circuit disconnected
Mediate	Mediate Technical Alarm	CPAP high

BeneView		Maquet SERVO-U
Priority	**Label**	**Label**
		CPAP low
		Edi signal interference from ECG
		Edi signal invalid
		Expiratory cassette disconnected
		Leakage too high
		No consistent patient effort
		No patient effort
		The nebulizer cannot be run on one battery
Low	Battery in Use	Battery operation
	Low Technical Alarm	Expiratory cassette replaced
		Inconsistent Edi signal
		Low Edi signal
		No Edi signal detected
		Volume delivery restricted

30.9.7 Draeger Evita 2

30.9.7.1 Output Signals—Parameters

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
O_2%	Oxygen concentration	%	Yes
PEEP	Positive end-expiratory pressure	cmH_2O hPa mbar	Yes
Ppeak	Peak pressure	cmH_2O hPa mbar	Yes
Pplat	Plateau pressure	cmH_2O hPa mbar	Yes
Pmean	Mean pressure	cmH_2O hPa mbar	Yes
VT	Tidal volume	ml	No
VTe	Expiratory tidal volume	ml	Yes
MV	Minute volume	L/min	Yes
MVspn	Spontaneous breathed minute volume	L/min	Yes
ftot	Total respiratory rate	bpm	Yes
fspn	Spontaneous breathing frequency	bpm	Yes
fSIMV	Frequency of SIMV	bpm	No

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
I:E	Inspiratory time:Expiratory time ratio	/	No
△int.PEEP	Intermittent PEEP	cmH_2O hPa mbar	No
FiO_2	Fractional concentration of O_2 in inspired gas	% mmHg kPa	Yes
Rdyn	Dynamic lung resistance	$cmH_2O/L/s$ hPa/L/s mbar/L/s	Yes
Cdyn	Dynamic compliance	ml/cmH_2O ml/hPa ml/mbar	Yes
F-Trigger	Inspiratory trigger level (flow trigger)	L/min	No
P-Trigger	Inspiratory trigger level (pressure trigger)	cmH_2O Mbar hPa	No
Phigh	Upper pressure level	cmH_2O mbar hPa	No
Plow	Lower pressure level	cmH_2O mbar hPa	No
Thigh	Time for the upper pressure level	s	No
Tlow	Time for the lower pressure level	s	No
Pmax	Maximum airway rressure	cmH_2O mbar hPa	No
Pmin	Minimum airway rressure	cmH_2O Mbar hPa	No
Vtrap	Trapped volume	ml	No
T	Inspiratory breathing gas temperature	℃ ℉	No
P0.1	100 ms occlusion pressure	cmH_2O hPa mbar	No
PEEPi	Intrinsic positive end-expiratory pressure	cmH_2O hPa mbar	No

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
$EtCO_2$	End-tidal carbon dioxide	% kPa mmHg	Yes
Flow	Flow	L/min	No
Tapnea	Apnea Time	s	No
ASB ramp	ASB ramp	s	No
PASB	Assisted spontaneous breathing	cmH_2O hPa mbar	No
Vds	Dead space	ml	No
VCO_2	CO_2 production	ml/min	No

30.9.7.2 Output Signals—Alarms

BeneView		Draeger Evita 2
Priority	**Label**	**Label**
Physiological alarms		
High	Paw Too High	PAW HIGH
	Paw Too Low	PAW LOW
	MV Too High	MIN VOL HIGH
	MV Too Low	MIN VOL LOW
	Apnea	APNEA EVITA
	FiO_2 Too High	% O_2 HIGH
	FiO_2 Too Low	% O_2 LOW
	AW-TEMP HIGH	AW-TEMP HIGH
	PEEP Too High	PEEP HIGH
	ASB>4s	ASB > 4 SEC
Mediate	$EtCO_2$ Too High	ET CO_2 HIGH
	$EtCO_2$ Too Low	ET CO_2 LOW
	VOL INCONST	VOL INCONST
	RR Too High	RESP RATE HI
Technical alarms		
High	Air Supply Pressure Low	AIR SUPPLY ?
	Check Flow Sensors	FLOW SENSOR?
	EXP-VALVE?	EXP-VALVE ?
	CLEAN CO_2	CLEAN CO_2
	High Technical Alarm	VOL ERR
		PRESS ERR
		AW-TEMP INOP
		AW-TEMP SENS

BeneView		Draeger Evita 2
Priority	**Label**	**Label**
		CO_2 NOT CAL
		% O_2 ERR
		EVITA ERR
		COOLING INOP
		CYCLE FAILED
Low	Low Technical Alarm	CO_2 ERR
		CO_2 SENS?
		MIXER INOP
		SYNCHRO INOP

30.9.8 Draeger Evita 4/ Evita2 dura /Evita XL

30.9.8.1 Output Signals—Parameters

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
O_2%	Oxygen concentration	%	Yes
PEEP	Positive end-expiratory pressure	cmH_2O hPa mbar	Yes
Ppeak	Peak pressure	cmH_2O hPa mbar	Yes
Pplat	Plateau pressure	cmH_2O hPa mbar	Yes
Pmean	Mean pressure	cmH_2O hPa mbar	Yes
VT	Tidal volume	ml	No
Vte	Expiratory tidal volume	ml	Yes
Vtapnea	Apnea tidal volume	ml	No
MV	Minute volume	L/min	Yes
MVspn	Spontaneous breathed minute volume	L/min	Yes
Ftot	Total respiratory rate	bpm	Yes
Fspn	Spontaneous breathing frequency	bpm	Yes
Fapnea	Breath rate for apnea ventilation	bpm	No
F	Breath rate	bpm	No
I:E	Inspiratory time: Expiratory time ratio	/	No
△int.PEEP	Intermittent PEEP	cmH_2O hPa mbar	No

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
FiO_2	Fractional concentration of O_2 in inspired gas	% mmHg kPa	Yes
Rdyn	Dynamic lung resistance	$cmH_2O/L/s$ hPa/L/s mbar/L/s	Yes
Cdyn	Dynamic compliance	ml/cmH_2O ml/hPa ml/mbar	Yes
RSBI	Rapid shallow breathing index	1/(min·L)	Yes
F-Trigger	Inspiratory trigger level (flow trigger)	L/min	No
Tinsp	Time of inspiration	s	No
Pinsp	Pressure control level of inspiration	cmH_2O mbar hPa	No
Papnea	Apnea pressure	cmH_2O mbar hPa	No
Phigh	Upper pressure level	cmH_2O mbar hPa	No
Plow	Lower pressure level	cmH_2O mbar hPa	No
Thigh	Time for the upper pressure level	s	No
Tlow	Time for the lower pressure level	s	No
Pmax	Maximum airway pressure	cmH_2O mbar hPa	No
Pmin	Minimum airway pressure	cmH_2O mbar hPa	No
Vtrap	Trapped Volume	ml	No
T	Inspiratory breathing gas temperature	°C °F	No
NIF	Negative inspiratory force	cmH_2O hPa mbar	No
P0.1	100 ms occlusion pressure	cmH_2O hPa mbar	No

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
PEEPi	Intrinsic positive end-expiratory pressure	cmH_2O hPa mbar	No
$EtCO_2$	End-tidal carbon dioxide	% kPa mmHg	Yes
Flow	Flow	L/min	No
Ext.Flow	External flow	L/min	No
Tapnea	Apnea time	s	No
ASB ramp	ASB ramp	s	No
PASB	Assisted spontaneous breathing	cmH_2O hPa mbar	No
FlowAssist	Flow assist	mbar.s/L cmH_2O.s/L hPa.s/L	No
Vol.Assist	Volume assist	mbar/L cmH_2O/L hPa/L	No
Tdisconnect	Delay time for "Airway pressure lower alarm limit"	s	No
Vds	Dead space	ml	No
VCO_2	CO_2 production	ml/min	No
ATC	Automatic tube Compensation	%	No
Tube ID	Tube ID	mm	No
PR	Pulse rate	bpm	Yes
SpO_2	Arterial oxygen saturation from pulse oximetry	%	Yes

30.9.8.2 Output Signals—Alarms

BeneView		Draeger Evita 4/ Evita2 dura /Evita XL
Priority	**Label**	**Label**
Physiological alarms		
High	Paw Too High	PAW HIGH
	Paw Too Low	PAW LOW
	MV Too High	MIN VOL HIGH
	MV Too Low	MIN VOL LOW
	Apnea	APNEA EVITA
	FiO_2 Too High	% O_2 HIGH
	FiO_2 Too Low	% O_2 LOW
	AW-TEMP HIGH	AW-TEMP HI

BeneView		Draeger Evita 4/ Evita2 dura /Evita XL
Priority	**Label**	**Label**
	PEEP Too High	PEEP HIGH
	ASB>4s	ASB > 4 SEC
	No Pulse	NO SPO_2 PULS
	PR Too Low	SPO_2 PULS LO
	SpO_2 Too Low	SPO_2 LOW
	PR Too High	SPO_2 PULS HI
	SpO_2 Too High	SPO_2 HIGH
Mediate	VTe Too High	TIDVOL HI
	$EtCO_2$ Too High	ET CO_2 HIGH
	$EtCO_2$ Too Low	ET CO_2 LOW
	VOL INCONST	VOL INCONST
	RR Too High	RESP RATE HI
Low	ASB > 1.5s	ASB > 1,5 SEC
	PPS-TI > 1.5s	PPS-TI > 1,5S
	ASB > Tinsp	ASB > TINSP
Physiological alarms		
High	Air Supply Pressure Low	AIR SUPPLY ?
	O_2 Supply Pressure Low	LO O_2 SUPPLY
	Airway Obstructed?	TUBE OBSTRUC
	Check Flow Sensors	FLOW SENSOR?
	EXP-VALVE?	EXP-VALVE ?
	CLEAN CO_2	CLEAN CO_2
	High Technical Alarm	VOL ERR
		PRESS ERR
		AW-TEMP INOP
		% O_2 ERR
		EVITA ERR
		CYCLE FAILED
		N-VOL ERR
		NEO FLOW ?
		CO_2 ZERO CAL
		SPO_2 SEN DISC
		SPO_2 ERR
		BATTERY ERR
		FAN ERR
		AIR PRESS HI
		HI O_2 SUPPLY
		LOSS OF DATA
		REM.PAD-ERR
		PEEP V ERR
Mediate	Mediate Technical Alarm	BATT. < 2MIN
		CHECK EVITA

BeneView		Draeger Evita 4/ Evita2 dura /Evita XL
Priority	**Label**	**Label**
		EVITA STDBY
		AMB PRESS ?
		NEBULIZ OFF
		ERR MULTIPCB
Low	Battery in Use	BATTERY ON
	Low Technical Alarm	CO_2 ERR
		CO_2 SENSOR ?
		MIXER INOP
		SYNCHRO INOP
		INSPHOLD END
		EXSPHOLD END

30.9.9 Hamilton G5

30.9.9.1 Output Signals—Parameters

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
f	Breath rate	bpm	No
VT	Tidal volume	ml	No
TPause	Apnea Time	s or %	No
P-Trigger	Inspiratory trigger level(pressure trigger)	cmH_2O hPa mbar	No
PEEP/CPAP	PEEP/CPAP	cmH_2O mbar hPa	No
Plow	Lower pressure level	cmH_2O mbar hPa	No
Psupp	Pressure support level	cmH_2O Mbar hPa	No
MV	Minute volume	L/min	Yes
Plimit	Pressure limit level	cmH_2O hPa mbar	No
Pinsp	Pressure control level of inspiration	cmH_2O hPa mbar	No
Phigh	Upper pressure level	cmH_2O mbar hPa	No

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
F-Trigger	Inspiratory trigger level (flow trigger)	L/min	No
I:E	Inspiratory time:Expiratory time ratio	/	No
Peak Flow	Peak flow	L/min	No
Exp%	Inspiration termination level	%	No
Ramp	Ramp	ms	No
IBW	Ideal body weight	kg	No
%MinVol	Percentage of minute volume to be delivered	%	No
Tlow	Time for the lower pressure level	s	No
Thigh	Time for the upper pressure level	s	No
Ti max	Maximum inspiration time	s	No
Tip	Inspiratory pause time	s	No
tube ID	Tube ID	mm	No
TRC	Tube resistance compensation	/	No
base flow	Base Flow	L/min	No
Ppeak	Peak pressure	cmH_2O hPa mbar	Yes
Pplat	Plateau pressure	cmH_2O hPa mbar	Yes
Pmean	Mean pressure	cmH_2O hPa mbar	Yes
PEEP	Positive end-expiratory pressure	cmH_2O hPa mbar	Yes
Pmin	Minimum airway pressure	cmH_2O mbar hPa	No
PEEPi	Intrinsic positive end-expiratory pressure	cmH_2O hPa mbar	No
P0.1	100 ms occlusion pressure	cmH_2O hPa mbar	No
PTP	Pressure time product	$cmH_2O.s$ mbar.s hPa.s	No
Insp.Flow	Inspiration flow	L/min	No
Exp. Flow	Expiratory flow	L/min	No
Vti	Inspired tidal volume	ml	Yes
Vte	Expiratory tidal volume	ml	Yes
VTe spn	Spontaneous expiratory tidal volume	ml	Yes

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
MVspn	Spontaneous breathed minute volume	L/min	Yes
ftot	Total respiratory rate	bpm	Yes
fspn	Spontaneous respiratory rate	bpm	Yes
Texp	Expiratory time	s	No
I:E	Inspiratory time:Expiratory time ratio	/	No
Ri	Inspiratory resistance	$cmH_2O/L/s$ hPa/L/s mbar/L/s	Yes
Re	Expiratory resistance	$cmH_2O/L/s$ hPa/L/s mbar/L/s	Yes
Cstat	Static compliance	ml/cmH_2O ml/hPa ml/mbar	Yes
RCexp	Expiratory time constant	s	No
RCinsp	Inspiratory time constant	s	No
RSBI	Rapid shallow breathing index	1/(min·L)	Yes
O_2%	Oxygen concentration	%	Yes
WOB	Work of breathing	J/L	Yes
$EtCO_2$	End-tidal carbon dioxide	% mmHg kPa	Yes
VCO_2	CO_2 production	ml/min	No
PR	Pulse rate	bpm	Yes
SpO_2	Arterial oxygen saturation from pulse oximetry	%	Yes
fCMV	CMV frequency	bpm	No
fSIMV	Frequency of SIMV	bpm	No
%Tinsp	Time of inspiration	%	No
Tinsp	Time of inspiration	s	No

30.9.9.2 Output Signals—Alarms

BeneView		Hamilton G5
Priority	**Label**	**Label**
Physiological alarms		
High	PawToo High	High pressure
	PawToo Low	Low pressure
	FiO_2 Too High	High oxygen
	FiO_2 Too Low	Low oxygen
	Apnea	Apnea
	SpO_2 Too Low	SpO_2 too low

BeneView		Hamilton G5
Priority	**Label**	**Label**
	SpO_2 Too High	SpO_2 too high
	Loss of PEEP	Loss of PEEP
	MV Too Low	Low minute volume
	MV Too High	High minute volume
Mediate	RR Too High	High frequency
	RR Too Low	Low frequency
	$EtCO_2$ Too High	High $PetCO_2$
	$EtCO_2$ Too Low	Low $PetCO_2$
Technical alarms		
High	Patient Disconnected	Disconnection Patient or, Disconnection on patient side
	Air Supply Pressure Low	Air supply failed
	O_2 Supply Pressure Low	Oxygen supply failed
	O_2 cell disconnect	O_2 cell missing
	O_2 cell cal. Needed	O_2 cell calibration needed
	Power Failure	Loss of mains power
	Check Flow Sensors	Check Flow Sensor type
	No Gas Supply Pressure	All gas supplies failed
	Disconnection ventilator side	Disconnection Ventilator or, Disconnection on ventilator side
	High Technical Alarm	Fail to Cycle
		Wrong Flow Sensor type
		O_2 cell defective
		Disconncetion
		Low internal pressure
		High pressure during sigh
		Pressure not released
		Exhalation obstructed
		TF5514:Check loudspeaker
		Internal battery empty
		Ventilator unit connection lost
		Check internal battery
Mediate	O_2 and air supply	Oxygen + air supplies failed
	O_2 and heliox supply	Oxygen + heliox supplies failed
	Mediate Technical Alarm	Gas Supply
		High leak
		Low tidal volume
		High tidal volume
		Turn the Flow Sensor
		APV init failed
		Internal battery low
		Panel connection lost

BeneView		Hamilton G5
Priority	**Label**	**Label**
		Heliox supply failed
		SpO_2: sensor error(left slot)
		SpO_2: sensor error(right slot)
		SpO_2: no sensor (left slot)
		SpO_2: no sensor (right slot)
		SpO_2: patient disconnected (left slot)
		SpO_2: patient disconnected (right slot)
		SpO_2: light interference (left slot)
		SpO_2: light interference (right slot)
		SpO_2: poor signal (left slot)
		SpO_2: poor signal (right slot)
		Large change in FiO_2
		Recruitment maneuver in process
		Brightness test alarm
		AERONEB disconnected
		Cuff disconnection
		Air + heliox supplies failed
		Oxygenation adjustment OFF (no SpO_2)
		Ventilation adjustment OFF (no $PetCO_2$)
		No hemodynamic status available
		High HLI
		MV oszillation
		FiO_2 oszillation
		PEEP oszillation
		Cuff high pressure
		FiO_2 set to 100% due to low saturation
Low	Low Technical Alarm	Operator
		General Alarm
		Volume too low for nebulizer
		ASV: Check high pressure limit
		APV: Check high pressure limit
		Pressure low limit reached
		Check %MinVol
		Check Body Wt
		ASV: Cannot meet target
		Check PEEP/high pressure limit
		Check PEEP/Pcontrol
		Check PEEP/Psupport
		Check P-ramp
		Check trigger
		Check %TI
		Check pause

BeneView		Hamilton G5
Priority	**Label**	**Label**
		Check I:E
		Check Vt
		Check rate
		Check peak flow
		Check TI
		Check Flow Pattern
		Flow sensor calibration needed
		Expiratory valve calibration needed
		Apnea ventilation ended
		Maximum leak compensation
		Low ExpMinVol alarm off
		CO_2 sensor calibration needed
		Check CO_2 airway adapter
		CO_2 sensor disconnected
		CO_2 sensor over temperature
		CO_2 sensor faulty
		External battery empty
		Sensor simulation active
		IRV
		Cuff leak
		IntelliCuff not found
		Check VThigh limit
		AERONEB module disconnected
		Oxygenation adjustment OFF (no SpO_2)
		Ventilation adjustment OFF (no $PetCO_2$)
		Check CO_2 sampling line
		Check INTELLiVENT PEEP limit setting
		Set low limit of ExpMinVol alarm
		Recruitment in Progress
		Oxygenation Controller on Limit
		Ventilation Controller on Limit
		SBT conditions fulfilled
		SBT in progress

30.9.10 Hamilton C2 /Galileo

30.9.10.1 Output Signals—Parameters

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
fCMV	CMV frequency	bpm	No
fSIMV	Frequency of SIMV	bpm	No
VT	Tidal volume	ml	No
%Tinsp	Time of inspiration	%	No
Tpause	Apnea Time	s or %	No
P-Trigger	Inspiratory trigger level(pressure trigger)	cmH_2O hPa mbar	No
PEEP/CPAP	PEEP/CPAP	cmH_2O mbar hPa	No
Psupp	Pressure support level	cmH_2O Mbar hPa	No
O_2%	Oxygen concentration	%	Yes
MV	Minute volume	L/min	Yes
I: E	Inspiratory time:Expiratory time ratio	/	No
Peak Flow	Peak flow	L/min	No
Exp%	Inspiration termination level	%	No
Ramp	Ramp	ms	No
IBW	Ideal body weight	kg	No
%MinVol	Percentage of minute volume to be delivered	%	No
$EtCO_2$	End-tidal carbon dioxide	% mmHg kPa	Yes
SpO_2	Arterial oxygen saturation from pulse oximetry	%	Yes
PR	Pulse rate	bpm	Yes
Vti	Inspired tidal volume	ml	Yes
Vte	Expiratory tidal volume	ml	Yes
ftot	Total respiratory rate	bpm	Yes
fspn	Spontaneous respiratory rate	bpm	Yes
Ppeak	Peak pressure	cmH_2O hPa mbar	Yes
Pmean	Mean pressure	cmH_2O hPa mbar	Yes

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
Pplat	Plateau pressure	cmH_2O hPa mbar	Yes
Texp	Expiratory time	s	No
Ri	Inspiratory resistance	$cmH_2O/L/s$ hPa/L/s mbar/L/s	Yes
Re	Expiratory resistance	$cmH_2O/L/s$ hPa/L/s mbar/L/s	Yes
Cstat	Static compliance	ml/cmH_2O ml/hPa ml/mbar	Yes
Insp.Flow	Inspiration flow	L/min	No
VTe spn	Spontaneous expiratory tidal volume	ml	Yes
PEEPi	Intrinsic positive end-expiratory pressure	cmH_2O hPa mbar	No
Pmin	Minimum airway pressure	cmH_2O mbar hPa	No
Tinsp	Time of inspiration	s	No
P0.1	100 ms occlusion pressure	cmH_2O hPa mbar	No
Exp. Flow	Expiratory flow	L/min	No
RCexp	Expiratory time constant	s	No
RCinsp	Inspiratory time constant	s	No
WOB	Work of breathing	J/L	Yes
PTP	Pressure time product	$cmH_2O.s$ mbar.s hPa.s	No
Pinsp	Pressure control level of inspiration	cmH_2O mbar hPa	No

30.9.10.2 Output Signals—Alarms

BeneView		Hamilton C2 /Galileo
Priority	**Label**	**Label**
Physiological alarms		
High	Paw Too High	High Pressue
	Apnea	Apnea
	Loss of PEEP	Loss of PEEP
	MV Too Low	Low Min Vol
	MV Too High	High Min Vol
Mediate	RR Too High	High Rate
Technical alarms		
High	Disconnection ventilator side	Disconnection Ventilator
	Patient Disconnected	Disconnection Patient
	High Technical Alarm	Fail to Cycle
Mediate	Mediate Technical Alarm	Gas Supply
Low	Low Technical Alarm	Operator
		General Alarm

30.9.11 Carefusion Vela

30.9.11.1 Output Signals—Parameters

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
PEEP	Positive end-expiratory pressure	cmH_2O hPa mbar	Yes
Ppeak	Peak pressure	cmH_2O hPa mbar	Yes
Pmean	Mean pressure	cmH_2O hPa mbar	Yes
VT	Tidal volume	ml	No
VTe	Expiratory tidal volume	ml	Yes
VTi	Inspiratory tidal volume	ml	Yes
VTe spn	Spontaneous expiratory tidal volume	ml	Yes
MVspn	Spontaneous breathed minute volume	L/min	Yes
MVe	Expiratory minute volume	L/min	Yes
ftot	Total respiratory rate	bpm	Yes
fspn	Spontaneous respiratory rate	bpm	Yes
f	Breath rate	bpm	No

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
I:E	Inspiratory time:Expiratory time ratio	/	No
FiO_2	Fractional concentration of O_2 in inspired gas	% mmHg kPa	Yes
Base Flow	Base Flow	L/min	No
F-trigger	Inspiratory trigger level (flow trigger)	L/min	No
Psupp	Pressure support level	cmH_2O hPa mbar	No
Tinsp	Time of inspiration	s	No
Texp	Expiratory time	s	No
Pinsp	Pressure control level of inspiration	cmH_2O hPa mbar	No
Phigh	Upper pressure level	cmH_2O mbar hPa	No
Plow	Lower pressure level	cmH_2O mbar hPa	No
Thigh	Time for the upper pressure level	s	No
Tlow	Time for the lower pressure level	s	No
Exp%	Inspiration termination level	%	No
PO_2	Oxygen supply pressure	kPa	No
Peak Flow	Peak flow	L/min	No
Ti max	Maximum inspiration time	s	No
O_2%	Oxygen concentration	%	Yes
Tpause	Apnea Time	s or %	No
$EtCO_2$	End-tidal carbon dioxide	% mmHg kPa	Yes
RSBI	Rapid shallow breathing index	1/(min·L)	Yes

30.9.11.2 Output Signals—Alarms

BeneView		Carefusion Vela
Priority	**Label**	**Label**
Physiological alarms		
High	MV Too Low	Low Ve
	Apnea	APNEA INTERVAL
	PEEP Too High	HIGH PEEP
	Ppeak Too High	HIGH PIP or HIGH PIP SUST
	Ppeak Too Low	LOW PIP
	FiO_2 Alarm	$\%O_2$ RANGE ERROR
Mediate	$EtCO_2$ Too High	High $EtCO_2$
	$EtCO_2$ Too Low	Low $EtCO_2$
	RR Too High	HIGH RATE
Technical alarms		
High	O_2 cell cal. Needed	CHECK O_2 CAL
	Circuit Disconnect	Circuit FAULT
	O_2 Supply Pressure Low	O_2 Inlet LOW
	High Technical Alarm	LOW BATTERY
		MOTOR FAULT
		VENT INOP
		H/W FAULT
Mediate	Mediate Technical Alarm	CHECK EVENTS
		LOW CLOCK BATTERY
		CO_2 COMMS ERROR
		CO_2 Out Of Range
		CO_2 Sensor Fault
		CO_2 Sensor Temp
		CO_2 Zero Reqd
		FAN FAILURE
		CO_2 Check Adapter
		DEFAULTS
		O_2 SENSOR FAILURE
		Invalid $EtCO_2$
		O_2 INLET HIGH
		MED BATTERY
		XDCR FAULT
Low	Battery in Use	ON BATTERY POWER
	Low Technical Alarm	INVALID SERIAL NUMBER

BeneView		Carefusion Vela
Priority	**Label**	**Label**
		NO CAL DATA

30.9.12 Draeger Evita Infinity V500

30.9.12.1 Output Signals—Parameters

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
Cdyn	Dynamic compliance	ml/cmH_2O ml/hPa ml/mbar	Yes
Rdyn	Dynamic lung resistance	cmH_2O/L/s hPa/L/s mbar/L/s	Yes
VCO_2	CO_2 production	ml/min	No
Pmin	Minimum airway pressure	cmH_2O mbar hPa	No
P0.1	100 ms occlusion pressure	cmH_2O hPa mbar	No
Pmean	Mean pressure	cmH_2O hPa mbar	Yes
Pplat	Plateau pressure	cmH_2O hPa mbar	No
PEEP	Positive end-expiratory pressure	cmH_2O hPa mbar	Yes
PEEPi	Intrinsic positive end-expiratory pressure	cmH_2O hPa mbar	Yes
fmand	Mandatory breathing frequency	bpm	No
Ppeak	Peak pressure	cmH_2O hPa mbar	Yes
Vtrap	Volume trapped in the lung by intrinsic PEEP, and not exhaled during subsequent expiration	ml	No

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
Vte spn	Spontaneous expiratory tidal volume	ml	No
Vds	Dead space	ml	No
NIF	Negative inspiratory force	cmH_2O hPa mbar	No
Mvleak	Leakage minute volume	L/min	Yes
Leak Comp	Leak compensation	%	No
fspn	Spontaneous respiratory rate	bpm	Yes
MV	Minute volume	L/min	Yes
RSBI	Rapid shallow breathing index	1/(min·L)	Yes
ftot	Total respiratory rate	bpm	Yes
$EtCO_2$	End-tidal carbon dioxide	% kPa mmHg	Yes
FiO_2	Fractional concentration of O_2 in inspired gas	% mmHg kPa	Yes
Vte	Expiratory tidal volume	ml	Yes
Vti	Inspired tidal volume	ml	Yes
Mve	Expiratory minute volume	L/min	Yes
Mvi	Inspiratory mimute volume	L/min	Yes
$VTCO_2$	CO_2 tidal elimination	ml	No
O_2%	Oxygen concentration	%	No
Flow	Flow	L/min	No
Tinsp	Time of inspiration	s	No
I:E	Inspiratory time:Expiratory time ratio	/	No
f	Breath rate	bpm	No
PEEP	Positive end-expiratory pressure	cmH_2O hPa mbar	No
∆ int.PEEP	Intermittent PEEP	cmH_2O hPa mbar	No
Plow	Lower pressure level	cmH_2O mbar hPa	No

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
Phigh	Upper pressure level	cmH_2O mbar hPa	No
Tlow	Time for the lower pressure level	s	No
Thigh	Time for the upper pressure level	s	No
Tapnea	Apnea time	s	No
Psupp	Pressure support level	cmH_2O hPa mbar	No
Pmax	Maximum airway pressure	cmH_2O mbar hPa	No
F-triger	Inspiratory trigger level (flow trigger)	L/min	No
Trise	Rise time	s	No
Flow Assist	Flow assist	mbar.s/L cmH_2O.s/L hPa.s/L	No
Vol Assist	Volume assist	mbar/L cmH_2O/L hPa/L	No
VT	Tidal volume	ml	No
fapnea	Breath rate for apnea ventilation	bpm	No
Pinsp	Pressure control level of inspiration	cmH_2O hPa mbar	No
ATC	Automatic tube compensation	%	No
Tube ID	Tube ID	mm	No
Tdisconnect	Delay time for "Airway pressure lower alarm limit"	s	No
Ti max	Maximum inspiration time	s	No
Vtapnea	Apnea tidal volume	ml	No
Tpause	Apnea Time	s or %	No
Exp%	Inspiration termination level	%	No

30.9.12.2 Output Signals—Alarms

BeneView		Evita Infinity V500
Priority	**Label**	**Label**
Physiological alarms		
High	FiO_2 Too Low	FiO_2 low
	Paw Too High	Airway pressure high
	MV Too Low	MV low
	MV Too High	MV high
	FiO_2 Too High	FiO_2 high
	Paw Too Low	Airway pressure low
	VT Not Achieved	Continuous high pressure
	VOL INCONST	VT not reached
	Apnea ventilation	Apnea ventilation
Mediate	$EtCO_2$ Too Low	$etCO_2$ low
	$EtCO_2$ Too High	$etCO_2$ high
	FiO_2 Too High	FiO_2 high
	RR Too High	High respiratory rate
	PEEP Too High	PEEP high
	PEEP Too Low	PEEP low
	VTe Too High	Tidal volume high
	VOL INCONST	VT not reached
Technical alarms		
High	Air Supply Pressure Low	Air supply down
	O_2 Supply Pressure Low	O_2 supply down
	CLEAN CO_2	Clean CO_2 cuvette
	Power Failure	Internal power supply failure
	Check Flow Sensors	ID Flow sensor failure
	Check Expiration-Valve	Expiratory valve malfunction
	Negative Airway Pressure	Airway pressure negative
	Neo Flow Sensor Error	Neo. flow sensor changed ?
	Circuit Disconnect	Disconnection Ventilator
	No O_2 Pressure	O_2 supply down
	High Technical Alarm	Pressure measurement inaccurate
		ID breathing circuit failure
		Alarm system malfunction
		Ventilation unit restarted
		O_2 measurement failed
		Gas delivery system needs calibration

BeneView		Evita Infinity V500
Priority	**Label**	**Label**
		Flow measurement inaccurate
		Pressure measurement inaccurate
		Device temp. measurement failed
		Device temperature high
		Silence key faulty/stuck
		Check settings
Mediate	Mediate Technical Alarm	Air supply down
		Nebulization finished
		ASU device failure
		Ambient pressure sensor?
		Device check incomplete
Low	Battery in Use	Internal battery activated
	Low Technical Alarm	Exp. hold interrupted
		CO_2 measurement failed
		D9H.CO_2 sensor ?
		Plow>high limit
		Plow<low limit

30.9.13 Draeger Savina 300

30.9.13.1 Output Signals—Parameters

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
Cdyn	Dynamic compliance	ml/cmH_2O ml/hPa ml/mbar	Yes
Rdyn	Dynamic lung resistance	cmH_2O/L/s hPa/L/s mbar/L/s	Yes
Pmean	Mean pressure	cmH_2O hPa mbar	Yes
PEEP	Positive end-expiratory pressure	cmH_2O hPa mbar	Yes

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
Ppeak	Peak pressure	cmH_2O hPa mbar	Yes
Vte	Expiratory tidal volume	ml	Yes
Vti	Inspired tidal volume	ml	Yes
MV	Minute volume	L/min	Yes
ftot	Total respiratory rate	bpm	Yes
MVspn	Spontaneous breathed minute volume	L/min	Yes
fspn	Spontaneous respiratory rate	bpm	Yes
FiO_2	Fractional concentration of O_2 in inspired gas	% mmHg kPa	Yes
T	Inspiratory breathing gas temperature	°C °F	No
I：E	Inspiratory time:Expiratory time ratio	/	No
$EtCO_2$	End-tidal carbon dioxide	% kPa mmHg	Yes
RSBI	Rapid shallow breathing index	1/(min·L)	Yes
Pplat	Plateau pressure	cmH_2O hPa mbar	Yes
O_2 %	Oxygen concentration	%	No
PEEP	Positive end-expiratory pressure	cmH_2O hPa mbar	No
VT	Tidal volume	ml	No
Vtapnea	Apnea tidal volume	ml	No
fapnea	Breath rate for apnea ventilation	bpm	No
f	Breath rate	bpm	No
I:E	Inspiratory time: Expiratory time ratio	/	No
△int.PEEP	Intermittent PEEP	cmH_2O hPa mbar	No
F-Trigger	Inspiratory trigger level (flow trigger)	L/min	No
Tapnea	Apnea Time	s	No

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
PASB	Assisted spontaneous breathing	cmH_2O hPa mbar	No
Pinsp	Pressure control level of inspiration	cmH_2O hPa mbar	No
Pmax	Maximum airway pressure	cmH_2O mbar hPa	No
Tdisconnect	Delay time for "Airway pressure lower alarm limit"	s	No
FlowACC	Flow acceleration	cmH_2O/s mbar/s hPa/s	No
Plow	Lower pressure level	cmH_2O mbar hPa	No
Phigh	Upper pressure level	cmH_2O mbar hPa	No
Thigh	Time for the upper pressure level	s	No
Tlow	Time for the lower pressure level	s	No

30.9.13.2 Output Signals—Alarms

BeneView		Savina 300
Priority	**Label**	**Label**
Physiological alarms		
High	Paw Too High	Air pressure high
	Paw Too Low	Air pressure low
	MV Too High	MV high
	MV Too Low	MV low
	FiO_2 Too High	O_2 HIGH
	FiO_2 Too Low	O_2 low
	PEEP Too High	PEEP HIGH
	ASB>4s	Assist Spontaneous Breathing>4s
	Apnea	Apnea ventilation

BeneView		Savina 300
Priority	**Label**	**Label**
	AW-TEMP HIGH	Airway temperature high
Mediate	VTe Too High	Tidal volume high
	VTe Too Low	Tidal volume low
	$EtCO_2$ Too Low	$EtCO_2$ low
	$EtCO_2$ Too High	$EtCO_2$ high
Technical alarms		
High	O_2 Supply Pressure Low	O_2 supply pressure low
	Check Flow Sensors	Check flow sensor
	Check Expiration-Valve	Check expiratory valve?
	Clean CO_2	CleanCO_2
	High Technical Alarm	High O_2 supply pressure
		insp.O_2 measurement in operation
		Failen to cycle
		Problem with fan
		Problem with PEEP control
		volume measurement inoperable
		Pressure measurement inoperable
		CO_2 not calibrated
		Battery inoperable
Mediate	Mediate Technical Alarm	Check cooling
		CHECK SAVINA 300
		NO nubelizer
		SAVINA STDBY
Low	Low Technical Alarm	insp hold aborted
		CO_2 device failure
		CO_2 sensor disconnected
		Expiration hold aborted

30.9.14 Draeger Babylog 8000 plus/Babylog 8000

30.9.14.1 Output Signals—Parameters

BeneView		Unit	Is it saved in the trends? Label
Label	**Description**		
Cdyn	Dynamic compliance	ml/cmH_2O ml/hPa ml/mbar	Yes
Rdyn	Dynamic lung resistance	cmH_2O/L/s hPa/L/s mbar/L/s	Yes
Pmean	Mean pressure	cmH_2O hPa mbar	Yes
PEEP	Positive end-expiratory pressure	cmH_2O hPa mbar	Yes
Ppeak	Peak pressure	cmH_2O hPa mbar	Yes
Vti	Inspired tidal volume	ml	Yes
Leak Comp	Leak compensation	%	No
MV	Minute volume	L/min	Yes
ftot	Total respiratory rate	bpm	Yes
FiO_2	Fractional concentration of O_2 in inspired gas	% mmHg kPa	Yes
O_2%	Oxygen concentration	%	Yes
Tinsp	Time of inspiration	s	No
I:E	Inspiratory time:Expiratory time ratio	/	No
fSIMV	Frequency of SIMV	bpm	No
PEEP/CPAP	PEEP/CPAP	cmH_2O mbar hPa	No
Tapnea	Apnea tidal volume	ml	No
Pmax	Maximum airway pressure	cmH_2O mbar hPa	No
f	Breath rate	bpm	No
VT	Tidal volume	ml	No

30.9.14.2 Output Signals—Alarms

BeneView		Babylog 8000/Babylog 8000 plus
Priority	**Label**	**Label**
Technical alarms		
Mediate	Mediate Technical Alarm	VOL ERR
		% O_2 ERR

30.9.15 Philips Respironics V60

30.9.15.1 Output Signals—Parameters

BeneView		Unit	Is it saved in the trends? Label
Label	**Description**		
f	Breath rate	bpm	No
O_2%	Oxygen concentration	%	Yes
PEEP	Positive end-expiratory pressure	cmH_2O hPa mbar	No
Psupp	Pressure support level	cmH_2O Mbar hPa	No
ftot	Total breath rate	bpm	Yes
VTe	Expiratory tidal volume	ml	Yes
MV	Minute volume	L/min	Yes
Ppeak	Peak pressure	cmH_2O hPa mbar	Yes
Pinsp	Pressure control level of inspiration	cmH_2O hPa mbar	No
Tinsp	Time of inspiration	s	No
MVe	Expiratory minute volume	L/min	Yes
MVLEAK	Leakage minute volume	L/min	No
Ti/Ttot	Oxygen concentration	%	No

30.9.15.2 Output Signals—Alarms

BeneView		Philips Respironics V60
Priority	**Label**	**Label**
Physiological alarms		
High	Paw Too High	High inhalation pressure
	Paw Too Low	Low inhalation pressure, or Low inspiratory pressure
	MV Too Low	Low exhaled minute volume, or Low minute volume
	PEEP Too Low	Low PEEP
Mediate	RR Too High	High respiratory rate
	RR Too Low	Apnea
	VTe Too low	Low exhaled mandatory/spontaneous tidal volume
Technical alarms		
High	O_2 Supply Pressure Low	Low O_2 supply
	Patient Disconnect	Occlusion or I-time too long
	Airway Obstructed?	Occlusion
	Check Expiration-Valve	Safety valve
	O_2 Supply Pressure Low	Low oxygen supply pressure
	High Technical Alarm	Low battery
		Low internal battery
		Primary alarm failure
		Air source fault
Mediate	Mediate Technical Alarm	High enclosure temperature
Low	Airway Leak?	High leak
	Low Technical Alarm	Nonvolatile memory failure

30.9.16 Resmed VSIII

30.9.16.1 Output Signals—Parameters

BeneView		Unit	Is it saved in the trends? Label
Label	**Description**		
ftot	Total respiratory rate	bpm	Yes
MVLEAK	Leakage minute volume	L/min	No
Leak Comp	Leak compensation	%	No
PEEP	Positive end-expiratory pressure	cmH_2O hPa mbar	No
VT	Tidal volume	ml	No
f	Breath rate	bpm	No
F-Trigger	Inspiratory trigger level (flow trigger)	L/min	No
Tinsp	Time of inspiration	s	No
Pinsp	Pressure control level of inspiration	cmH_2O mbar hPa	No
Exp%	Inspiration termination level	%	No
Ti max	Maximum inspiration time	s	No

30.9.16.2 Output Signals—Alarms

BeneView		Resmed VSIII
Priority	**Label**	**Label**
Physiological alarms		
High	Paw Too High	High pressure
	Paw Too Low	Low Pressure
	Apnea	Apnea alarm
Mediate	RR Too High	High Frequency alarm
Technical alarms		
High	Power Failure	Main disconnect
	Tube Disconnected?	Turbine alarm
	O_2 cell cal.Needed	FiO_2 Cell Defective
	O_2 cell disconnect	Fi O_2 Cell Missing
	High Technical Alarm	No power supply
		Without external DC power supply

BeneView		Resmed VSIII
Priority	**Label**	**Label**
		Technical Alarm
		Internal battery temperature out of range
Mediate	Patient Circuit Leak	Patient circuit disconnected
	Mediate Technical Alarm	With power supply
		With mains power
		No power supply

30.9.17 ALMS Monnal T75

30.9.17.1 Output Signals—Parameters

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
PEEP	Positive end-expiratory pressure	cmH_2O hPa mbar	Yes
Ppeak	Peak pressure	cmH_2O hPa mbar	Yes
Pplat	Plateau pressure	cmH_2O hPa mbar	Yes
Pmean	Mean pressure	cmH_2O hPa mbar	Yes
VT	Tidal volume	ml	No
VTe	Expiratory tidal volume	ml	Yes
VTi	Inspiratory tidal volume	ml	Yes
MVe	Expiratory minute volume	L/min	Yes
f	Breath rate	bpm	No
ftot	Total respiratory rate	bpm	Yes
I:E	Inspiratory time: Expiratory time ratio	/	No
FiO_2	Fractional concentration of O_2 in inspired gas	% mmHg kPa	Yes
Psupp	Pressure support level	cmH_2O hPa mbar	No
Tinsp	Time of inspiration	s	No

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
$EtCO_2$	End-tidal carbon dioxide	% mmHg kPa	Yes

30.9.17.2 Output Signals—Alarms

BeneView		ALMS Monnal T75
Priority	**Label**	**Label**
Physiological alarms		
High	Apnea Ventilation	Apnea ventilation
	CO_2 Apnea	CO_2 apnea
	FiO_2 Too High	High FiO_2
	FiO_2 Too Low	Low FiO_2
	MV Too High	High MVe
	MV Too Low	Low MVe
	Paw Too High	High pressure
	Ppeak Too High	High Ppeak
	Ppeak Too Low	Patient demand higher than set peak flow
Mediate	$EtCO_2$ Too High	High $etCO_2$
	$EtCO_2$ Too Low	Low $etCO_2$
	PEEPe Too High	PEEP greater than set PEEP + 5 cmH_2O
	RR Too High	High RR
	RR Too Low	Low RR
	VTe Too High	High VTe
	VTe Too Low	Low VTe
Low	Plimit Reached	PI limit reached
	VT Not Achieved	VT not reached
Technical alarms		
High	Airway Obstructed?	Expiration blocked
	Check Flow Sensors	Expiratory flow sensor failure
	High Technical Alarm	Internal battery low
		O_2 sensor failure
		Restart self-tests
		Technical failure detected
	O_2 Supply Pressure Low	O_2 supply failure
	Patient Disconnected	Patient disconnection
Mediate	Mediate Technical Alarm	Internal battery discharged

BeneView		ALMS Monnal T75
Priority	**Label**	**Label**
		Technical failure detected
Low	Airway Leak?	Important leak
	Battery in Use	Ventilator operates from internal battery
	Low Technical Alarm	Maintenance required
		Ventilator operates from external battery

30.9.18 GE CARESCAPE R860

30.9.18.1 Output Signals—Parameters

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
PEEP	Positive end-expiratory pressure	cmH_2O hPa mbar	Yes
Ppeak	Peak pressure	cmH_2O hPa mbar	Yes
Pplat	Plateau pressure	cmH_2O hPa mbar	Yes
Pmean	Mean pressure	cmH_2O hPa mbar	Yes
VT	Tidal volume	ml	No
VTe	Expiratory tidal volume	ml	Yes
VTi	Inspired tidal volume	ml	Yes
VT/kg	TVe/IBW	ml/kg	No
VTe spn	Spontaneous expiratory tidal volume	ml	Yes
MVspn	Spontaneous breathed minute volume	L/min	Yes
MVe	Expiratory minute volume	L/min	Yes
MVi	Inspiratory mimute volume	L/min	Yes
fmand	Mandatory breathing frequency	bpm	No
fspn	Spontaneous respiratory rate	bpm	Yes
I:E	Inspiratory time:Expiratory time ratio	/	No
FiO_2	Fractional concentration of O_2 in inspired gas	% mmHg kPa	Yes
EtO_2	End-tidal O_2	% mmHg kPa	Yes

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
ΔO_2	Difference between inspiratory and expiratory O_2	% mmHg kPa	No
Rdyn	Dynamic lung resistance	$cmH_2O/L/s$ hPa/L/s mbar/L/s	Yes
Cstat	Static compliance	ml/cmH_2O ml/hPa ml/mbar	Yes
Cdyn	Dynamic compliance	ml/cmH_2O ml/hPa ml/mbar	Yes
RSBI	Rapid shallow breathing index	1/(min·L)	Yes
Base Flow	Base Flow	L/min	No
Tsupp	Support time	s	Yes
F-Trigger	Inspiratory trigger level (flow trigger)	L/min	No
P-Trigger	Inspiratory trigger level (pressure trigger)	cmH_2O Mbar hPa	No
Psupp	Pressure support level	cmH_2O Mbar hPa	No
Plimit	PRESSURE LIMit level	cmH_2O mbar hPa	No
Tinsp	Time of inspiration	s	No
Texp	Expiratory time	s	No
Pinsp	Pressure control level of inspiration	cmH_2O hPa mbar	No
Tpause	Apnea Time	s or %	No
Trise	Rise time	s	No
Phigh	Upper pressure level	cmH_2O mbar hPa	No
Plow	Lower pressure level	cmH_2O mbar hPa	No
Thigh	Time for the upper pressure level	s	No
Tlow	Time for the lower pressure level	s	No

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
Pmax	Maximum airway pressure	cmH_2O mbar hPa	No
Paux Peak	Peak auxiliary pressure	cmH_2O hPa mbar	No
Paux Mean	Mean auxiliary pressure	cmH_2O hPa mbar	No
Paux Min	Minimum auxiliary pressure	cmH_2O hPa mbar	No
PO_2	oxygen supply pressure	kPa	No
Pair	air supply pressure	kPa	No
PEEPi	Intrinsic positive end-expiratory pressure	cmH_2O hPa mbar	No
PEEPe	Extrinsic positive end-expiratory pressure	cmH_2O hPa mbar	No
PEEPtot	Total PEEP	cmH_2O hPa mbar	No
$EtCO_2$	End-tidal carbon dioxide	% mmHg kPa	Yes
$RRCO_2$	Respiratory rate of CO_2	bpm	Yes
Flow	Inspiratory flow	L/min	No
Tapnea	Apnea tidal volume	ml	No
Tdisconnect	Delay time for "Airway pressure lower alarm limit"	s	No
EE	Energy expenditure	kcal/day	No
RQ	Respiratory quotient	/	No
VO_2	Oxygen consumption	ml/min	Yes
VCO_2	CO_2 production	ml/min	No
VO_2/m^2	Oxygen consumption per body surface area	$ml/min/m^2$	No
VCO_2/ m^2	CO_2 consumption per body surface area	$ml/min/m^2$	No
VO_2/kg	Oxygen consumption per body weight	ml/min/kg	No
VCO_2/kg	CO_2 consumption per body weight	ml/min/kg	No
Tube ID	Tube ID	mm	No
O_2%	Oxygen concentration	%	Yes

30.9.18.2 Output Signals—Alarms

BeneView		GE CARESCAPE R860
Priority	**Label**	**Label**
Physiological alarms		
High	Apnea	Apnea
	AW-TEMP HIGH	Air Temp High
	FiO_2 Too High	FiO_2 high
	FiO_2 Too Low	FiO_2 low
	MV Too High	MVexp high
	MV Too Low	MVexp low
	Ppeak Too High	Ppeak High
	Ppeak Too Low	Ppeak Low
	Pressure Sustained	Sustained Paw
	VT Not Achieved	Tidal volume not delivered(VT Not Achieved)
Mediate	$EtCO_2$ Too High	$EtCO_2$ High
	$EtCO_2$ Too Low	$EtCO_2$ Low
	EtO_2 Too High	EtO_2 High
	EtO_2 Too Low	EtO_2 Low
	Paux Too High	Paux High
	PEEPe Too High	PEEPe High
	PEEPe Too Low	PEEPe Low
	PEEPi Too High	PEEPi High
	RR Too High	RR High
	RR Too Low	RR Low
	VTe Too High	VTexp high
	VTe Too Low	VTexp Low
Low	Plimit Reached	Plimit Reached
Technical alarms		
High	Air Supply Pressure Low	Air Supply Pressure Low
	Airway Obstructed?	Breathing Circuit Occlusion
	Circuit Leak	Circuit Leak
	Check Flow Sensors	Expiratory Flow Sensor Error/ Exp Flow Sensor Failure
	Negative Airway Pressure	Negative Airway Pressure
	Neo Flow Sensor Error	Neo Flow Sensor Error
	No Gas Supply Pressure	No Gas Supply Pressure
	O_2 Supply Pressure Low	O_2 Supply Pressure Low
	Patient Connection Leak	Patient Connection Leak
	Patient Connected?	Patient detected (Patient Connected?)
	Patient Disconnected	Patient Disconnected
	Power Failure	Power Supply Fail

BeneView		GE CARESCAPE R860
Priority	**Label**	**Label**
	High Technical Alarm	Air Supply Pressure High
		Air Temp Sensor Error
		Backup Audio Failure
		Clean Neo Flow Sensor
		FiO_2 Control Error
		Relief Valve Opened
		Low Internal Battery 1 Min
		Low Internal Battery 5 Min
		Low Internal Battery 10 Min
		Mixed Gas Temp Sensor Error
		Neo Flow Sensor Reversed
		Neo Flow Sensor Off
		No Battery Backup
		No D-Lite Sensor?
		No Expiratory Flow Sensor
		No Neo Flow Sensor
		O_2 Supply Pressure High
		O_2 Temp Sensor Error
		Pressure Sensor Failure
		Primary Audio Failure
		Relief Valve Failure
		Replace Neo Flow Sensor
		Temp High Shutdown Possible
		Total Flow Sensor Communication Failure
		Volume Delivery Error
Mediate	FiO_2 Sensor Disconnected	O_2 Sensor Failure
	Mediate Technical Alarm	Backup Ventilation on
		Check D-fend
		Check Sample Gas Out
		Circuit Leak Alarm Off
		Fans Require Service
		Low Internal Battery 20 Min
		Module Fail No CO_2, O_2 Data
		No Battery Backup
		Replace D-fend
		Sample Flow Deviation
		Sample Line Blocked
		SBT Ended
Low	Battery in Use	Battery in use
	Low Technical Alarm	Air Supply Pressure Sensor Out of Range

BeneView		GE CARESCAPE R860
Priority	**Label**	**Label**
Low	Low Technical Alarm	Alarm Light Failure
		Alarms Silenced
		Apnea Alarm Off
		Cannot Calculate FRC
		Carrier Board Overheat
		Case Fan Speed Fail
		Connect Nebulizer
		Controls Frozen Need Service
		CPU Fan Speed Fail
		CPU Overheat
		Missed Scheduled FRC
		Module Not Compatible
		Module Warming Up 2 Min
		Module Warming Up 5 Min
		No Patient Effort
		MVexp Low Alarm Off
		O_2 Supply Pressure Sensor Out of Range
		Pinsp Sensor Out of Range
		Pexp Sensor Out of Range
		Paux Sensor Out of Range
		SBT Completed successfully
		Touchscreen Failure

30.9.19 GE Engstrom Carestation

30.9.19.1 Output Signals—Parameters

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
Ppeak	Peak pressure	cmH_2O hPa mbar	Yes
Pplat	Plateau pressure	cmH_2O hPa mbar	Yes
Pmean	Mean pressure	cmH_2O hPa mbar	Yes
$FiCO_2$	Fraction of inspired carbon dioxide	% mmHg kPa	Yes

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
Pmax	Maximum airway pressure	cmH_2O mbar hPa	No
Psupp	Pressure support level	cmH_2O hPa mbar	No
P-Trigger	Inspiratory trigger level (pressure trigger)	cmH_2O Mbar hPa	No
PO_2	Oxygen supply pressure	kPa	No
P0.1	100 ms occlusion pressure	cmH_2O hPa mbar	No
Ri	Inspiratory resistance	cmH_2O/L/s hPa/L/s mbar/L/s	Yes
VT	Tidal volume	ml	No
VTe	Expiratory tidal volume	ml	Yes
VTi	Inspired tidal volume	ml	Yes
VT/kg	TVe/IBW	ml/kg	No
VTe spn	Spontaneous expiratory tidal volume	ml	Yes
MVspn	Spontaneous breathed minute volume	L/min	Yes
MVe	Expiratory minute volume	L/min	Yes
MVi	Inspiratory mimute volume	L/min	Yes
ftot	Total respiratory rate	bpm	Yes
fmand	Mandatory breathing frequency	bpm	No
fspn	Spontaneous respiratory rate	bpm	Yes
I:E	Inspiratory time:Expiratory time ratio	/	No
FiO_2	Fractional concentration of O_2 in inspired gas	% mmHg kPa	Yes
EtO_2	End-tidal O_2	% mmHg kPa	Yes
ΔO_2	Difference between inspiratory and expiratory O_2	% mmHg kPa	No
Rdyn	Dynamic lung resistance	cmH_2O/L/s hPa/L/s mbar/L/s	Yes

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
Cstat	Static compliance	ml/cmH_2O ml/hPa ml/mbar	Yes
Cdyn	Dynamic compliance	ml/cmH_2O ml/hPa ml/mbar	Yes
RSBI	Rapid shallow breathing index	1/(min·L)	Yes
Texp	Expiratory time	s	No
Paux Peak	Peak auxiliary pressure	cmH_2O hPa mbar	No
Paux Mean	Mean auxiliary pressure	cmH_2O hPa mbar	No
Paux Min	Minimum auxiliary pressure	cmH_2O hPa mbar	No
PO_2	oxygen supply pressure	kPa	No
Pair	air supply pressure	kPa	No
PEEPi	Intrinsic positive end-expiratory pressure	cmH_2O hPa mbar	No
PEEPe	Extrinsic positive end-expiratory pressure	cmH_2O hPa mbar	No
PEEPtot	Total PEEP	cmH_2O hPa mbar	No
$EtCO_2$	End-tidal carbon dioxide	% mmHg kPa	Yes
$RRCO_2$	Respiratory rate of CO_2	bpm	Yes
EE	Energy expenditure	kcal/day	No
RQ	Respiratory quotient	/	No
VCO_2	CO_2 production	ml/min	No
VCO_2/m^2	CO_2 consumption per body surface area	ml/min/m^2	No
VCO_2/kg	CO_2 consumption per body weight	ml/min/kg	No
VO_2	Oxygen consumption	ml/min	Yes
VO_2/m^2	Oxygen consumption per body surface area	ml/min/m^2	No
VO_2/kg	Oxygen consumption per body weight	ml/min/kg	No
O_2%	Oxygen concentration	%	Yes

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
PEEP	Positive end-expiratory pressure	cmH_2O hPa mbar	Yes
Base flow	Base Flow	L/min	No
Tsupp	Support time	s	No
F-Trigger	Inspiratory trigger level (flow trigger)	L/min	No
Trigger	inspiratory trigger level	%	No
P-Trigger	Inspiratory trigger level (pressure trigger)	cmH_2O Mbar hPa	No
Psupp	Pressure support level	cmH_2O hPa mbar	No
Plimit	Pressure limit level	cmH_2O hPa mbar	No
Tinsp	Time of inspiration	s or %	No
Pinsp	Pressure control level of inspiration	cmH_2O hPa mbar	No
Tpause	Apnea Time	s or %	No
Trise	Rise time	s	No
Phigh	Upper pressure level	cmH_2O mbar hPa	No
Plow	Lower pressure level	cmH_2O mbar hPa	No
Thigh	Time for the upper pressure level	s	No
Tlow	Time for the lower pressure level	s	No
Pmax	Maximum airway pressure	cmH_2O mbar hPa	No
Flow	Inspiratory flow	L/min	No
Tapnea	Apnea time	s	No
Tdisconnect	Delay time for "Airway pressure lower alarm limit"	s	No
Tube ID	Tube ID	mm	No

30.9.19.2 Output Signals—Alarms

BeneView		GE Engstrom Carestation
Priority	**Label**	**Label**
Physiological alarms		
High	Apnea	Apnea
	FiO_2 Too High	FiO_2 High
	FiO_2 Too Low	FiO_2 Low
	MV Too High	MVexp High
	MV Too Low	MVexp Low
	Ppeak Too High	Ppeak High
	Ppeak Too Low	Ppeak Low
	Pressure Sustained	Sustained Paw
	RR Too Low	RR Low
	VT Not Achieved	TV Not Achieved
Mediate	$EtCO_2$ Too High	$EtCO_2$ High
	$EtCO_2$ Too Low	$EtCO_2$ Low
	EtO_2 Too High	EtO_2 High
	EtO_2 Too Low	EtO_2 Low
	Paux Too High	Paux High
	PEEPe Too High	PEEPe High
	PEEPe Too Low	PEEPe Low
	PEEPi Too High	PEEPi High
	Plimit Reached	Plimit Reached
	RR Too High	RR High
	VTe Too High	TVexp High
	VTe Too Low	TVexp Low
Low	Base Flow Too High	Bias Flow High
Technical alarms		
High	Air Supply Pressure Low	Air Supply Pressure Low
	Airway Obstructed?	Breathing Circuit Occlusion
	Check Flow Sensors	Exp Flow Sensor Error
	Circuit Leak	Circuit Leak
	Negative Airway Pressure	Negative Airway Pressure
	Neo Flow Sensor Error	Neo Flow Sensor Error
	No VO_2, FiO_2 > 85%	No VO_2, FiO_2 > 85%
	O_2 Supply Pressure Low	O_2 Supply Pressure Low
	Patient Connected?	Patient Connected?
	Patient Connection Leak	Patient Connection Leak
	Patient Disconnected	Patient Disconnected
High	High Technical Alarm	Air Supply Pressure High
		Air Temp Sensor Error
		Clean Neo Flow Sensor

BeneView		GE Engstrom Carestation
Priority	**Label**	**Label**
		Exp Flow Sensor Failure
High	High Technical Alarm	FiO_2 Control Error
		Mixed Gas Temp Sensor Error
		Neo Flow Sensor Off
		Neo Flow Sensor Reversed
		No D-Lite Sensor?
		No Expiratory Flow Sensor
		No Gas Supply Pressure
		No Neo Flow Sensor
		O_2 Temp Sensor Error
		O_2 Supply Pressure High
		Pressure Sensor Failure
		Relief Valve Failure
		Replace Neo Flow Sensor
		Volume Delivery Error
Mediate	Mediate Technical Alarm	Backup Audio Failure
		Check D-fend
		Check Sample Gas Out
		Display Fans Failed
		Fans Require Service
		Low Internal Battery 1 Min
		Low Internal Battery 5 Min
		Low Internal Battery 10 Min
		Low Internal Battery 20 Min
		Module Fail No CO_2, O_2 Data
		No Battery Backup
		O_2 Sensor Failure
		Replace D-fend
		Sample Line Blocked
Low	Battery in Use	On Battery
	Low Technical Alarm	Artifact
		Cannot Calculate FRC
		Controls Frozen Need Service
		Connect Nebulizer
		CO_2 Over of Range
		FRC Series Stopped
		Missed Scheduled FRC
		Module Not Compatible
		No Patient Effort
		O_2 Over of Range

BeneView		GE Engstrom Carestation
Priority	**Label**	**Label**
		Pair Sensor Out of Range
		Paux Sensor Out of Range
		Pexp Sensor Out of Range
		Pinsp Sensor Out of Range
		PO_2 Sensor Out of Range
		SBT Ends < 2 Minutes
		Unable to Deliver TV
		VCO_2 Out of Range
		VO_2 Out of Range

30.9.20 HUL Leoni Plus

30.9.20.1 Output Signals—Parameters

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
O_2%	Oxygen concentration	%	Yes
PEEP	Positive end-expiratory pressure	cmH_2O hPa mbar	No
Ppeak	Peak pressure	cmH_2O hPa mbar	Yes
Pmean	Mean pressure	cmH_2O hPa mbar	Yes
VT	Tidal volume	ml	No
VTe	Expiratory tidal volume	ml	Yes
VTi	Inspiratory tidal volume	ml	Yes
MV	Minute volume	L/min	Yes
ftot	Total respiratory rate	bpm	Yes
fspn	Spontaneous respiratory rate	bpm	Yes
fapnea	Breath rate for apnea ventilation	bpm	No
f	Breath rate	bpm	No
I:E	Inspiratory time: Expiratory time ratio	/	No
Rstat	Static lung resistance	cmH_2O/L/s hPa/L/s mbar/L/s	Yes
Cdyn	Dynamic compliance	ml/cmH_2O ml/hPa ml/mbar	Yes

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
F-Trigger	Inspiratory trigger level (flow trigger)	L/min	No
Trigger	inspiratory trigger level	%	No
Tinsp	Time of inspiration	s	No
Pinsp	Pressure control level of inspiration	cmH_2O hPa mbar	No
Pmax	Maximum airway pressure	cmH_2O mbar hPa	No
Flow	Inspiratory flow	L/min	No
Tapnea	Apnea tidal volume	ml	No
SpO_2	Arterial oxygen saturation from pulse oximetry	%	Yes

30.9.20.2 Output Signals—Alarms

BeneView		HUL Leoni Plus
Priority	**Label**	**Label**
Physiological alarms		
High	Apnea	Apnea
	FiO_2 Too High	O_2 high
	FiO_2 Too Low	P: O_2 too low
	MV Too High	MV high
	MV Too Low	MV low
	PEEP Not Achieved	PEEP pressure not reached
	PEEP Too High	PEEP too high
	Pinsp Not Achieved	Set pressure not reachable
	Ppeak Too High	Ppeak high
	Ppeak Too Low	Ppeak low
	SpO_2 Too High	SpO_2 too high
	SpO_2 Too Low	SpO_2 too low
	VT Not Achieved	Volume not reached
Mediate	RR Too High	P: Frequency too high
	VTe Too High	VTe to high
	VTe Too Low	Vte low
Technical alarms		
High	Airway Obstructed?	P: Tube occluded
	Check Flow Sensors	64: Flow sensor broken 65: Flow sensor broken 66: Flowsensor fail

BeneView		HUL Leoni Plus
Priority	**Label**	**Label**
		67: Calibrate Flowsensor Flowsensor contaminated. Flowsensor contaminated.
	No O_2 Pressure	O_2 supply failed. Freshgas is Air
	Patient Disconnected	Disconnection
High	High Technical Alarm	Air supply
		Air supply failed. Freshgas is O_2
		Battery almost empty
		Battery empty. Mechanical ventilation stopped.
		Battery empty. Supply voltage too low
		Excess pressure Exsp-Tube
		Excess pressure Insp-Tube
		O_2 and Air supply failed. Dosing fresh gas stopped.
		O_2 supply
		4: Deviation pressure sensors
		7: Technical Failure
		8: Technical Failure
		9: Technical Failure
		10: Technical Failure
		11: Technical Failure
		12: Technical Failure
		13: Technical Failure
		15: Technical Failure
		16: Technical Failure
		17: Technical Failure
		20: Technical Failure
		21: Technical Failure
		22: Current consumption too high
		23: Technical Failure
		30: 3.3V supply on NetDCU too high
		31: 3.3V supply on NetDCU too low
		32: 5V supply on NetDCU too high
		33: 5V supply on NetDCU too low
		34: 12V supply on NetDCU too high
		35: 12V supply on NetDCU too low
		36: 24V supply on NetDCU too high
		37: 24V supply on NetDCU too low
		40: Versions not compatible
		44: Technical Failure
		45: Failsafe
		47: Controllerboard EEPROM checksum failed
		55: Patient safe: Reboot the device

BeneView		HUL Leoni Plus
Priority	**Label**	**Label**
		61: Technical Failure
		62: Technical Failure
		63: Technical Failure
		77: Sensor Fail Patient Pressure
		78: Sensor Fail Patient Pressure
		79: Driving gas blender failed.
		84: Checksum error
		85: Encoder without function
Mediate	FiO_2 Sensor Disconnected	19: Oxy Measurement Fail
	Patient Circuit Leak	P: Leak too high
	Mediate Technical Alarm	Battery almost empty
		Check O_2 concentration
		Low Perfusion
		O_2 control aborted
		Oximetry cable failure
		Oximetry cable not connected
		SpO_2: communication error
		SpO_2: No adhesive sensor connected
		SpO_2: No cable connected
		SpO_2: Sensor failure
		SpO_2: Sensor not connected
		SpO_2: Sensor off patient
		1: Battery Fail
		2: Battery Fail
		3: Battery not connected
		38: Broken loudspeaker. Audible alarming not possible.
		41: Batteries deep discharged. Please change.
		71: O2 Calibration failure
		83: Broken microphone. No checking of audible alarming
Low	Battery in Use	Device running on batteries
	Low Technical Alarm	Observe battery runtime
		6: Fan Fail
		46: Controllerboard EEPROM not write protected

30.9.21 Draeger Evita V300

30.9.21.1 Output Signals—Parameters

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
Cdyn	Dynamic compliance	ml/cmH_2O ml/hPa ml/mbar	Yes
Rdyn	Dynamic lung resistance	cmH_2O/L/s hPa/L/s mbar/L/s	Yes
VCO_2	CO_2 production	ml/min	No
Pmin	Minimum airway pressure	cmH_2O mbar hPa	No
P0.1	100 ms occlusion pressure	cmH_2O hPa mbar	No
Pmean	Mean pressure	cmH_2O hPa mbar	Yes
Pplat	Plateau pressure	cmH_2O hPa mbar	Yes
PEEP	Positive end-expiratory pressure	cmH_2O hPa mbar	No
PEEPi	Intrinsic positive end-expiratory pressure	cmH_2O hPa mbar	No
fmand	Mandatory breathing frequency	bpm	No
Ppeak	Peak pressure	cmH_2O hPa mbar	Yes
Vtrap	Volume trapped in the lung by intrinsic PEEP, and not exhaled during subsequent expiration	ml	No
Vte spn	Spontaneous expiratory tidal volume	ml	No
Vds	Dead space	ml	No
NIF	Negative inspiratory force	cmH_2O hPa mbar	No

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
Mvleak	Leakage minute volume	L/min	Yes
Leak Comp	Leak compensation	%	No
fspn	Spontaneous respiratory rate	bpm	Yes
MV	Minute volume	L/min	Yes
RSBI	Rapid shallow breathing index	1/(min·L)	Yes
ftot	Total respiratory rate	bpm	Yes
$EtCO_2$	End-tidal carbon dioxide	% kPa mmHg	Yes
I:E	Inspiratory time:Expiratory time ratio	/	No
FiO_2	Fractional concentration of O_2 in inspired gas	% mmHg kPa	Yes
Mve	Expiratory minute volume	L/min	Yes
Mvi	Inspiratory mimute volume	L/min	Yes
Vte	Expiratory tidal volume	ml	Yes
Vti	Inspired tidal volume	ml	Yes
VT/kg	TVe/IBW	ml/kg	No
$VTCO_2$	CO_2 tidal elimination	ml	No
O_2 %	Oxygen concentration	%	No
Flow	Flow	L/min	No
Tinsp	Time of inspiration	s	No
f	Breath rate	bpm	No
PEEP	Positive end-expiratory pressure	cmH_2O hPa mbar	No
∆ int.PEEP	Intermittent PEEP	cmH_2O hPa mbar	No
Plow	Lower pressure level	cmH_2O mbar hPa	No
Phigh	Upper pressure level	cmH_2O mbar hPa	No
Tlow	Time for the lower pressure level	s	No
Thigh	Time for the upper pressure level	s	No

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
Tapnea	Apnea time	s	No
Psupp	Pressure support level	cmH_2O hPa mbar	No
Pmax	Maximum airway pressure	cmH_2O mbar hPa	No
F-triger	Inspiratory trigger level (flow trigger)	L/min	No
Trise	Rise time	s	No
Flow Assist	Flow assist	mbar.s/L cmH_2O.s/L hPa.s/L	No
Vol Assist	Volume assist	mbar/L cmH_2O/L hPa/L	No
fapnea	Breath rate for apnea ventilation	bpm	No
Pinsp	Pressure control level of inspiration	cmH_2O hPa mbar	No
ATC	Automatic Tube Compensation	%	No
Tube ID	Tube ID	mm	No
Tdisconnect	Delay time for "Airway pressure lower alarm limit"	s	No
Ti max	Maximum inspiration time	s	No
VT	Tidal volume	ml	No
VTapnea	Apnea tidal volume	ml	No
Exp%	Inspiration termination level	%	No
Trigger	Trigger	L/min	No

30.9.21.2 Output Signals—Alarms

BeneView		Draeger Evita V300
Priority	**Label**	**Label**
Physiological alarms		
High	FiO_2 Too Low	FiO_2 LOW
	FiO_2 Too High	O_2 HIGH
	Paw Too High	Airway pressure high
	Paw Too Low	PAW LOW
	MV Too High	MIN VOL HIGH
	MV Too Low	MIN VOL LOW
	Apnea	APNEA RESP
	PEEP Too High	PEEP HIGH
	Apnea Ventilation	APNEA VENT
	VT Not Achieved	TIDAL VOL LO
Mediate	$EtCO_2$ Too Low	$ETCO_2$ LOW
	$EtCO_2$ Too High	$ETCO_2$ HIGH
	VOL INCONST	VOL INCONST
	RR Too High	RESP RATE HI
	Vte Too High	TIDAL VOL HI
Technical alarms		
High	Air Supply Pressure Low	AIR SUPPLY
	O_2 Supply Pressure Low	LOW O_2 SUPPLY
	Check Flow Sensors	FLOW SENSOR
	CLEAN CO_2	CLEAN CO_2
	Negative Airway Pressure	PAW NEGATIVE
	EXP-VALVE?	EXP-VALVE
	No O_2 Pressure	NO OXYGEN
	Circuit Disconnect	DISCONNECT
	Neo Flow Sensor Error	NEO FLOW
	Airway Obstructed?	TUBE OBSTRUC
	Power Failure	POWER ERR
	Check Flow Sensors	EXP TIME ERR
	High Technical Alarm	CO_2 NOT CAL
		BATTERY ERR
		SPEAKER FAIL
		EVITA ERR

BeneView		Draeger Evita V300
Priority	**Label**	**Label**
		% O_2 ERR
		VOL CAL
		VOL ERR
		PRESS ERR
		AW-TEMP INOP
		COOLING
		INT.TMP.HIGH
		CO_2 SENSOR
		AIR PRESS HI
		HI O_2 SUPPLY
		SYSTEM FAUL
		LOSS OF DATA
		HOSE ERROR
		SC ABORTED
		SC INOP
		CENTRAL HYPO
		PERS TACHYP
		UNEXPL HYPER
Mediate	Mediate Technical Alarm	GAS FAILURE
		NO AIR
		AMB PRESS
		CHECK EVITA
		NEBULIZ. OFF
		BATT. LOW
Low	Battery in Use	BATTERY ON
	Low Technical Alarm	EXPHOLD END
		PMIN REACHED
		PLOW LOW
		PLOW HIGH
		PLOW LOW

30.9.22 Hamilton S1

30.9.22.1 Output Signals—Parameters

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
O_2%	Oxygen concentration	%	Yes
PEEP	Positive end-expiratory pressure	cmH_2O hPa mbar	No
Ppeak	Peak pressure	cmH_2O hPa mbar	Yes
Pplat	Plateau pressure	cmH_2O hPa mbar	Yes
Pmean	Mean pressure	cmH_2O hPa mbar	Yes
VT	Tidal volume	ml	No
VTe	Expiratory tidal volume	ml	Yes
VTi	Inspired tidal volume	ml	Yes
VT/kg	TVe/IBW	ml/kg	No
VTe spn	Spontaneous expiratory tidal volume	ml	Yes
MV	Minute volume	L/min	Yes
MVspn	Spontaneous breathed minute volume	L/min	Yes
ftot	Total respiratory rate	bpm	Yes
fspn	Spontaneous respiratory rate	bpm	Yes
f	Breath rate	bpm	No
RSBI	Rapid shallow breathing index	1/(min·L)	Yes
I:E	Inspiratory time: Expiratory time ratio	/	No
Cstat	Static compliance	ml/cmH_2O ml/hPa ml/mbar	Yes
WOB	Work of breathing	J/L	Yes
Insp.Flow	Inspiration flow	L/min	No
Exp. Flow	Expiratory flow	L/min	No
Base Flow	Base Flow	L/min	No
F-trigger	Inspiratory trigger level (flow trigger)	L/min	No

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
P-Trigger	Inspiratory trigger level (pressure trigger)	cmH_2O Mbar hPa	No
Psupp	Pressure support level	cmH_2O Mbar hPa	No
VCO_2	CO_2 production	ml/min	No
PR	Pulse rate	bpm	Yes
Texp	Expiratory time	s	No
Pinsp	Pressure control level of inspiration	cmH_2O hPa mbar	No
Tpause	Apnea Time	s or %	No
Phigh	Upper pressure level	cmH_2O mbar hPa	No
Plow	Lower pressure level	cmH_2O mbar hPa	No
Thigh	Time for the upper pressure level	s	No
Tlow	Time for the lower pressure level	s	No
Exp%	Inspiration termination level	%	No
Ri	Inspiratory resistance	$cmH_2O/L/s$ hPa/L/s mbar/L/s	Yes
Plimit	Pressure limit level	cmH_2O mbar hPa	No
Re	Expiratory resistance	$cmH_2O/L/s$ hPa/L/s mbar/L/s	Yes
RCexp	Expiratory time constant	s	No
RCinsp	Inspiratory time constant	s	No
PTP	Pressure time product	$cmH_2O.s$ mbar.s hPa.s	No
Pmin	Minimum airway pressure	cmH_2O mbar hPa	No

BeneView		Unit	Is it saved in the trends?
Label	**Description**		
P0.1	100 ms occlusion pressure	cmH_2O hPa mbar	No
PEEPi	Intrinsic positive end-expiratory pressure	cmH_2O hPa mbar	Yes
$EtCO_2$	End-tidal carbon dioxide	% kPa mmHg	Yes
Peak Flow	Peak flow	L/min	No
IBW	Ideal body weight	kg	No
Ti max	Maximum inspiration time	s	No
Tip	Inspiratory pause time	s	No
Ramp	Ramp	ms	No
%MinVol	Percentage of minute volume to be delivered	%	No
tube ID	Tube ID	mm	No
SpO_2	Arterial oxygen saturation from pulse oximetry	%	Yes

30.9.22.2 Output Signals—Alarms

BeneView		Hamilton S1
Priority	**Label**	**Label**
Physiological alarms		
High	FiO_2 Too High	high Oxygen
	FiO_2 Too Low	low Oxygen
	PawToo Low	Low pressure
	MV Too High	High minite volume
	MV Too Low	Low minite volume
	Apnea	Apnea
	Paw Too High	high pressure
	Loss of PEEP	Loss of PEEP
	Apnea Ventilation	Apnea ventilation
	SpO_2 Too Low	SpO_2 too low
	SpO_2 Too High	SpO_2 too high
Mediate	RR Too Low	Low frequency
	RR Too High	High frequency
	$EtCO_2$ Too High	High $PetCO_2$

BeneView		Hamilton S1
Priority	**Label**	**Label**
	$EtCO_2$ Too Low	Low $PetCO_2$
Technical alarms		
High	Patient Disconnected	Disconnection Patient
	Air Supply Pressure Low	Air supply
	O_2 Supply Pressure Low	Oxygen supply
	O_2 cell disconnect	O_2 cell missing
	O_2 cell cal. Needed	O_2 cell cal. needed
	Disconnection ventilator side	Disconnection ventilator
	Power Failure	Loss of mains power
	Check Flow Sensors	Check Flow Sensor type
	No Gas Supply Pressure	All gas supplies failed
	High Technical Alarm	Wrong Flow Sensor type
		O_2 cell defective
		Disconnection
		Low internal pressure
		High pressure during sigh
		Pressure not released
		Exhalation obstructed
		TF 5514: Check loudspeaker
		Internal battery empty
		Ventilator unit connection lost
		Check internal battery
Mediate	O_2 and air supply	Oxygen and air supply
	O_2 and heliox supply	Oxygen and heliox supply
	Mediate Technical Alarm	High leak
		Low tidal volume
		High tidal volume
		Turn the Flow Sensor
		APV init Failed
		Check P-ramp
		Internal battery Low
		Panel connection lost
		Heliox supply failed
		SPO_2:sensor error(left slot)
		SPO_2:sensor error(right slot)
		SPO_2:no sensor(left slot)

BeneView		Hamilton S1
Priority	**Label**	**Label**
		SPO_2:no sensor(right slot)
		SPO_2:patient disconnected(left slot)
		SPO_2:patient disconnected(right slot)
		SPO_2:light interference(left slot)
		SPO_2:light interference(right slot)
		SPO_2:poor signal (left slot)
		SPO_2:poor signal (right slot)
		Large change in FiO_2
		Recruitment meaneuver in progress
		Brightness test alarm
		AERONEB disconnected
		Cuff disconnection
		Air +heliox supplies failed
		Oxygenation adjustment OFF(no SpO_2)
		Ventilation adjustment OFF(no $PetO_2$)
		No hemodynamic staus avaliable
		High HLI
		MV oszillation
		FiO_2 oszillation
		PEEP oszillation
		Cuff high pressure
		FiO_2 set to 100% due to low saturation
Low	Low Technical Alarm	Volume too low for nebulizer
		ASV: Check high pressure limit
		APV: Check high pressure limit
		pressure low limit reached
		Check %MinVol
		Check Body Wt
		ASV:Cannot meet target
		Check PEEP/high pressure limit
		Check PEEP/Pcontrol
		Check PEEP/Psupport
		Check P-ramp
		Check trigger
		Check %TI
		Check pause
		Check I:E

BeneView		Hamilton S1
Priority	**Label**	**Label**
		Check Vt
		Check rate
		Check peak flow
		Check TI
		Check FlowPattern
		Flow Sensor calibration needed
		Expiratory valve calibration needed
		Apnea ventilation ended
		Maximum leak compensation
		Low ExpMinVol alarm off
		CO_2 Sensor calibration needed
		Check CO_2 airway adapter
		CO_2 sensor disconnected
		CO_2 sensor over temperature
		CO_2 sensor faulty
		External battery empty
		Sensor simulation active
		IRV
		Cuff leak
		IntelliCuff not found
		Check VThigh limit
		AERONEB modle disconnected
		Oxygenation adjustment OFF(no SpO_2)
		Ventilation adjustment OFF(no $PetO_2$)
		Check CO2 sampling line
		Check INTELLIVENT PEEP limit setting
		Set low limit for ExpMinVol alram
		Recuritment in progress
		Oxygenation controller on limit
		Vetilation controller on limit
		SBT conditions fulfilled
		SBT in progress

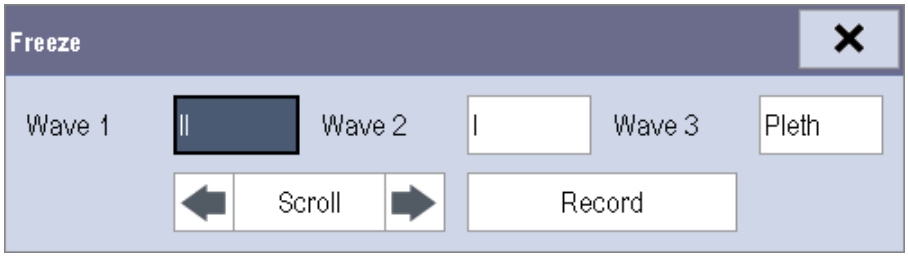
FOR YOUR NOTES

31 Freezing Waveforms

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

31.1 Freezing Waveforms

1. To freeze waveforms, select the ⋈ hardkey on the monitor's front.
2. The system closes the displayed menu (if any), and opens the [**Freeze**] menu.



3. All displayed waveforms are frozen, i.e. the waveforms stop being refreshed or scrolling.

The freeze feature exerts no effect on the split-screen view of minitrends, oxyCRG and other patients.

31.2 Viewing Frozen Waveforms

To view the frozen waveforms, you can either:

- Select the [**Scroll**] button and then rotate the Knob clockwise or counter-clockwise, or
- Directly select the ◀ or ▶ beside the [**Scroll**] button using a mouse or through the touchscreen.

The frozen waveforms will scroll left or right accordingly. And meanwhile, at the lower right corner of the bottommost waveform, there is an upward arrow. The freeze time is displayed below the arrow and the initial frozen time is [**0 s**]. With the waveforms scrolling, the freeze time changes at intervals of 1 second. This change will be applied for all waveforms on the screen.

31.3 Unfreezing Waveforms

To unfreeze the frozen waveforms, you can either:

- Select the button at the upper right corner of the [**Freeze**] menu,
- Select the hardkey on the monitor's front, or
- Perform any other action that causes the screen to be readjusted or opens a menu, such as plugging in or out a module, pressing the hardkey, etc.

31.4 Recording Frozen Waveforms

1. In the [**Freeze**] menu, select, in turn, [**Wave 1**], [**Wave 2**] and [**Wave 3**] and then select your desired waveforms.
2. Select the [**Record**] button. The selected waveforms and all numerics at the frozen time are printed out by the recorder.

32 Review

32.1 Accessing Respective Review Windows

1. Select the [**Review**] QuickKey, or [**Main Menu**]→[**Review >>**].
2. Select [**Graphic Trends**], [**Tabular Trends**], [**Events**], [**Full Disclosure**] or [**12-lead ECG**] to access their respective review windows.

32.2 Reviewing Graphic Trends

In the [**Review**] menu, select [**Graphic Trends**] to access the following window.

1. Event mark area
2. Time axis
3. Graphic trends area
4. Parameter area
5. Cursor

Events are marked with colors in the event mark area. Red represents high level alarm event. Yellow represents medium/low level alarm event. Green represents manual event.

In this review window:

- Select [**Trend Group**] and you can select a trend group for viewing in the popup menu. If [**Custom 1**] or [**Custom 2**] is selected, you can further select [**Define Trend Group**]. Then you can select the parameters for viewing in the popup menu.
- You can set the time length of the review window by selecting [**Zoom**].
- You can set the number of waves displayed in one page by selecting [**Waves**].

- Select [**Scale >>**] to enter the [**Scale**] menu.
  - Set the [**Upper Scale**] or [**Lower Scale**] of Resp, ECG, SpO_2, Temp, IBP, or NIBP when [**Auto Scale**] is [**Off**].
  - Restore the scales of all parameters to auto adjustment by selecting the [**All Auto**] button at the lower right corner of the [**Scale**] menu.
- To browse the graphic trends, you can either:
  - Select  or  beside [**Scroll**] to move the cursor one step to the left or right to navigate through the graphic trends, or
  - Select  or  to move the cursor one page to the left or right to navigate through the graphic trends.

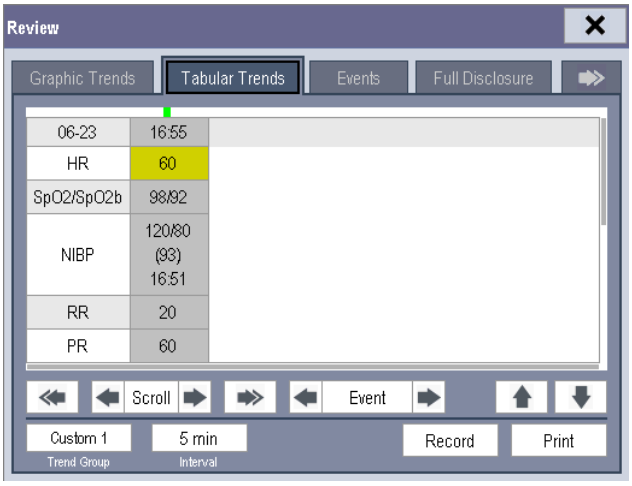
  A time indicating your current position is displayed above the parameter area. Numeric measurement values corresponding to the cursor location change as the cursor is moved. The measurement value that triggered high level alarm has red background. The one that triggered medium/low level alarm has yellow background.
- By selecting  or  beside [**Event**], you can position the cursor to different event time.
- By selecting the [**Record**] button, you can print out the currently displayed graphic trends by the recorder.
- By selecting the [**Print**] button, you can set and print out the graphic trends report by the printer. For how to set the graphic trends report, please refer to the ***Print*** chapter.

NOTE

- **The scales of the graphic trends restore to auto adjustment when you discharge a patient, change a unit or restart the monitor.**
- **Only the scales of Resp, ECG, SpO_2, Temp, IBP and NIBP support manual adjustment.**

32.3 Reviewing Tabular Trends

In the [**Review**] menu, select [**Tabular Trends**] to access the following window.



Events are marked with colors in window's top area. Red represents high level alarm event. Yellow represents medium/low level alarm event. Green represents manual event.

In this review window:

- Select [**Trend Group**] and you can select a trend group for viewing in the popup menu. If [**ANA Monitoring**], [**Custom 1**] or [**Custom 2**] is selected, you can further select [**Define Trend Group**]. Then you can select the parameters for viewing in the popup menu.
- You can change the resolution of the trend data by selecting [**Interval**] and then selecting the appropriate setting:
  - [**5 s**] or [**30 s**]: select to view up to 4 hours of tabular trends at 5- or 30-second resolution.
  - [**1 min**], [**5 min**], [**10 min**], [**15 min**], [**30 min**], [**1 h**], [**2 h**] or [**3 h**]: select to view up to 120 hours of tabular trends at your selected resolution.
  - [**NIBP**]: select to view the tabular trends when NIBP measurements were acquired.
- To browse the tabular trends, you can either:
  - Select or beside [**Scroll**] to drag the scrollbar left or right to navigate through the trend database, or
  - Select or to scroll left or right to navigate through the trend database.

The measurement value that triggered high level alarm has red background. The one that triggered medium/low level alarm has yellow background.

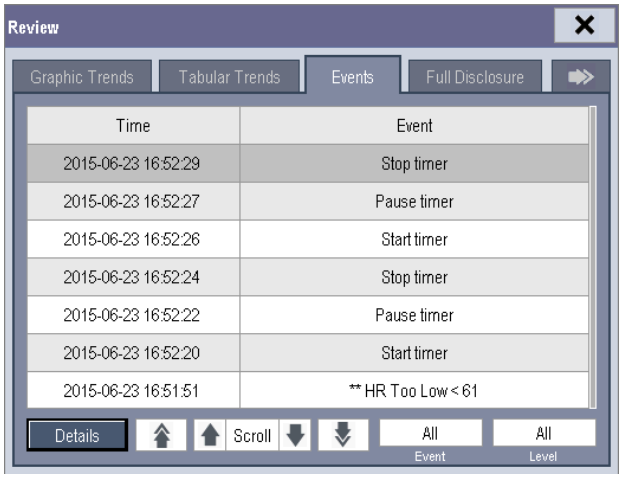
- By selecting or beside [**Event**], you can position the cursor to different event time.
- By selecting the [**Record**] button, you can access the [**Record Setup**] menu and set the start and end time of the tabular trends you want to record. This feature is not available when reviewing a history patient. By further selecting [**Record**], you can print out the currently displayed tabular trends by the recorder.
- By selecting the [**Print**] button, you can set and print out the tabular trends report by the printer. For how to set the tabular trends report, please refer to the ***Print*** chapter.

32.4 Reviewing Events

The monitor saves the events in real time. You can review these events.

In the [**Review**] menu, select [**Events**] to access the following window.

The events that can be reviewed include parameter alarm events, arrhythmia alarm events and manual events. When an event occurs, all the measurement numerics at the event trigger time and related waveforms 4 seconds, 8 seconds, or 16 seconds, as per the setting of recording length, respectively before and after the event trigger time are stored.



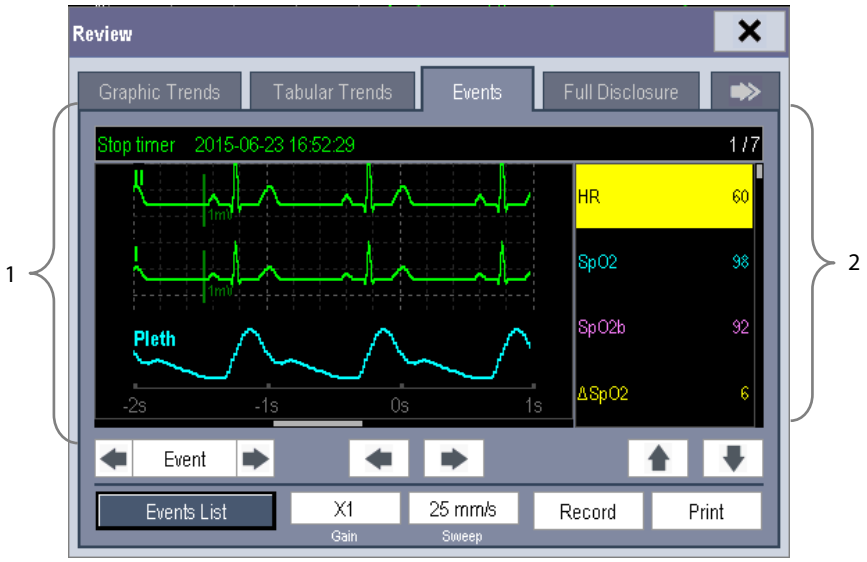
NOTE

- **Pausing or switching off alarms will not be recorded as events. The time of these operations will not be recorded in the system log.**
- **A total loss of power has no impact on the saved events.**
- **Earlier-recorded events might be overwritten by later ones if it reaches capacity.**

In this window:

- You can view the desired events by selecting [**Event**].
- You can view the desired events according to the level by selecting [**Level**].

After selecting the desired event, you can select [**Details**] to access the following window. In this window, the waveform area displays the waveforms related to the event, and the parameter area displays the parameter values happened at the event trigger time.



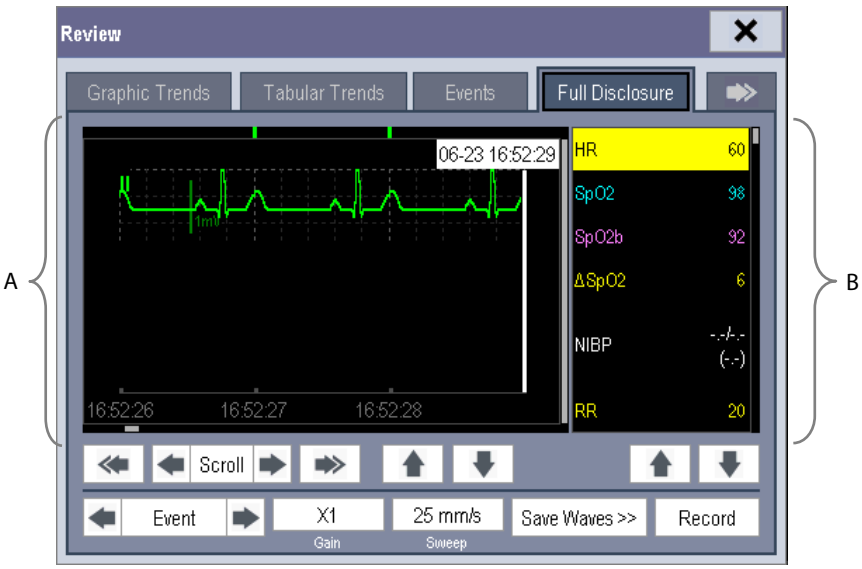
1. Waveform area 2. Parameter area

In this window:

- You can select ◀ or ▶ to navigate through the waveforms.
- You can select ◀ or ▶ beside the [**Event**] button to switch between events.
- You can set the desired [**Gain**] for ECG waveform.
- You can set the desired [**Sweep**].
- By selecting the [**Record**] button, you can print out the currently displayed alarm events by the recorder.
- By selecting the [**Print**] button, you can print out the currently displayed alarm events by the printer.
- By selecting the [**Events List**] button, you can view the events list.

32.5 Reviewing Waveforms

In the [**Review**] menu, select [**Full Disclosure**] to access the following window.



A. Waveform area B. Parameter area

In this review window:

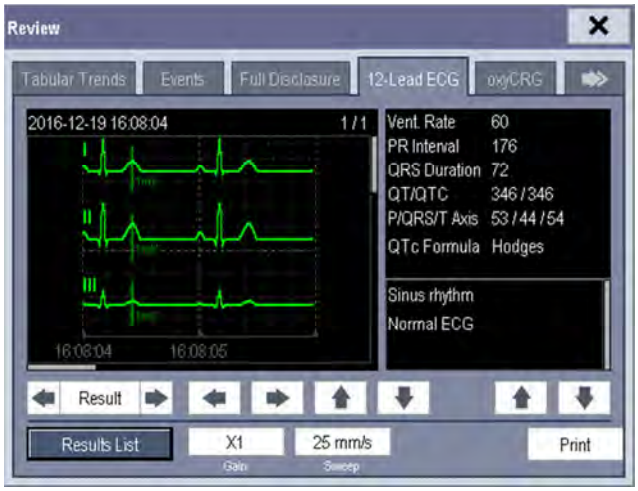
- To review full-disclosure waveforms, you need to save waveforms first. Select [**Save Waves >>**] and then select the parameters whose waveforms you want to view. To save full-disclosure waveform, your monitor must be equipped with a CF storage card.
- To view the waveforms, you can either:
  - Select or beside the [**Scroll**] button to move the cursor one step left or right to navigate through the waveforms, or
  - Select or to move the cursor one page left or right to navigate through the waveforms.

  A time indicating your current position is displayed at the top of the waveform area. Numeric measurement values corresponding to the cursor location are displayed in the parameter area, and change as the cursor is moved.
- You can change the ECG wave gain by selecting [**Gain**] and then selecting the appropriate setting.
- You can change the waveform sweep speed by selecting [**Sweep**] and then selecting the appropriate setting.
- By selecting the [**Record**] button, you can print out the first three waveforms and measurement numerics by the recorder.
- By selecting or beside the [**Event**] button, you can position the cursor between events.

32.6 Reviewing 12-Lead ECG Results

You can review up to twenty 12-lead ECG results of each patient in the [**Review**] menu. In the [**Review**] menu, select [**12-Lead ECG**] to access the following window.

- Select ▲ or ▼ beside the [**Scroll**] button to switch between 12-lead ECG results.
- Select ⏫ or ⏬ to switch between pages.
- Select the [**Details**] button to access the following window.



- Select ◀ or ▶ beside the [**Result**] button to switch between 12-lead ECG results.
- Select ◀ or ▶ to navigate through the waveforms.
- Select ▲ or ▼ to navigate through the waveforms or 12-lead ECG results.
- Select [**Results List**] to switch to the 12-lead ECG results list.
- Select [**Gain**] and then selec the appropriate setting to change the ECG wave gain.
- Select [**Sweep**] and then select the appropriate setting to change the ECG waveform sweep speed.
- Select the [**Print**] button to print out the currently displayed 12-lead ECG result by the printer.
- Select the [**Record**] button to print out the currently displayed 12-lead ECG result by the recorder. The [**Record**] button is only available for Mindray algorithm.

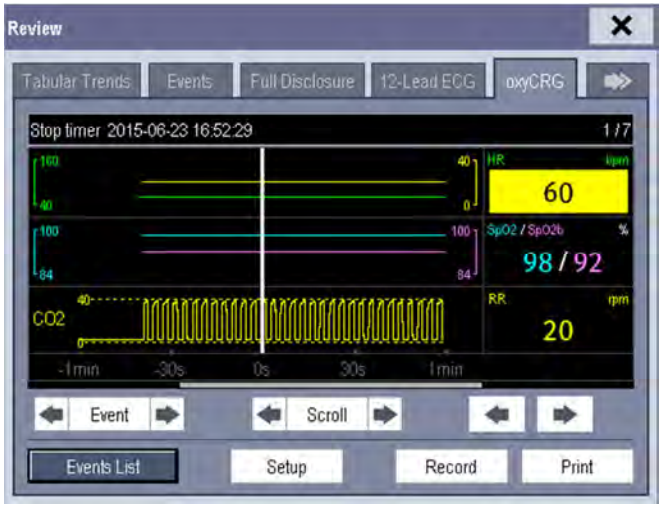
32.7 Reviewing OxyCRG

In the [**Review**] menu, select [**OxyCRG**] tab to access the following window.

In this window:

- Select [**Details**] to view the trends, waveform and measurement numerics of selected parameters.
- Select ⬆ or ⬇ beside the [**Scroll**] button to switch between events.
- Select ⏫ or ⏬ to switch between pages.
- Select the button at the lower right corner of this window to change the parameter events to be displayed.

After selecting the [**Details**] button, you can access the following window. In this window, the waveform area displays the trends and waveform of the OxyCRG, and the parameter area displays the parameter values happened at the event trigger time.



A. Waveform area B. Parameter area

In this window:

- Select [**Events List**] to switch to the OxyCRG events list.
- Select [**Setup**] to change the displayed parameters.
- Select ◀ or ▶ beside the [**Event**] button, you can position the cursor between events.
- Select ◀ or ▶ beside the [**Scroll**] button to move the cursor one step left or right to navigate through the trends and waveform.
- Select ◀ or ▶ to navigate through the parameter trends and waveform.
- Select the [**Record**] button to print out the currently displayed trends, waveform, and measurement numerics by the recorder.
- Select the [**Print**] button to print to the independent printer.

NOTE

- **Pausing or switching off alarms will not be recorded as events. The time of these operations will not be recorded in the system log.**
- **Earlier-recorded OxyCRG events might be overwritten by later ones if it reaches capacity.**
- **A total loss of power has no impact on the saved events.**

33 Calculations

33.1 Introduction

The calculation feature is available with your patient monitor. The calculated values, which are not directly measured, are computed based on the values you provide.

Your can perform the following calculations:

- Dose calculations
- Oxygenation calculations
- Ventilation calculations
- Hemodynamic calculations
- Renal calculations

To perform a calculation, select [**Main Menu**] → [**Calc >>**], or the [**Calculations**] QuickKey and then select the calculation you want to perform.

NOTE

- **The calculation feature is independent of other monitoring functions and can be therefore used for patients being monitored by other monitors. Any operation in a calculation window does not affect the patient monitoring by the local patient monitor.**

⚠ WARNING

- **After the calculation is finished, verify the entered values are correct and the calculated values are appropriate. We assume no responsibility for any consequences caused by wrong entries and improper operations.**

33.2 Dose Calculations

33.2.1 Performing Calculations

To perform a dose calculation:

1. Select [**Main Menu**]→[**Calculations >>**]→[**Dose >>**], or select [**Calculations**] QuickKey→[**Dose >>**].
2. Select, in turn, [**Patient Cat.**] and [**Drug Name**] and then select the appropriate settings. The dose calculation program has a library of commonly used drugs, of which Drug A through Drug E are for those not specified in this library.
   - ◆ Drug A, B, C, D, E
   - ◆ Aminophylline
   - ◆ Dobutamine
   - ◆ Dopamine
   - ◆ Epinephrine
   - ◆ Heparin
   - ◆ Isuprel
   - ◆ Lidocaine
   - ◆ Nipride
   - ◆ NItroglycerin
   - ◆ Pitocin
3. The system gives a set of default values when the above steps are finished. However, these values cannot be used as the calculated values. The user must enter values following the doctor's instructions, and then the calculated values can only be used
4. Enter the patient's weight.
5. Enter other values.
6. Verify if the calculated values are correct.

33.2.2 Selecting the Proper Drug Unit

Each drug has its fixed unit or unit series. Among a unit series, one unit may change to another automatically depending on the entered value.

The units for each drug are as follows:

- ■ Drug A, B, C, Aminophylline, Dobutamine, Dopamine, Epinephrine, Isuprel, Lidocaine, Nipride and NItroglycerin use the unit series: g, mg and mcg.
- ■ Drug D, Heparin and Pitocin use the unit series: Unit, KU (kilo units) and MU (million units).
- ■ Drug E uses the unit: mEq (milli-equivalents).

You must select the proper drug name (A, B, C, D or E) according to the units when you define a drug not listed in this library.

NOTE

- **For neonate patients, [Drip Rate] and [Drop Size] are disabled.**

33.2.3 Titration Table

To open the titration table, select [**Titration Table >>**] in the [**Dose Calculation**] window after the dose calculation is finished.

In the titration table, when you change:

- [**Reference**]
- [**Interval**]
- [**Dose Type**]

The titrated values change accordingly.

You can also:

- Select or , or or beside the vertical scrollbar to view more values.
- Select [**Record**] to print out the currently displayed titrated values by the recorder.

33.2.4 Drug Calculation Formulas

Abbreviation	Unit	Formula
Conc.	g/ml, unit/ml or mEq/ml	Amount / Volume
Dose	Dose/hr, Dose/kg/min	Rate × Conc.
Volume	ml	Rate × Duration
Amount	g, unit, mEq	Rate × Duration
Duration	h	Amount/Dose
Drip Rate	gtt/min	INF Rate × Drop Size / 60

33.3 Oxygenation Calculations

33.3.1 Performing Calculations

To perform an oxygenation calculation:

1. Select [**Main Menu**]→[**Calculations >>**]→[**Oxygenation >>**], or select [**Calculations**] QuickKey→[**Oxygenation >>**].
2. Enter values for calculation.
3. Select the [**Calculate**] button. The system performs a calculation per the current settings and displays the calculated values.
   - ◆ If a calculated value is outside the range, its background will highlight in yellow. You can select [**Range**] to view its normal range in the unit field.
   - ◆ Invalid values are displayed as [**---**].

In the [**Oxygenation Calculation**] window, you can:

- Change the pressure unit, Hb unit and oxygen content unit by selecting [**Press. Unit**], [**Hb Unit**] and [**OxyCont Unit**] and then selecting the appropriate settings. The changes take effect automatically.

- Trigger a recording by selecting the [**Record**] button. The currently displayed oxygenation calculations are printed out by the recorder.
- Review the previously performed calculations by selecting [**Review**].

33.3.2 Entered Parameters

Abbreviation	Unit	Full spelling
C.O.	L/min	cardiac output
FiO_2	%	percentage fraction of inspired oxygen
PaO_2	mmHg	partial pressure of oxygen in the arteries
$PaCO_2$	mmHg	partial pressure of carbon dioxide in the arteries
SaO_2	%	arterial oxygen saturation
PvO_2	mmHg	partial pressure of oxygen in venous blood
SvO_2	%	venous oxygen saturation
Hb	g/L	hemoglobin
CaO_2	ml/L	arterial oxygen content
CvO_2	ml/L	venous oxygen content
VO_2	ml/min	oxygen consumption
RQ	None	respiratory quotient
ATMP	mmHg	atmospheric pressure
Height	cm	height
Weight	kg	weight

33.3.3 Calculated Parameters and Formulas

Abbreviation	Unit	Full spelling	Formula
BSA	m^2	body surface area	$Wt^{0.425} \times Ht^{0.725} \times 0.007184$
VO_2 calc	ml/min	oxygen consumption	$C(a\text{-}v)O_2 \times$ C.O.
$C(a\text{-}v)O_2$	ml/L	arteriovenous oxygen content difference	$CaO_2 - CvO_2$
O_2ER	%	oxygen extraction ratio	$100 \times C(a\text{-}v)O_2 / CaO_2$
DO_2	ml/min	oxygen transport	C.O. $\times CaO_2$
PAO_2	mmHg	partial pressure of oxygen in the alveoli	$FiO_2 / 100 \times (ATMP - 47) - PaCO_2 \times [FiO_2 / 100 + (1 - FiO_2 / 100) / RQ]$
$AaDO_2$	mmHg	alveolar-arterial oxygen difference	$PAO_2 - PaO_2$
CcO_2	ml/L	capillary oxygen content	$Hb \times 1.34 + 0.031 \times PAO_2$
Qs/Qt	%	venous admixture	$100 \times [1.34 \times Hb \times (1 - SaO_2 / 100) + 0.031 \times (PAO_2 - PaO_2)] / [1.34 \times Hb \times (1 - SvO_2 / 100) + 0.031 \times (PAO_2 - PvO_2)]$
C.O. calc	L/min	calculated cardiac output	$VO_2 / (CaO_2 - CvO_2)$

33.4 Ventilation Calculations

33.4.1 Performing Calculations

To perform a ventilation calculation:

1. Select [**Main Menu**]→[**Calculations >>**]→[**Ventilation >>**], or select [**Calculations**] QuickKey→[**Ventilation >>**].
2. Enter values for calculation. If the patient monitor is connected to an anesthesia machine or a ventilator, the system automatically loads the supported parameter values to the [**Ventilation Calculation**] window.
3. Select the [**Calculate**] button. The system performs a calculation per the current settings and displays the calculated values.
   - ◆ If a calculated value is outside the range, its background will highlight in yellow. You can select [**Range**] to view its normal range in the unit field.
   - ◆ Invalid values are displayed as [**---**].

In the [**Ventilation Calculation**] window, you can:

- ■ Change the pressure unit by selecting [**Press. Unit**] and then selecting the appropriate setting. Corresponding pressure values shall convert and update automatically.
- ■ Trigger a recording by selecting the [**Record**] button. The currently displayed ventilation calculations are printed out by the recorder.
- ■ Review the previously performed calculations by selecting [**Review**].

33.4.2 Entered Parameters

Abbreviation	Unit	Full spelling
FiO_2	%	percentage fraction of inspired oxygen
RR	rpm	respiration rate
$PeCO_2$	mmHg	partial pressure of mixed expiratory CO_2
$PaCO_2$	mmHg	partial pressure of carbon dioxide in the arteries
PaO_2	mmHg	partial pressure of oxygen in the arteries
TV	ml	tidal volume
RQ	None	respiratory quotient
ATMP	mmHg	atmospheric pressure

33.4.3 Calculated Parameters and Formulas

Abbreviation	Unit	Full spelling	Formula
PAO_2	mmHg	partial pressure of oxygen in the alveoli	(ATMP－47) × FiO_2 /100 －$PaCO_2$ × [FiO_2 /100 ＋ (1－FiO_2 /100) / RQ]
$AaDO_2$	mmHg	alveolar-arterial oxygen difference	PAO_2 － PaO_2
Pa/FiO_2	mmHg	oxygenation ratio	100 × PaO_2 / FiO_2
a/AO_2	%	arterial to alveolar oxygen ratio	100 × PaO_2 / PAO_2
MV	L/min	minute volume	(TV × RR) / 1000
Vd	ml	volume of physiological dead space	TV × (1 － $PeCO_2$ / $PaCO_2$)
Vd/Vt	%	physiologic dead space in percent of tidal volume	100 × Vd/TV
VA	L/min	alveolar volume	(TV－ Vd) × RR / 1000

33.5 Hemodynamic Calculations

33.5.1 Performing Calculations

To perform a hemodynamic calculation:

1. Select [**Main Menu**]→[**Calculations >>**]→[**Hemodynamic >>**], or select [**Calculations**] QuickKey→[**Hemodynamic >>**].
2. Enter values for calculation.
   - ◆ For a patient who is being monitored, [**HR**], [**Art mean**], [**PA mean**] and [**CVP**] are automatically taken from the currently measured values. If you just have performed C.O. measurements, [**C.O.**] is the average of multiple thermodilution measurements. [**Height**] and [**Weight**] are the patient's height and weight you have entered. If the monitor does not provide these values, their fields appear blank.
   - ◆ For a patient who is not being monitored, confirm the values you have entered.
3. Select the [**Calculate**] button. The system performs a calculation per the current settings and displays the calculated values.
   - ◆ If a calculated value is outside the range, its background will highlight in yellow. You can select [**Range**] to view its normal range in the unit field.
   - ◆ Invalid values are displayed as [**---**].

In the [**Hemodynamic Calculation**] window, you can:

- ■ Trigger a recording by selecting the [**Record**] button. The currently displayed hemodynamic calculations are printed out by the recorder.
- ■ Review the previously performed calculations by selecting [**Review**].

33.5.2 Entered Parameters

Abbreviation	Unit	Full spelling
C.O.	L/min	cardiac output
HR	bpm	heart rate
PAWP	mmHg	pulmonary artery wedge pressure
Art Mean	mmHg	artery mean pressure
PA Mean	mmHg	pulmonary artery mean pressure
CVP	mmHg	central venous pressure
EDV	ml	end-diastolic volume
Height	cm	height
Weight	kg	weight

33.5.3 Calculated Parameters and Formulas

Abbreviation	Unit	Full spelling	Formula
BSA	m^2	body surface area	$Wt^{0.425} \times Ht^{0.725} \times 0.007184$
C.I.	$L/min/m^2$	cardiac index	C.O. / BSA
SV	ml	stroke volume	C.O. / HR × 1000
SI	ml/m^2	stroke index	SV/ BSA
SVR	DS/cm^5	systemic vascular resistance	79.96 × (AP MAP — CVP) / C.O.
SVRI	$DS{\cdot}m^2/cm^5$	systemic vascular resistance index	SVR × BSA
PVR	DS/cm^5	pulmonary vascular resistance	79.96 × (PAMAP — PAWP) / C.O.
PVRI	$DS{\cdot}m^2/cm^5$	pulmonary vascular resistance index	PVR × BSA
LCW	kg·m	left cardiac work	0.0136 × APMAP × C.O.
LCWI	$kg{\cdot}m/m^2$	left cardiac work index	LCW / BSA
LVSW	g·m	left ventricular stroke work	0.0136 × APMAP× SV
LVSWI	$g{\cdot}m/m^2$	left ventricular stroke work index	LVSW / BSA
RCW	kg·m	right cardiac work	0.0136 × PAMAP × C.O.
RCWI	$kg{\cdot}m/m^2$	right cardiac work index	RCW / BSA
RVSW	g·m	right ventricular stroke work	0.0136 × PAMAP × SV
RVSWI	$g{\cdot}m/m^2$	right ventricular stroke work index	RVSW / BSA
EF	%	ejection fraction	100 × SV / EDV

33.6 Renal Calculations

33.6.1 Performing Calculations

To perform a renal calculation:

1. Selecting [**Main Menu**]→[**Calculations >>**]→[**Renal >>**], or select [**Calculations**] QuickKey→[**Renal >>**].
2. Enter values for calculation.
3. Select the [**Calculate**] button. The system performs a calculation per the current settings and displays the calculated values.
   - ◆ If a calculated value is outside the range, its background will highlight in yellow. You can select [**Range**] to view its normal range in the unit field.
   - ◆ Invalid values are displayed as [**---**].

In the [**Renal Calculation**] window, you can:

- ■ Trigger a recording by selecting the [**Record**] button. The currently displayed renal calculations are printed out by the recorder.
- ■ Review the previously performed calculations by selecting [**Review**].

33.6.2 Entered Parameters

Abbreviation	Unit	Full spelling
URK	mmol/L	urine pstassium
URNa	mmol/L	urinary sodium
Urine	ml/24h	urine
Posm	mOsm/ kgH_2O	plasm osmolality
Uosm	mOsm/ kgH_2O	urine osmolality
SerNa	mmol/L	serum sodium
Cr	μmol/L	creatinine
UCr	μmol/L	urine creatinine
BUN	mmol/L	blood urea nitrogen
Height	cm	height
Weight	kg	weight

33.6.3 Calculated Parameters and Formulas

Abbreviation	Unit	Full spelling	Formula
URNaEx	mmol/24h	urine sodium excretion	Urine × URNa / 1000
URKEx	mmol/24h	urine potassium excretion	Urine × URK / 1000
Na/K	%	sodium potassium ratio	100 × URNa / URK
CNa	ml/24h	clearance of sodium	URNa × Urine / SerNa
Clcr	ml/min	creatinine clearance rate	Ucr × Urine / Cr / (BSA / 1.73) / 1440
FENa	%	fractional excretion of sodium	100 × （URNa × Cr) / (SerNa × Ucr)
Cosm	ml/min	osmolar clearance	Uosm × Urine / Posm / 1440
CH_2O	ml/h	free water clearance	Urine × (1－Uosm / Posm) / 24
U/P osm	None	urine to plasma osmolality ratio	Uosm / Posm
BUN/Cr	None*	blood urea nitrogen creatinine ratio	1000 × BUN / Cr
U/Cr	None	urine-serum creatinine ratio	Ucr / Cr

*: BUN/Cr is a ratio under the unit of mol.

33.7 Understanding the Review Window

With the review feature, you can review oxygenation, ventilation, hemodynamic and renal calculations. The review window for each calculation is similar. Take the hemodynamic calculations review window for example, you can access it by selecting [**Review**] in the [**Hemodynamic Calculation**] window.

In this review window:

- You can select ◀, ▶, ◀◀ or ▶▶ to view more values.
- The values that exceed the range are displayed in yellow background. The [**Unit**] field displays parameter units. If some parameter values are outside of their normal ranges, you can view their normal range in the [**Unit**] field by selecting [**Range**].
- You can review an individual calculation by selecting its corresponding column and then selecting [**Original Calc**]. You can record the currently displayed calculations or perform another calculation is this window

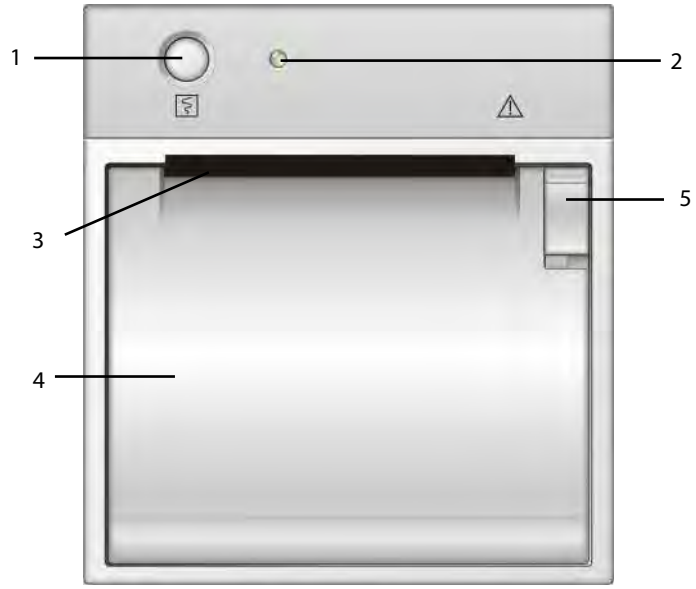
.

FOR YOUR NOTES

34 Recording

34.1 Using a Recorder

The thermal recorder records patient information, measurement numerics, up to three waveforms, etc.



1. Start/Stop key: press to start a recording or stop the current recording.
2. Indicator
   - On: when the recorder works correctly.
   - Off: when the monitor is switched off.
   - Flashes: if an error occurred to the recorder, e.g., the recorder runs out of paper.
3. Paper outlet
4. Recorder door
5. Latch

34.2 Overview of Recording Types

By the way recordings are triggered, the recordings can be classified into the following categories:

- Manually-triggered realtime recordings.
- Timed recordings.
- Alarm recordings triggered by an alarm limit violation or an arrhythmia event.
- Manually-triggered, task-related recordings.

NOTE

- **For details about alarm recording, refer to chapter 8 Alarms.**
- **For details about task-related recordings, refer to respective sections of this manual.**

34.3 Starting and Stopping Recordings

To manually start a recording, you can either:

- Select the ⚿ hardkey on the front of either the patient monitor or the recorder module, or
- Select the [**Record**] button from the current menu or window.

Automatic recordings will be triggered in the following conditions:

- Timed recordings will start automatically at preset intervals.
- If both [**Alarm**] and [**Alm Rec**] for a measurement are set on, an alarm recording will be triggered automatically as alarms occur.

To manually stop a recording, you can either:

- Select the ⚿ hardkey again, or
- Select [**Clear All Tasks**] in the [**Record Setup**] menu.

Recordings stop automatically when:

- A recording is completed.
- The recorder runs out of paper.
- When the recorder has an alarm condition.

When a recording is stopped, the following markers will be added:

- Automatically stopped recording: print two columns of '*' at the end of the report.
- Manually or abnormally stopped recording: print one column of '*' at the end of the report.

34.4 Setting up the Recorder

34.4.1 Accessing the Record Setup Menu

By selecting [**Main Menu**]→[**Record Setup >>**], you can access the [**Record Setup**] menu.

34.4.2 Selecting Waveforms for Recording

The recorder can record up to 3 waveforms at a time. You can select, in turn, [**Waveform 1**], [**Waveform 2**] and [**Waveform 3**] in the [**Record Setup**] menu, and then select the waveforms you want. You can also turn off a waveform recording by selecting [**Off**]. These settings are intended for realtime and scheduled recordings.

34.4.3 Setting the Realtime Recording Length

After starting a realtime recording, the recording time depends on your monitor's settings. In the [**Record Setup**] menu, select [**Length**] and toggle between [**8 s**] and [**Continuous**].

- [**8 s**]: record 4-second waveforms respectively before and after current moment.
- [**Continuous**]: record the waveforms from the current moment until stopped manually.

34.4.4 Setting the Interval between Timed Recordings

Timed recordings start automatically at preset intervals. Each recording lasts 8 seconds. To set the interval between timed recordings: in the [**Record Setup**] menu, select [**Interval**] and then select the appropriate setting.

34.4.5 Changing the Recording Speed

In the [**Record Setup**] menu, select [**Paper Speed**] and toggle between [**25 mm/s**] and [**50 mm/s**]. This setting is for all recordings containing waveforms.

34.4.6 Setting the IBP Wave Overlap Recordings

You can switch on or off the recordings for IBP wave overlapping.

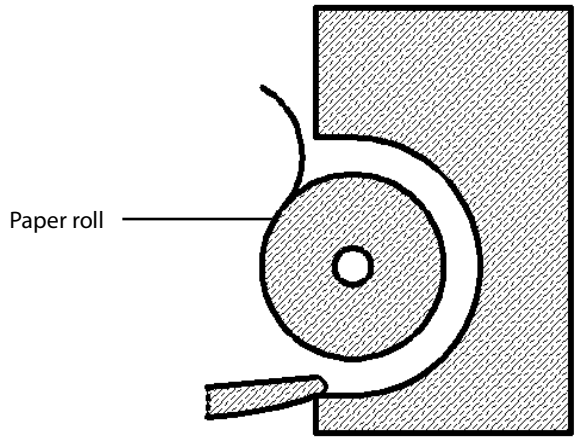
1. Open [**Record Setup**] menu.
2. Set [**IBP Overlap**] to:
   - [**On**]: If two or more waveforms in the selected waveforms for recording are IBP waveforms, the IBP waveforms will be recorded in the overlapping format.
   - [**Off**]: IBP waveforms will be recorded normally.

34.4.7 Clearing Recording Tasks

In the [**Record Setup**] menu, select [**Clear All Tasks**]. All queued recording tasks are cleared and the current recording is stopped.

34.5 Loading Paper

1. Use the latch at the upper right of the recorder door to pull the door open.
2. Insert a new roll into the compartment as shown below.
3. Close the recorder door.
4. Check if paper is loaded correctly and the paper end is feeding from the top.



⚠CAUTION

- **Use only specified thermal paper. Otherwise, it may cause damage to the recorder's printhead, the recorder may be unable to print, or poor print quality may result.**
- **Never pull the recorder paper with force when a recording is in process. Otherwise, it may cause damage to the recorder.**
- **Do not leave the recorder door open unless you reload paper or remove troubles.**

34.6 Removing Paper Jam

If the recorder works incorrectly or produces unusual sounds, check if there is a paper jam first. If a paper jam is detected, follow this procedure to remove it:

1. Open the recorder door.
2. Take out the paper and tear off the draped part.
3. Reload the paper and close the recorder door.

34.7 Cleaning the Recorder Printhead

If the recorder has been used for a long time, deposits of paper debris may collect on the printhead compromising the print quality and shortening the lifetime of the roller. Follow this procedure to clean the printhead:

1. Take measures against the static electricity such as Disposable Wrist Strap for the work.
2. Open the recorder door and take out the paper.
3. Gently wipe around the printhead using cotton swabs dampened with alcohol.
4. After the alcohol has completely been dried, reload the paper and close the recorder door.

⚠CAUTION

- **Do not use anything that may destroy the thermal element.**
- **Do not add unnecessary force to the thermal head.**

35 Printing

35.1 Printer

The monitor can output patient reports via a connected printer. So far, the monitor supports the following printer:

- HP LaserJet 1505n
- HP LaserJet P2035n
- HP LaserJet P4015n
- HP LaserJet Pro 400 M401n
- HP LaserJet 600 M602
- HP LaserJet M202DW

The specifications of the reports the monitor prints are:

- Paper: A4, Letter
- Resolution: 300 dpi

For more details about the printer, see the document accompanying the printer. With the upgrading of products, the monitor will support more printers and no prior notice will be given. If you have any doubt about the printer you have purchased, contact our company.

35.2 Connecting a printer

To print the reports or the trend data of a patient, you can choose either:

- the local printer

  Connect the printer and the patient monitor through the network, and then start printing what you want, or
- the Central Monitoring System

  If your monitor is connected to a central monitoring system, it is recommended to use the central monitoring system for printing.

35.3 Setting Up the Printer

To set the printer's properties, select [**Main Menu**]→[**Print Setup >>**]→[**Printer Setup >>**]. In the [**Printer Setup**] menu, you can:

- Select a connected printer

  Select [**Printer**] and then select a connected printer as the monitor's printer.

- Search for a printer

  If your selected printer is not in the list or a new printer is added into the network, you can select the [**Search Printer**] to re-search for all printers in the network.

- Set up the paper

  Select [**Paper Size**] and toggle between [**A4**] and [**Letter**].

35.4 Starting Report Printouts

Reports	Contents	Procedures
ECG reports	ECG waveforms and relevant parameter values	Select [**Main Menu**]→[**Print Setup >>**]→[**ECG Reports >>**]→[**Print**]
Tabular trends	Depend on the selected parameter group, resolution and time period	Select [**Main Menu**]→[**Print Setup >>**]→[**Tabular Trends Reports >>**]→[**Print**], or select [**Main Menu**]→[**Review >>**]→[**Tabular Trends**]→[**Print**]→[**Print**]
Graphic trends	Depend on the selected parameter group, resolution and time period	Select [**Main Menu**]→[**Print Setup >>**]→[**Graphic Trends Reports >>]**→[**Print**], or select [**Main Menu**]→[**Review >>**]→[**Graphic Trends**]→[**Print**]→[**Print**]
Arrh. alarm review	ECG waveforms and relevant parameter values	Select [**Print**] in [**Arrh. Events**]
Parameter alarm review	Depend on the selected alarms	Select [**Main Menu**]→[**Review >>**]→[**Alarms**]→[**Print**]
Interpretation of resting 12-lead ECG	12-lead ECG waveforms and analysis results	Select [**12-lead Analysis**]→[**Print**] when a interpretation of resting 12-lead ECG is completed, or select [**Main Menu**]→[**Review >>**]→[**12-lead Analysis**]→[**Print**]
Realtime waves	Depend on the selected waveforms	Select [**Main Menu**]→[**Print Setup >>**]→[**Realtime Reports >>**]→[**Print**]

35.5 Stopping Reports Printouts

To stop report printouts, select [**Main Menu**]→[**Print Setup >>**]→[**Stop All Reports**].

35.6 Setting Up Reports

35.6.1 Setting Up ECG Reports

You can print out ECG reports only under full-screen, half-screen or 12-lead monitoring screen. To set up ECG reports, select [**Main Menu**]→[**Print Setup >>**]→[**ECG Reports >>**].

- [**Amplitude**]: set the amplitude of the ECG waveforms.
- [**Sweep**]: set the wave print speed to 25 mm/s or 50 mm/s.
- [**Auto Interval**]: If [**Auto Interval**] is set to [**On**], the system will automatically adjust the space between waveforms to avoid overlapping.
- [**Gridlines**]: choose whether to show gridlines.
- [**12-Lead Format**]: If you select [**12×1**], 12 waveforms will be printed on a paper from top to bottom. If you select [**6×2**], 12 waveforms will be printed from left to right with 6 waveforms on each half part and a rhythm waveform will be printed at the bottommost. If you select [**3×4**], 12 waveforms will be printed from left to right with 3 waveforms on each of the 4 columns and a rhythm waveform will be printed at the bottommost.

35.6.2 Setting Up Tabular Trends Reports

To set up tabular trends reports, select [**Main Menu**]→[**Print Setup >>**]→[**Tabular Trends Reports >>**].

- Start time: You can set a time period whose trend data will be printed out by setting [**From**] and [**Back**]. For example, if you set [**From**] as 2007-4-2 10:00:00 and [**Back**] as [**2 h**], the outputted data will be from 2007-4-2 08:00:00 to 2007-4-2 10:00:00. In addition, the [**Back**] can be set to either:
  - [**Auto**]: If [**Report Layout**] is set to [**Time Oriented**], the report will be printed by time. If [**Report Layout**] is set to [**Parameter Oriented**], the report will be printed by parameters.
  - [**All**]: If you select [**All**], all trend data will be printed out. In this case, it is no need to set [**From**].
- [**Interval**]: choose the resolution of the tabular trends printed on the report.
- [**Report Layout**]: If you select [**Time Oriented**], the report will be printed by time. If you select [**Parameter Oriented**], the report will be printed by parameters.
- [**Select Parameter >>**]: from the popup menu, you can:
  - [**Currently Displayed Trended Parameters**]: print the parameter trend data selected from the [**Tabular Trends**].
  - [**Standard Parameter Group**]: select the standard parameter group for printing.
  - [**Custom**]: You can define a parameter group for printing from the parameters displayed in the low part of the menu.

35.6.3 Setting Up Graphic Trends Reports

To set up graphic trends reports, select [**Main Menu**]→[**Print Setup >>**]→[**Graphic Trends Reports >>**]. As setting up graphic trends reports is similar with tabular trends reports, you can refer to the ***Setting Up Tabular Trend Reports*** section for details.

35.6.4 Setting Up Realtime Reports

To set up realtime reports, select [**Main Menu**]→[**Print Setup >>**]→[**Realtime Reports >>**].

- [**Sweep**]: set the wave print speed to 12.5 mm/s, 25 mm/s, 50 mm/s, or Auto.
- [**Select Wave >>**]: from the popup menu, you can:
  - [**Current**]: select the currently displayed waves for printing.
  - [**Select Wave**]: select the desired waves for printing.

35.7 End Case Reports

ECG reports, tabular trends reports, graphic trends reports, NIBP review reports and realtime reports can be set as end case reports. When you discharge a patient, the system will automatically print out all contents that are set as end case reports.

For example, to set ECG report as end case report:

1. select [**Main Menu**]→[**Print Setup >>**]→[**ECG Report >>**].
2. select [**End Case Report**]→[**Set as End Case Report**] and then select [**Ok**] from the popup dialog box.
3. set as described in the ***35.6.1 Setting Up ECG Reports***.

35.8 Printer Statuses

35.8.1 Printer Out of Paper

When the printer runs out of paper, the print request will not be responded. If there are too many print jobs that are not responded, a printer error may occur. In these cases, you need to install paper and then re-send the print request. Restart the printer if necessary.

Therefore, you'd better ensure that there is enough paper in the printer before sending a print request.

35.8.2 Printer Status Messages

Printer Status Message	Possible causes and suggested action
Printer unavailable	The selected printer is not available. Check if the printer is switched on or correctly connected or installed with paper.

36 Other Functions

36.1 Marking Events

During patient monitoring, some events may exert effects on the patient and as a result change the waveforms or numerics displayed on the monitor. To help analysing the waveforms or numerics at that time, you can mark these events.

Select [**Main Menu**]→[**Mark Event >>**]. In the popup menu, you can select the waves to be stored when a manual event is triggered. You can select [**Trigger Manual Event**] from the [**Mark Event**] menu or the [**Manual Event**] QuickKey to trigger a manual event and store it at the same time.

When you are reviewing graphic trends, tabular trends or full-disclosure waveforms, the manual event symbol is displayed at the time the event is triggered.

36.2 Privacy Mode

Privacy mode is only available when a patient who is admitted at a patient monitor is also monitored by the central station.

To activate the privacy mode:

1. Select [**Main Menu**]→[**Screen Setup >>**].
2. Select [**Privacy Mode**] to activate the privacy mode.

The patient monitor behaves as follows as soon as the privacy mode is activated:

- The screen turns blank and [**Under monitoring. Press any key to exit the privacy mode.**] is displayed.
- Monitoring and data storing continue but patient data is only visible at the central station.
- Alarms can still be triggered. But all audible alarms are suppressed and the alarm light is deactivated at the patient monitor.
- All system sounds are suppressed, including heart beat tone, pulse tone, all prompt tones, etc.

⚠WARNING

- **During privacy mode, all audible alarms are suppressed and the alarm light is deactivated at the patient monitor. Alarms sound only at the central station.**

To cancel the privacy mode, proceed as follows:

- Press any key.

The patient monitor exits the privacy mode automatically in one of the following situations:

- The patient monitor disconnects from central station.
- The alarm of [**Battery Too Low**] and [**The monitor will quit soon. Please use AC power.**] message appear.

36.3 Night Mode

To avoid disturbing the patient, night mode may be used.

To activate the night mode:

1. Select the [**Night Mode**] QuickKey or [**Main Menu**]→[**Screen Setup >>**]→[**Night Mode >>**].
2. In the pop-up menu, set the desired brightness, alarm volume, QRS volume, key volume, NIBP end tone, or whether to stop NIBP measurement or not. When [**Stop NIBP**] is selected, all the NIBP measurements terminate after entering the night mode.
3. Select the [**Enter Night Mode**] button.

To cancel the night mode:

1. Select the [**Night Mode**] QuickKey or [**Main Menu**]→[**Screen Setup >>**]→[**Night Mode >>**].
2. Select [**Ok**] in the popup.

⚠WARNING

- **Before entering night mode, confirm the settings of brightness, alarm volume, QRS volume, and key volume. Pay attention to the potential risk when the setting value is a bit low.**

36.4 Analog Output

The patient monitor provides analog output signals to accessory equipment via the Micro-D connector on the rear of the monitor. To obtain analog output signals, connect the accessory equipment such as an oscillograph, etc. to the monitor and then follow this procedure:

1. Select [**Main Menu**] then [**Analog Output Setup>>**].
2. Select [**Analog Out**.] and then select [**On**].

NOTE

- **The analog output feature is seldom applied in clinical applications. You can contact your service personnel for more details.**

36.5 Exporting the Log

The monitor stores system status information, including failures, abnormity, and technical alarms, into the log. You can export the log to a USB disk.

To export the log,

1. Connect a USB disk to the monitor's USB connector. See ***2.2.3 Rear View*** for the proper location of the USB connector.
2. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password→[**Others >>**].
3. Select [**Export Log**].

36.6 Transferring Data

You can transfer the patient data saved in the monitor to a PC via a crossover network cable or CF storage card, or within a LAN for data management, review or print.

36.6.1 Data Export System

You must install the data export system on the intended PC before performing the data transfer operation. Refer to the document accompanying the installation CD-ROM for installation instructions.

The data transfer feature supports patient management, data review, data format conversion, print, etc. in addition to data transfer. Refer to the help file of the system software for more details.

36.6.2 Transferring Data by Different Means

NOTE

- **Never enter the data transfer mode when the patient monitor is in normal operation or performs monitoring. You must re-start the patient monitor to exit the data transfer mode.**

Transfer data via a crossover network cable

Before transferring data using a crossover network cable, do as follows:

1. Connect one end of the crossover network cable to the patient monitor and the other end to the PC.
2. Set the IP address of the PC. This IP address must be in the same network segment with that of the patient monitor.
3. Make sure that the data export system is active on the PC.

Then, follow this procedure to transfer data:

1. Select [**Main Menu**]→[**Patient Data >>**]→[**Transfer Data**].
2. Select [**Yes**] from the popup message box.
3. Input the IP address already set on the PC.
4. Select [**Start**] to start transferring data.

Transfer data within a LAN

Before transferring data within a LAN, do as follows:

1. Connect the patient monitor and the intended PC into the same LAN and acquire the PC's IP address.
2. Make sure that the data export system is active on the PC.

Follow the same procedure as via a crossover network cable to transfer data.

Transfer data via a CF storage card

1. Power off the patient monitor and remove the CF storage card from it. Refer to the ***Basic Operations*** section for details.
2. Run the data export system on the PC.
3. Insert the CF storage card into the card reader that connects the PC.
4. Perform the data transfer operation following the help file of the system software.

36.7 Nurse Call

The patient monitor provides a nurse call connector to output nurse call signal when a user-defined alarm occurs. To obtain nurse call signal, use the nurse call cable (***PN: 8000-21-10361***) we supply to connect the hospital nurse call system to the nurse call connector of the monitor and then follow this procedure:

1. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password.
2. Select [**Others >>**] to access the [**Others**] menu.
3. Select [**Nurse Call Setup >>**] to change the nurse call settings as follows:

- Select [**Signal Type**] and toggle between [**Pulse**] and [**Continuous**].
  - [**Pulse**]: the nurse call signal is a pulse signal and each pulse lasts 1 second. When multiple alarms occur simultaneously, only one pulse signal is outputted. If an alarm occurs but the previous one is not cleared yet, a new pulse signal will also be outputted.
  - [**Continuous**]: the nurse call signal lasts until the alarm ends, i.e. the duration of a nurse call signal equals to that of the alarm condition.
- Select [**Contact Type**] and toggle between [**Normally Open**] and [**Normally Closed**].
  - [**Normally Open**]: select if your hospital's nurse call relay contact is normally open.
  - [**Normally Closed**]: select if your hospital's nurse call relay contact is normally closed.
- Select [**Alm Lev**] and set the alarm level for nurse call-triggering alarms.
- Select [**Alarm Cat.**] and then select the category to which the nurse call-triggering alarms belong.

Alarm conditions are indicated to nurses only when:

- The nurse call system is enabled,
- An alarm that meets your preset requirements occurs, and
- The monitor is not in the alarm paused or reset status.

⚠ WARNING

- **To obtain the nurse call signal, use the nurse call cable** (*PN: 8000-21-10361*) **we supply. Otherwise the nurse call function will not work and the monitor may be damaged.**
- **Do not rely exclusively on the nurse call system for alarm notification. Remember that the most reliable alarm notification combines audible and visual alarm indications with the patient's clinical condition.**

NOTE

- **If no setting is selected from [Alm Lev] or [Alarm Cat.], no nurse call signal will be triggered whatever alarms occur.**

36.8 iView System (not applicable to BeneView T5 and BeneView T5 OR patient monitor)

The iView system of this monitor can be configured with Windows operating system. You can install and use the required PC application program on the monitor through Windows operating system.

36.8.1 Start, Power off and Restart iView System

Start iView System

Select [**Main Menu**]→[**Maintenance>>**]→[**User Maintenance>>**]→enter the required password→[**iView Setup >>**]→[**iView Start**], and select [**OK**] in the popup. Then the iView system runs and the ShortCut [**iView**] in the main screen is enabled.

Power off iView system

Select [**Main Menu**]→[**Maintenance>>**]→[**User Maintenance>>**]→enter the required password→[**iView Setup >>**]→[**iView Power Off**], and select [**OK**] in the popup. Then the iView system shuts down and the ShortCut [**iView**] in the main screen is disabled.

Restart iView System

Select [**Main Menu**]→[**Maintenance>>**]→[**User Maintenance>>**]→enter the required password→[**iView Setup >>**]→[**iView Restart**], and select [**OK**] in the popup.

NOTE

- **The Restart, Shutdown, Sleep and Hibernate operations from [Start] menu of the configured Windows system are ineffective to iView system. The corresponding operations have to be performed in [iView Setup >>] menu.**

36.8.2 Installing applications

To install applications, follow this procedure:

1. Access the iView system. See ***36.8.1 Start, Power off and Restart iView System***.
2. Let McAfee Solidifier enter the update status. See ***36.8.9 Using McAfee Solidifier***.
3. Copy the installation files of the applications to the hard disk of the iView system. See ***36.8.3 Obtaining the installation files.***
4. Access the folder where the installation files locate, and double click the "Setup.exe".
5. Follow the wizard to perform installation.
6. Let McAfee Solidifier enter the monitor status. See ***36.8.9 Using McAfee Solidifier.***

WARNING

- **Improper installation of applications may cause dead halt or system crash. Consult the service personel before installation.**

36.8.3 Obtaining the installation files

You can obtain the installation files either from a USB drive or from other devices within a LAN.

Obtaining the installation files from a USB drive

To obtain the installation files from a USB drive:

1. Insert the USB drive containing the installation files to the iView USB connector on the rear of the monitor.
2. Copy the installation files to the hard disk of the iView system.

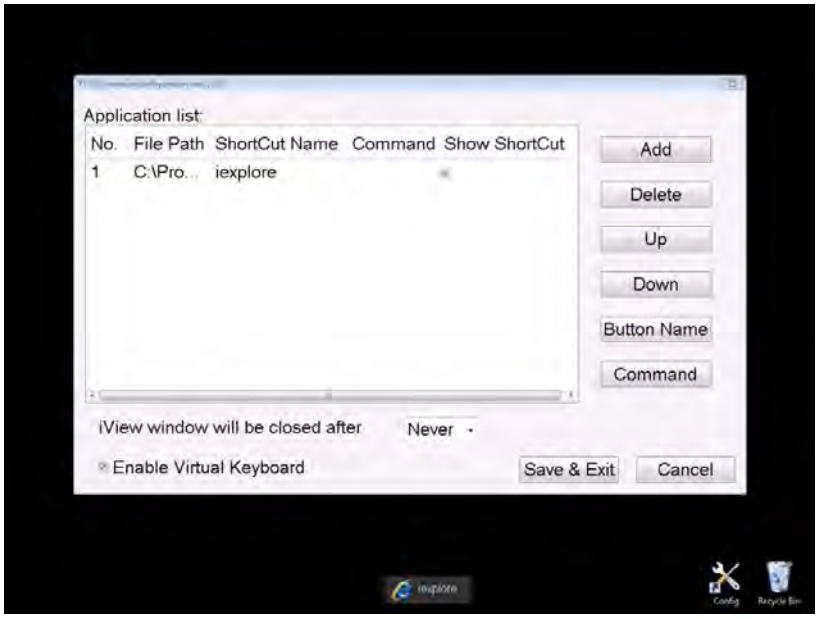
Obtaining the installation files within a LAN

1. Connect one end of the network cable to the iView network connector on the rear of the monitor and the other end to the network.
2. Configure the IP address of the iView system, and confirm that the iView system and target device are in proper network connection.
3. In the target device, share the folder containing the installation files.
4. In the iView system, select [**Start**]→[**Run**]→enter the IP address of the target device (enter the user name and password if required)→access the shared folder.
5. Copy the installation files to the local hard disk of the iView system.

36.8.4 Configuring Application Program ShortCuts

Select [**iView**] and iView ShortCuts area is displayed. Up to five PC application program ShortCuts can be displayed in this area. You can select from these ShortCuts to use the necessary software. To configure the ShortCuts,

1. Select [**Main Menu**]→[**Maintenance>>**]→[**User Maintenance>>**]→enter the required password→[**iView Setup >>**]→[**iView Setup**].
2. To start the configuration tool, click "Config" on the desk or select [**Start**]→[**My Computer**]in the lower left corner of the desk. Run "Config.exe" under the path "C:\Program Files\Mindray".



NOTE

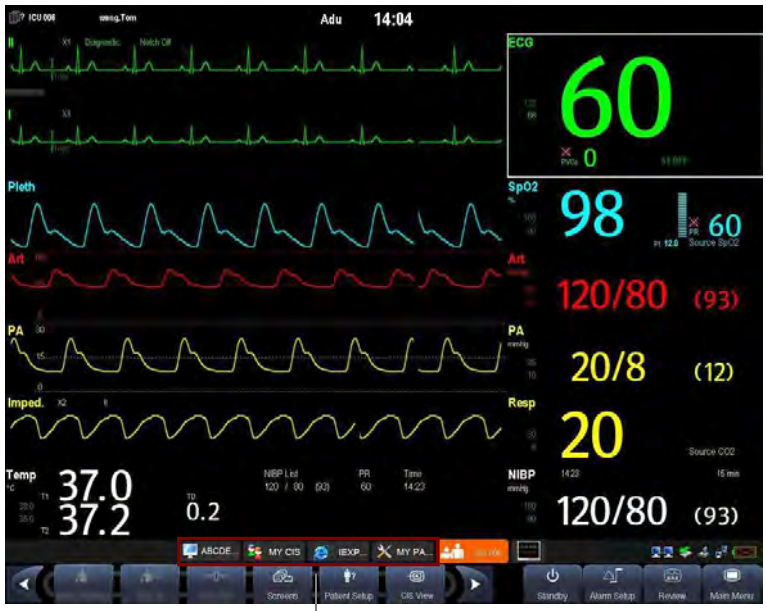
- **The task bar is hidden automatically and is displayed when the mouse is placed at the bottom of the screen.**

3. Select [**Add**] and select the application program to be added from the accessed dialog box. Then select [**Open**]to complete adding the application program.

You can select whether to display ShortCuts. [**Show ShortCut**] is ticked by default. If not ticked, the application program ShortCuts will not be displayed in the iView ShortCuts area. Not selecting the checkbox usually occurs when application program is started up indirectly. In this case, add both startup program and started program into [**T8 iView shortcut configuration tool**] and do not tick the started program. For example, if you want to start "iexplore.exe" application program to access"www.mindray.com" through "IE.bat" batch file, write parameters into the batch file. Then add "IE.bat" and "iexplore.exe" application programs into [**T8 iView shortcut configuration tool**] and set "iexplore.exe" to unticked status. Finally, save the setting and exit.

4. Select [**Up**] or [**Down**] to change the display order of ShortCuts.
5. Select the cell under [**ShortCut Name**] to change the name of application program.
6. For the application program that can be started up together with parameter, select the cell under [**Command**] to configure a parameter of the application program. For example, if you add application program "iexplore.exe" into [**T8 iView shortcut configuration tool**], set [**Command**] to "www.mindray.com". Then in the iView ShortCuts area, select the ShortCut of "iexplore.exe" and the system enters the website "www.mindray.com".
7. Select [**Save&Exit**] to finish ShortCut configuration.
8. Tick the checkbox before [**Enable Virtual Keyboard**], and the virtual keyboard can be used after application program runs.
9. Select [**Never**], [**10**], [**30**] or [**60**] in the drop-down list of [**iView window will be closed after**] to set the time interval for system to automatically close iView window. For example, when you set to [**10**], if no operation in iView window is done in 10 minutes, the iView window will automatically close.

Push [**Main Menu**] key on the monitor front panel to return to the main screen.



iView ShortCuts Area

36.8.5 Using PC Software

1. Select [**Main Menu**] and select [**iVew**], or select [**iView**] on the main screen directly. The ShortCuts of the PC software with which your monitor is configured will be displayed.
2. Select the ShortCut corresponding to the PC software you want to use to access the corresponding software screen. Only one PC software screen can be accessed at a time.

iView ShortCuts Area is automatically hidden while the PC software is running. It is automatically displayed when PC software display is minimized or turned off. You can adjust the size or display position of the window of application program via mouse.

WARNING

- **All the waveforms and parameters on the monitor are hidden when PC software display is maximized. Pay attention to the risk arising from this operation.**
- **Exit PC software or minimize PC software display when PC software is not in use.**

To hide PC software screen,

- Click  button in the upper right corner of the software screen.
- Click other area on the monitor screen.
- Push [**Main Menu**] key or [**Freeze**] key on the monitor front panel.

If PC software is open, and [**Enable Virtual Keyboard**] is ticked in [**T8 iView shortcut configuration tool**], a virtual keyboard icon  hides at the left corner of application window. Click the icon, the virtual keyboard will display.

36.8.6 iView Window Close and Standby

The monitor will automatically close iView window if you have not done operation in iView window for a period of time. To re-access iView window, select the ShortCut [**iView**] in main screen.

When monitor enters standby, the iView system will enter standby together.

36.8.7 Recover iView System

The USB disk for iView maintenance can be used to recover iView system.

NOTE

- **Use the USB disk for iView maintenance under the guidance of factory representative or professionals. The USB disk is only for BeneView T8 and BeneView T9 patient monitor. Never use it on other equipment.**

36.8.8 Remote Login

If the monitor is networked via iView network connector, you can remotely log in to the monitor's built-in Windows system through the PC within the LAN to view the program running on the monitor and to carry out remote maintenance. Before exiting remote login, you need to restart the monitor's Windows system. To restart the monitor's Windows system, select [[**Start**]→[**Run**] on the remote PC and then enter "Shutdown –f –r –t 0".

36.8.9 Using McAfee Solidifier

McAfee Solidifier is the default installation software on Windows system of iView. McAfee Solidifier solidifies the executable files of the system, dynamic link library and batch files by way of dynamic white list. Executable files not included in the white list are held back so as to protect the system. You can update the application program or monitor Windows system via McAfee Solidifier.

Follow these steps to update an application program.

1. Enter update status

   Before adding, updating or deleting an application program on iView system, let McAfee Solidifier enter update status first. In this case, select "McAfee Solidifier" on the desk to enter command line dialog box and then enter command "sadmin bu".

NOTE

- **Before updating an application program, pay attention to anti-virus measures such as network anti-virus strategy and USB device virus scanning.**

2. Enter monitor status

   After adding, updating or deleting an application program of the built-in PC, let McAfee Solidifier enter monitor status. In this case, select "McAfee Solidifier" on the desk to enter command line dialog box and then enter command "sadmin eu".

Other commonly used commands of McAfee Solidifier include:

- sadmin help: used to view the commonly used commands;
- sadmin status: used to view the status of McAfee.

36.9 Wireless Network

The patient monitors, each equipped with a wireless network card, constitute a wireless network via AP (access point). The designated service engineer or personnel shall be responsible for installing and configuring the wireless network for you and perform relative performance tests as well.

The radio device used in the monitor is in compliance with the essential requirements and other relevant provisions of Directive 1999/5/EC (Radio Equipment and Telecommunications Terminal Equipment Directive).

NOTE

- **The design, installation, restruction and maintenance of the wireless network's distribution shall be performed by authorized service personnel of our company.**
- **The existence of obstacles (such as wall) will exert impact on data transferring or even cause network interruption.**
- **The Central Monitoring System is capable of connecting up to 16 bedside monitors via the wireless network.**
- **The modified module configuration is effective after the monitor is restarted.**

36.10 Setting the Monitor Network

The monitor can automatically acquire network parameters. You can also manually enter these parameters.

To set the network,

1 Select [**Main Menu**]→[**Maintenance>>**]→[**User Maintenance>>**]→enter the required password.→[**Network Setup >>**]→[**Monitor Network Setup >>**].

2 In the [**Monitor Network Setup**] menu, set [**Network Type**] and [**Address Type**].

- Set [**Network Type**] to [**LAN**] or [**WLAN**].
- Set [**Address Type**] to [**DHCP**] or [**Manual**].

- If [**Address Type**] is set to [**DHCP**], the monitor can automatically acquire network parameters.
- If [**Address Type**] is set to [**Manual**], you need to manually input the monitor IP address, subnet mask and gateway address.

36.11 Viewing the MAC Address

You can get the MAC address from the monitor for network management.

To view the MAC address:

1. Select [**Main Menu**]→[**Maintenance>>**]→[**User Maintenance>>**]→enter the required password→select [**Ok**].
2. Select [**Network Setup** >>].
3. Select [**Monitor Network Setup** >>].

36.12 Enabling the Data Encryption

If you enable the data encryption, the patient's MRN (Medical Record Number), visit number, first name and last name are encrypted when transferring data to the CMS or eGateway.

To enable the data encryption:

1. Select [**Main Menu**]→[**Maintenance>>**]→[**User Maintenance>>**]→enter the required password→select [**Ok**].
2. Select [**Network Setup** >>].
3. Set [**Network Encrypt Switch**] to [**On**].

36.13 Connecting the monitor to the CMS

To connect the monitor to the CMS, proceed as follows:

1 Select [**Main Menu**]→[**Maintenance>>**]→[**User Maintenance>>**]→enter the required password→[**Network Setup >>**]→[**Monitor Network Setup >>**].

2. In the [**Monitor Network Setup**] menu, set [**Network Type**] and [**Address Type**].
3. Input the monitor IP address, subnet mask and gateway address if the [**Address Type**] is set to [**Manual**]
4. Connect the monitor to the CMS through either of the following methods:
   - Admit the monitor on the CMS. Refer to the Hypervisor VI Operator's Manual (PN: H-300B-20-47610) for details of admitting a monitor.
   - Setting the CMS (refer to section ***36.13.1 Setting the CMS*** for details), and then selecting a CMS (refer to section ***36.13.2 Selecting a CMS*** for details).

36.13.1 Setting the CMS

You can configure up to 30 central stations (CMS) for your monitor. To set the CMSs,

1 Select [**Main Menu**]→[**Maintenance>>**]→[**User Maintenance>>**]→enter the required password.→[**Network Setup >>**]→[**Central Station Setup >>**].

2. Set CMS names and corresponding IP addresses.

36.13.2 Selecting a CMS

If [**Select CMS**] is enabled, you can select the CMS for the current monitoring.

To select the CMS, select the prompt message area at the bottom of the screen. Then the selected CMS name will display. If the CMS you select does not have a name, this area displays "???".

36.13.3 Clearing the Selected CMS at Startup

You can clear the selected CMS each time the monitor restarts after being powered off for more than 2 minutes.

To clear the selected CMS,

1 Select [**Main Menu**]→[**Maintenance>>**]→[**User Maintenance>>**]→enter the required password→[**Others >>**].

2. Set [**Clear CMS IP at startup**] to [**On**]

The selected CMS will not be cleared when only one CMS is configured, or the monitor is restarted within 2 minutes.

This function is switched off by default.

36.14 Setting the Multicast Parameters

Whether the equipment is presented by broadcast or multicast is defined before the equipment leaves the factory. If [**Multicast**] is selected, you need to set the multicast parameters.

To do so,

1 Select [**Main Menu**]→[**Maintenance>>**]→[**User Maintenance>>**]→enter the required password.→[**Network Setup >>**]→[**Multicast Setup >>**].

2. Set [**Multicast Addr**] and [**TTL**].

36.15 Using DVI-VGA Adapter Box

The patient monitor can be connected with a VGA device via a DVI-VGA adapter box.

1. Connect the patient monitor's DVI output with DVI-VGA adapter box's DVI input.
2. Connect the DVI-VGA adapter box's VGA output with VGA device.

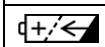
FOR YOUR NOTES

37 Batteries

37.1 Overview

The monitor is designed to operate on one or two rechargeable Lithium-ion battery whenever AC power supply is interrupted. The battery is charged whenever the patient monitor is connected to an AC power source regardless of whether or not the patient monitor is currently on. Since no external battery charger is supplied, the battery can only be charged inside the monitor so far. Whenever the AC power is interrupted during patient monitoring, the patient monitor will automatically run power from the internal batteries.

On-screen battery symbols indicate the battery status as follows:

	Indicates that batteries work correctly. The solid portion represents the current charge level of the batteries in proportion to its maximum charge level.
	Indicates that the batteries have low charge level and need to be charged.
	Indicates that the batteries are almost depleted and need to be charged immediately.
	Indicates that no batteries are installed or only one battery is installed to the BeneView T8 or BeneView T9 monitor.

The capacity of the internal battery is limited. If the battery capacity is too low, a technical alarm will be triggered and the [**Battery Too Low**] message displayed. At this moment, apply AC power to the patient monitor. Otherwise, the patient monitor will power off automatically before the battery is completely depleted.

NOTE

- **Remove the battery before transporting the equipment or if the equipment will not be used for a long time.**
- **Use AC power supply when iView is in use.**

WARNING

- **Keep the battery out of children's reach.**
- **Use only specified batteries.**

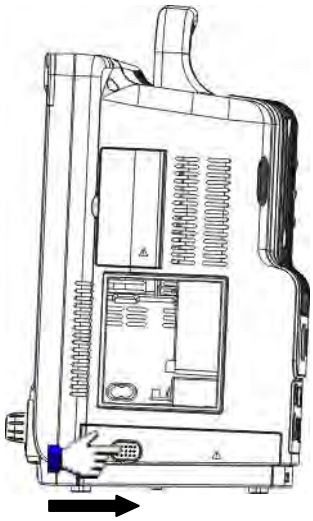
37.2 Installing or Replacing a Battery

BeneView T5

When the patient monitor uses two battery packs, one battery pack can be easily exchanged while the patient monitor operates from the other. If the patient monitor uses one battery pack, you should insert a new battery pack before the old one depletes.

To install or replace a battery, follow this procedure:

1. Push down the button on the battery door and then slide backward as indicated to open the battery door.



2. Push aside the latch latch fixing the battery and then remove the battery.
3. Place the new battery into the slot with its face up and its contact point inward.
4. If necessary, replace the other battery following the steps above.
5. Restore the latch to the original position and close the battery door.

NOTE

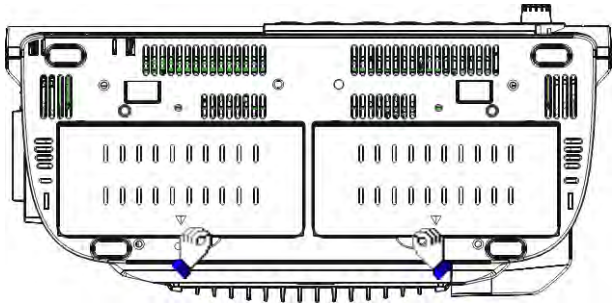
- **Using two batteries are recommended when SMR is connected.**

BeneView T8/BeneView T9

The patient monitor uses two battery packs. If the two batteries have very different charge capacity, the message [**Diff. Battery Voltages**] is displayed. In this case, apply AC power to the patient monitor until the two batteries have approximately equal charge capacity or are both fully charged. You cannot use them before they have approximately equal charge capacity or are fully charged. In situations where no patient monitoring is performed or interrupting the patient monitoring is permitted, you can replace the batteries.

The patient monitor uses two batteries. You can install the batteries by following this procedure:

1. Turn off the patient monitor and disconnect the power cord and other cables.
2. Place the patient monitor with its face up.
3. Open the battery compartment door.



4. Place the batteries into the slots per the "+" and "-" indications.
5. Close the battery door and place the patient monitor upright.

37.3 Conditioning a Battery

A battery needs at least two conditioning cycles when it is put into use for the first time. A battery conditioning cycle is one complete, uninterrupted charge of the battery, followed by an uninterrupted discharge of the battery. Batteries should be conditioned regularly to maintain their useful life. Condition the batteries once when they are used or stored for two months, or when their run time becomes noticeably shorter.

To condition a battery, follow this procedure:

1. Disconnect the patient monitor from the patient and stop all monitoring and measuring procedures.
2. Insert the battery in need of conditioning into the battery slots of the patient monitor.
3. Apply AC power to the patient monitor and allow the battery to charge uninterruptedly for above 6 hours.
4. Remove AC power and allow the patient monitor to run from the battery until it shuts off.
5. Apply AC power again to the patient monitor and allow the battery to charge uninterruptedly for above 6 hours.
6. This battery is now conditioned and the patient monitor can be returned to service.

37.4 Checking a Battery

The performance of a rechargeable battery may deteriorate over time. To check the performance of a battery, follow this procedure:

1. Disconnect the patient monitor from the patient and stop all monitoring and measuring procedures.
2. Apply AC power to the patient monitor and allow the battery to charge uninterruptedly for above 6 hours.
3. Remove AC power and allow the patient monitor to run from the battery until it shuts off.
4. The operating time of the battery reflects its performance directly.

If the operating time of a battery is noticeably shorter than that stated in the specifications, replace the battery or contact your service personnel.

NOTE

- **Life expectancy of a battery depends on how frequent and how long it is used. For a properly maintained and stored lithium-ion battery, its life expectancy is about 3 years. For more aggressive use models, life expectancy can be less. We recommend replacing lithium-ion batteries every 3 years.**
- **The operating time depends on the configuration and operation. For example, monitoring NIBP repeatedly will also shorten the operating time of the batteries.**

37.5 Recycling a Battery

When a battery has visual signs of damage, or no longer holds a charge, it should be replaced. Remove the old battery from the patient monitor and recycle it properly. To dispose of a battery, follow local laws for proper disposal.

WARNING

- **Do not disassemble batteries, or put them into fire, or cause them to short circuit. They may ignite, explode, or leak, causing personal injury.**

38 Care and Cleaning

Use only the substances approved by us and methods listed in this chapter to clean or disinfect your equipment. Warranty does not cover damage caused by unapproved substances or methods.

We make no claims regarding the efficacy of the listed chemicals or methods as a means for controlling infection. For the method to control infection, consult your hospital's Infection Control Officer or Epidemiologist.

In this chapter we only describe cleaning and disinfection of the main unit. For the cleaning and disinfection of other reusable accessories, refer to instructions for use of corresponding accessories.

38.1 General Points

Keep you equipment and accessories free of dust and dirt. To avoid damage to the equipment, follow these rules:

- Always dilute according the manufacturer's instructions or use lowest possible concentration.
- Do not immerse part of the equipment into liquid.
- Do not pour liquid onto the equipment or accessories.
- Do not allow liquid to enter the case.
- Never use abrasive materials (such as steel wool or silver polish), or erosive cleaners (such as acetone or acetone-based cleaners).

⚠ WARNING

- **The responsible hospital or institution shall carry out all cleaning and disinfection procedure specified in this chapter.**
- **Be sure to disconnect all power cables from the outlets before cleaning the equipment.**

⚠ CAUTION

- **If you spill liquid on the equipment or accessories, contact us or your service personnel.**

NOTE

- **To clean or disinfect reusable accessories, refer to the instructions delivered with the accessories.**
- **Avoid the external connectors and thermovent during cleaning or disinfection procedures.**

38.2 Cleaning

Your equipment should be cleaned on a regular basis. If there is heavy pollution or lots of dust and sand in your place, the equipment should be cleaned more frequently. Before cleaning the equipment, consult your hospital's regulations for cleaning the equipment.

Recommended cleaning agents are:

- Water
- Sodium hypochlorite bleach (10%, Sodium hypochlorite)
- Hydrogen peroxide (3%)
- Ethanol (70%)
- Isopropyl alcohol (70%)
- 1-Propanol (50%)
- Virkon
- Descosept forte
- Descosept AF
- Dismozon® plus
- Mikrozid® AF liquid
- Terralin Liquid
- Perform® classic concentrateOXY ($KHSO_4$ solution)

To clean your equipment, follow these rules:

1. Clean the display screen using a soft, clean cloth dampened with a glass cleaner, making sure that no cleanser is dripping from the cloth.
2. Clean the exterior surface of the equipment using a soft cloth dampened with the cleaner, making sure that no cleanser is dripping from the cloth.
3. Wipe off all the cleaning solution with a dry cloth after cleaning if necessary.
4. Dry your equipment in a ventilated, cool place.

38.3 Disinfection

Disinfect the equipment as required in your hospital's servicing schedule. Cleaning equipment before disinfecting is recommended.

38.4 Sterilization

Sterilization is not recommended for this monitor, related products, accessories, or supplies unless otherwise indicated in the Instructions for Use that accompany the products, accessories or supplies.

39 Maintenance

⚠ WARNING

- **Failure on the part of the responsible individual hospital or institution employing the use of this equipment to implement a satisfactory maintenance schedule may cause undue equipment failure and possible health hazards.**
- **The safety checks or maintenance involving any disassembly of the equipment should be performed by professional servicing personnel. Otherwise, undue equipment failure and possible health hazards could result.**
- **Do not open the equipment housings. All servicing and future upgrades must be carried out by the service personnel.**
- **No modification of this equipment is allowed.**
- **If you discover a problem with any of the equipment, contact your service personnel or us.**
- **The service personnel must be properly qualified and thoroughly familiar with the operation of the equipment.**

39.1 Regular Inspection

Before first use, after your patient monitor has been used for 6 to 12 months, or whenever your patient monitor is repaired or upgraded, a thorough inspection should be performed by qualified service personnel to ensure the reliability.

Follow these guidelines when inspecting the equipment:

- Make sure that the environment and power supply meet the requirements.
- Inspect the equipment and its accessories for mechanical damage.
- Inspect all power cords for damage, and make sure that their insulation is in good condition.
- Make sure that only specified accessories are applied.
- Inspect if the alarm system functions correctly.
- Make sure that the recorder functions correctly and the recorder paper meets the requirements.
- Make sure that the batteries meet the performance requirements.
- Make sure that the patient monitor is in good working condition.

In case of any damage or abnormity, do not use the patient monitor. Contact the hospital's biomedical engineers or your service personnel immediately.

39.2 Maintenance and Testing Schedule

The following maintenance and tests, except for visual inspection, power on test, touchscreen calibration, battery check and recorder check, shall be carried out by the service personnel only. Contact your service personnel if any maintenance is required. Make sure to clean and disinfect the equipment before any test and maintenance.

<table>
<tr><th colspan="2">Check/Maintenance Item</th><th>Recommended Frequency</th></tr>
<tr><td colspan="3">Preventative Maintenance Tests</td></tr>
<tr><td colspan="2">Visual inspection</td><td>When first installed or reinstalled.</td></tr>
<tr><td rowspan="2">NIBP test</td><td>Pressure check</td><td rowspan="8">1. If the user suspects that the measurement is incorrect.
2. Following any repairs or replacement of relevant module.
3. At least once a year.
4. AG leakage test should be performed before AG measurement.</td></tr>
<tr><td>Leakage test</td></tr>
<tr><td rowspan="3">Sidestream and Microstream CO_2 tests</td><td>Leakage test</td></tr>
<tr><td>Performance test</td></tr>
<tr><td>Calibration</td></tr>
<tr><td rowspan="3">AG tests</td><td>Leakage test</td></tr>
<tr><td>Performance test</td></tr>
<tr><td>Calibration</td></tr>
<tr><td colspan="3">Performance Tests</td></tr>
<tr><td rowspan="2">ECG test and calibration</td><td>Performance test</td><td rowspan="28">1. If the user suspects that the measurement is incorrect.
2. Following any repairs or replacement of relevant module.
3. At least once every two years. At least once a year is recommended for NIBP, CO_2, NMT and AG.
4. AG leakage test should be performed before AG measurement.</td></tr>
<tr><td>Calibration</td></tr>
<tr><td colspan="2">Resp performance test</td></tr>
<tr><td colspan="2">SpO_2 test</td></tr>
<tr><td rowspan="2">NIBP test</td><td>Pressure check</td></tr>
<tr><td>Leakage test</td></tr>
<tr><td colspan="2">Temp test</td></tr>
<tr><td rowspan="2">IBP test and calibration</td><td>Performance test</td></tr>
<tr><td>Pressure calibration</td></tr>
<tr><td colspan="2">C.O. test</td></tr>
<tr><td colspan="2">Mainstream CO_2 test and calibration</td></tr>
<tr><td rowspan="3">Sidestream and Microstream CO_2 tests and calibration</td><td>Leakage test</td></tr>
<tr><td>Performance test</td></tr>
<tr><td>Calibration</td></tr>
<tr><td rowspan="3">AG test</td><td>Leakage test</td></tr>
<tr><td>Performance test</td></tr>
<tr><td>Calibration</td></tr>
<tr><td colspan="2">ICG test</td></tr>
<tr><td colspan="2">BIS test</td></tr>
<tr><td colspan="2">RM test</td></tr>
<tr><td rowspan="2">CCO/SvO_2 test</td><td>Interconnecting function</td></tr>
<tr><td>Output calibration</td></tr>
<tr><td rowspan="2">NMT test</td><td>Performance test</td></tr>
<tr><td>Sensor check</td></tr>
<tr><td colspan="2">PiCCO test</td></tr>
<tr><td colspan="2">$ScvO_2$ test</td></tr>
<tr><td colspan="2">EEG test</td></tr>
<tr><td colspan="2">Nurse call relay performance test</td><td>If the user suspects that the analog output does not work well.</td></tr>
</table>

Check/Maintenance Item		Recommended Frequency
Analog output performance test		
Electrical Safety Tests		
Electrical safety tests		At least once every two years.
Other Tests		
Power on test		1. When first installed or reinstalled. 2. Following any maintenance or the replacement of any main unit parts.
Touchscreen calibration		1. When the touchscreen appears abnormal. 2. After the touchscreen is replaced.
Recorder check		Following any repair or replacement of the recorder.
Network print test		1. When first installed. 2. Whenever the printer is serviced or replaced.
Device integration check		1. When first installed. 2. Following any repair or replacement of the external device.
Battery check	Functionality test	1. When first installed. 2. Whenever a battery is replaced.
	Performance test	Once a year or if the battery run time reduced significantly.

39.3 Checking Monitor and Module Information

To view the information about system start time, selftest, etc., select [**Main Menu**]→[**Maintenance >>**]→[**Monitor Information >>**]. You can print out the information for the convenience of troubleshooting. The information will not be saved during shut down.

You can also view the information about the monitor configuration and system software version by selecting [**Main Menu**]→[**Maintenance >>**]→[**Software Version >>**].

39.4 Calibrating ECG

The ECG signal may be inaccurate due to hardware or software problems. As a result, the ECG wave amplitude becomes greater or smaller. In that case, you need to calibrate the ECG module.

1. Select the ECG parameter window or waveform area→[**Filter**]→[**Diagnostic**].
2. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password→[**Module Maintenance >>**]→[**Calibrate ECG**]. A square wave appears on the screen and the message [**ECG Calibrating**] is displayed.
3. Compare the amplitude of the square wave with the wave scale. The difference should be within 5%.
4. After the calibration is completed, select [**Stop Calibrating ECG**]

You can print out the square wave and wave scale and then measure the difference between them if necessary. If the difference exceeds 5%, contact your service personnel.

39.5 NIBP Tests

39.5.1 NIBP Leakage Test

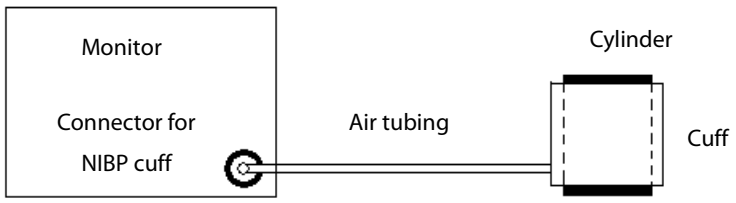
The NIBP leakage test checks the integrity of the system and of the valve. It is required at least once a year or when you doubt the measured NIBP. If the test failed, corresponding prompt messages will be given. If no message is displayed, it means no leakage is detected.

Tools required:

- An adult cuff
- An air tubing
- A correct sized cylinder

Follow this procedure to perform the leakage test:

1. Set the patient category to [**Adu**].
2. Connect the cuff to the NIBP connector on the monitor.
3. Wrap the cuff around the cylinder as shown below.



4. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]. Enter the required password and then select [**OK**].
5. Select [**Module Maintenance >>**]→[**NIBP Leakage Test**]. The NIBP display shows [**Leakage Testing…**].

After about 20 seconds, the monitor will automatically deflate. This means the test is completed. If the message [**NIBP Pneumatic Leak**] is displayed, it indicates that the NIBP airway may have leakages. Check the tubing and connections for leakages. If you ensure that the tubing and connections are all correct, perform a leakage test again.

If the problem persists, contact your service personnel.

39.5.2 NIBP Accuracy Test

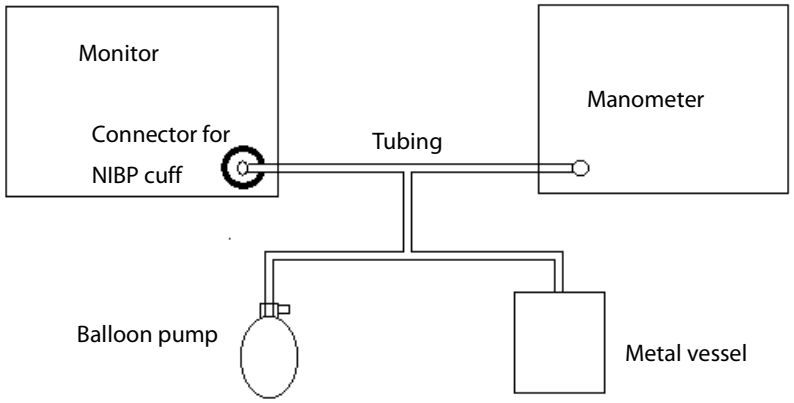
The NIBP accuracy test is required at least once a year or when you doubt the measured NIBP.

Tools required:

- T-piece connector
- Approprating tubing
- Balloon pump
- Metal Vessel (volume 500±25 ml)
- Reference manometer (calibrated with accuracy higher than 0.75 mmHg)

Follow this procedure to perform the accuracy test:

1. Connect the equipment as shown.



2. Before inflation, the reading of the manometer should be 0. If not, open the valve of the balloon pump to let the whole airway open to the atmosphere. Close the valve of the balloon pump after the reading is 0.
3. Select [**Main Menu**]→ [**Maintenance >>**]→[**User Maintenance >>**]. Enter the required password and then select [**OK**].
4. Select [**Module Maintenance >>**]→[**NIBP Accuracy Test**].
5. Check the manometer values and the monitor values. Both should be 0mmHg.
6. Raise the pressure in the rigid vessel to 50 mmHg with the balloon pump. Then, wait for 10 seconds until the measured values become stable.
7. Compare the manometer values with the monitor values. The difference should be 3 mmHg. If it is greater than 3 mmHg, contact your service personnel.
8. Raise the pressure in the rigid vessel to 200 mmHg with the balloon pump. Then, wait for 10 seconds until the measured values become stable and repeat step 6.

39.6 CO_2 Tests

39.6.1 CO_2 Leakage Test

For sidestream and microstream CO_2 modules, leakage test is needed every year or when you suspect the measurement.

Follow this procedure to perform the test:

1. Connect the CO_2 module with the patient module.
2. Wait until CO_2 warmup is finished and then use your hand or other objects to completely block the gas inlet of the module or watertrap. The sidestream and microstream CO_2 modules will behave as follows:
   - Sidestream: The alarm message [**CO2 FilterLine Err**] is displayed on the screen after certain time. Block the gas inlet for another 30 s. If the alarm message does not disappear, it indicates that the module does not leak.
   - Microstream: The alarm message [**CO2 Purging**] is displayed on the screen after certain time. Block the gas inlet for another 30s. If alarm message [**CO2 FilterLine Err**] is shown, it indicates that the module does not leak.

39.6.2 CO_2 Accuracy Test

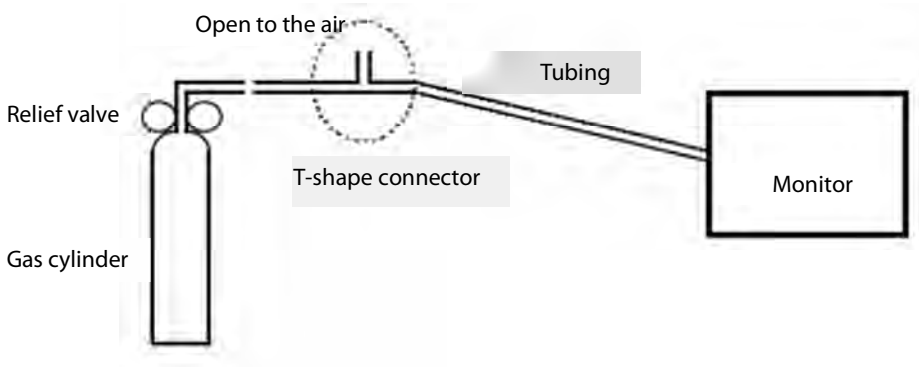
For sidestream and microstream CO_2 modules, leakage test is needed every year or when you suspect the measurement.

Tools required:

- A steel gas cylinder with 6±0.05% CO_2 and balance gas N_2
- T-shape connector
- Tubing

Follow this procedure to perform the test:

1. Connect the CO_2 module with the patient module.
2. Wait until the CO_2 module warmup is finished, and check the airway for leakage and perform a leakage test as well to make sure the airway has no leakage.
3. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password→[**Module Maintenance >>**]→[**Maintain CO2 >>**]→[**Calibrate CO2 >>**].
4. Connect the test system as follows:



5. Open the relief valve to vent standard CO_2 and make sure that there is an excess gas flow through the T-shape connector to air.
6. Check the realtime CO_2 value is within 6.0±0.3% in the [**Calibrate CO2**] menu.

39.6.3 Calibrating CO_2

For sidestream and microstream CO_2 modules, a calibration is needed every year or when the measured values have a great deviation. For maintream CO_2 module, no calibration is needed. Calibration for sidestream CO_2 module can be performed only when the sidestream module enters the full accuracy mode.

⚠ WARNING

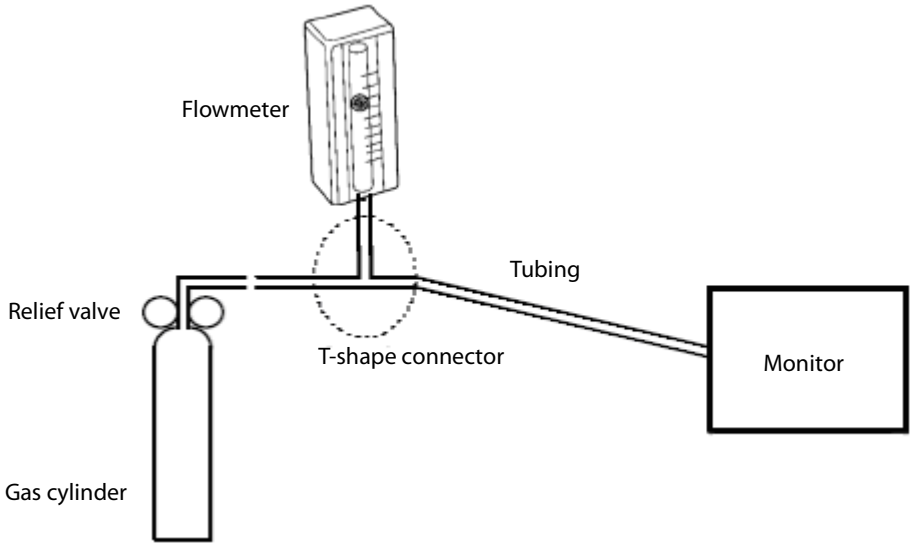
- **Connect an exhaust tube to the gas outlet connector of the monitor to remove the calibration gases to a scavenging system.**

Tools required:

- A steel gas cylinder with 6±0.05% CO_2 and balance gas N_2
- T-shape connector
- Tubing

Follow this procedure to perform a calibration:

1. Make sure that the sidestream or microstream CO_2 module has been warmed up or started up.
2. Check the airway for leakage and perform a leakage test as well to make sure the airway has no leakage.
3. Select [**Main Menu**]→ [**Maintenance >>**]→ [**User Maintenance** >>]→ enter the required password→ [**Module Maintenance >>**]→ [**Maintain CO_2 >>**]→ [**Calibrate CO_2 >>**].
4. In the [**Calibrate CO_2**] menu, select [**Zero**].
5. After the zero calibration is finished successfully, connect the equipment as follows:



6. Turn on and adjust the relief valve to make the flowmeter reads within 10-50ml/min and keeps stable as well.
7. In the [**Calibrate CO_2**] menu, enter the vented CO_2 concentration in the [**CO_2**] field.
8. In the [**Calibrate CO_2**] menu, the measured CO_2 concentration is displayed. After the measured CO_2 concentration becomes stable, select [**Calibrate CO_2**] to calibrate the CO_2 module.

9. If the calibration is finished successfully, the message [**Calibration Completed!**] is displayed in the [**Calibrate CO_2**] menu. If the calibration failed, the message [**Calibration Failed!**] is displayed. In this case, perform another calibration.

39.7 AG Tests

39.7.1 AG Leakage Test

The AG leakage test is required every time before the AG measurement. Follow this procedure to perform the test:

1. Plug the AG module into the module rack.
2. Wait for more than10mins until the AG module warmup is finished and then use your hand or other objects to completely block the gas inlet of the AG module. An alarm message [**AG Airway Occluded**] will appear on the screen.
3. Block the gas inlet for another 30 s. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password→[**Module Maintenance >>**]→[**Calibrate AG >>**].

Check that the current flow rate is less than 10ml/min, and the alarm message [**AG Airway Occluded**] does not disappear. This indicates that the module does not leak.

If the alarm message disappears, or the flow rate is equal to or greater, it indicates that the module leaks. Perform the leakage test again. If the problem remains, contact your service personnel for help.

39.7.2 AG Accuracy Test

Tools required:

- Gas cylinder with 100% O_2 and/or a certain standard gas (such as 6±0.05% CO_2, Bal N_2), or standard gas mixture (such as 5±0.03% CO_2, 1.5±0.15% ISO, 45±0.23% O_2 bal N_2O).
- Gas concentration should meet the following requirements respectively: AA≥1.5%, CO_2≥1.5%, N_2O≥40%, O_2≥40%, of which AA represents an anaesthetic agent. The gas concentration accuracy should have a tolerance as follows: AA±0.15%, CO_2±0.1%, N_2O±1%, O_2±1%.
- T-shape connector
- Tubing

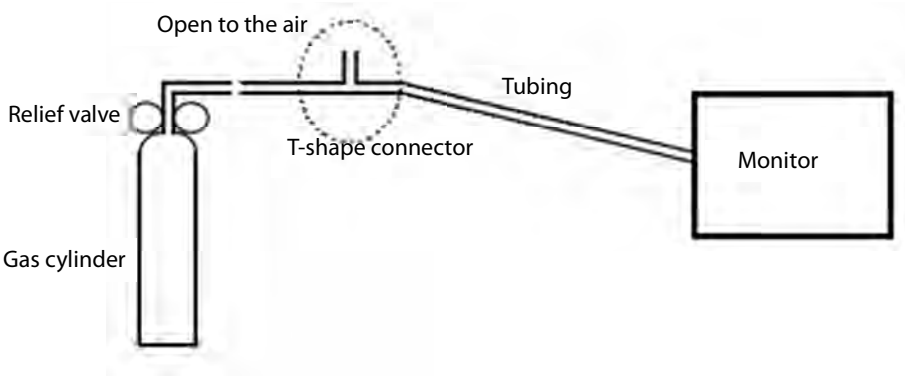
NOTE

- **When testing a particular gas in a mixture, only the concentration of the gas to be tested needs to meet the requirements.**
- **Handle the gas cylinder by following the instructions on the gas cylinder.**

Follow this procedure to perform the test:

1. Plug the AG module into the module rack.
2. Wait at least 10 min and then perform a leakage test to make sure the airway has no leakage.
3. Check if the fan inside the AG module works correctly.

4. Connect the test system as follows:



5. Open the relief valve and vent a standard gas and make sure that there is an excess gas flow through the T-shape connector to air. And wait for at least 30 seconds until the gas reading stable.
6. Check that the concentration of each composition meets the specification stated in the Operator's Manual.

⚠WARNING

- **When performing AG accuracy test, be sure to dispose of exhaust gas properly.**

39.7.3 AG Calibration

Calibrate the AG module every year or when the measured value is outside the specification.

Tools required:

- Gas cylinder with a certain standard gas or standard gas mixture. Gas concentration should meet the following requirements respectively: AA≥1.5%, CO2≥1.5%, N2O≥40%, O2≥40%, of which AA represents an anaesthetic agent. The gas concentration accuracy should have a tolerance as follows: AA±0.15%, CO2±0.1%, N2O±1%, O2±1%.
- T-shape connector
- Tubing

NOTE

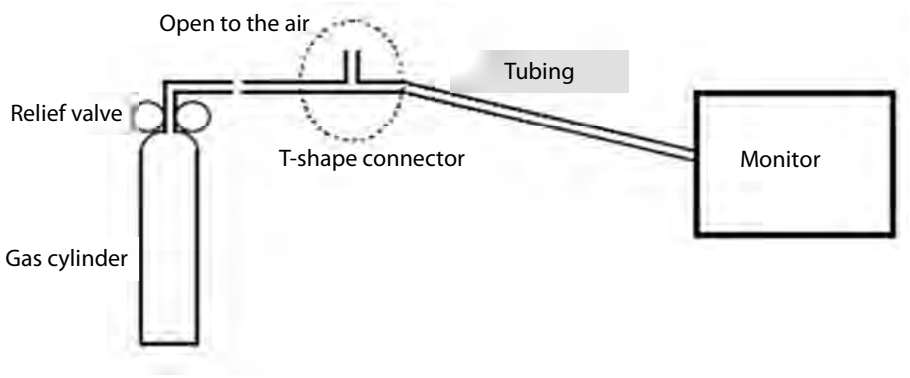
- **When calibrating a particular gas in a mixture, only the concentration of the gas to be calibrated needs to meet the requirements.**
- **Handle the gas cylinder by following the instructions on the gas cylinder(s).**

Follow this procedure to perform the AG calibration:

1. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password→[**Module Maintenance >>**]→[**Calibrate AG >>**].
2. Check the airway and make sure that there are no occlusions or leaks.

- Vent the sampling tubing to the air and check if the [**Current FlowRate**] and [**SetFlowRate**] are approximately the same. If the deviation is great, it indicates that there is an occlusion in the tubing. Check the tubing for an occlusion.
- Perform a leakage test to make sure that the airway has no leakage.

3. Connect the test system as follows:



4. Open the relief valve and vent a certain standard gas or gas mixture and make sure that there is an excess gas flow through the T-shape connector to air. And wait for at least 30 seconds until the gas reading stable.
5. In the [**Calibrate AG**] menu, the concentration of each measured gas and flow rate are displayed.
   - If the difference between the measured gas concentration and the actual one is within the tolerances in the user manual, a calibration is not needed.
   - If the difference for one gas composition or more gas compositions is outside of the stated tolerances, a calibration for one gas composition or more gas compositions should be performed. Select [**Calibrate >>**] to enter the calibrate menu.
6. Enter the vented gas concentration(s) for one gas composition or more gas compositions which needs calibration. If only one gas composition in gas mixture is to be calibrated i.e. CO_2 only, set the concentration of the other gases to 0.
7. Select [**Start**] to start a calibration.
8. If the calibration is finished successfully, the message [**Calibration Completed!**] is displayed. If the calibration failed, the message [**Calibration Failed!**] is displayed. Perform another calibration.

After the calibration finished, an accuracy test should be performed according to the Accuracy Test chapter. If one gas composition of the gas mixture is outside of the stated tolerances, please perform the calibration for the gas which reading is out of stated tolerances by using the calibration gas cylinder or another calibration gas cylinder following the instruction of Calibration chapter again.

⚠WARNING

- **When performing AG calibration, be sure to dispose of exhaust gas properly.**

⚠CAUTION

- **Calibrate the AG module, if it has been transported for a long distance or not used for a prolonged period of time.**

- **Calibrate the AG module, if the module was subject to physical impact damage i.e. dropped etc. or when the measured value(s) has a great deviation.**
- **It is not recommended to calibrate the anaesthetic agents (Halothane, Isoflurane, Enflurane, Sevoflurane and Desflurane) for AG user calibration. If the gas measurement reading for anaesthetic agents is outside the specification please contact Mindray Medical for advice.**

NOTE

- **For measurement of O_2 concentration more than 80%, it recommends to use gas cylinder with 100% O_2 to do the O_2 calibration again.**

39.8 Checking NMT Sensor

NMT sensor check is required once a year or when you doubt the measured values.

To calibrate the NMT transducer,

1. Select [**Main Menu**]→ [**Maintenance >>**]→ [**User Maintenance >>**]→ enter the required password→[**NMT Sensor Check >>**].
2. Follow the on-screen instructions to check the NMT sensor in four ways.

If sensor check completes successfully, the message "Test passed. The function of NMT sensor is OK" is presented. If any of the four steps fails, check if the sensor is placed correctly as instructed, and does the sensor check again. Replace the sensor or contact your service personnel if you cannot pass the sensor check.

NOTE

- **Stop NMT measurement or calibration before starting NMT sensor check.**
- **Take care to handle the the NMT sensor, avoiding rough impact.**

39.9 Calibrating the Touchscreen

1. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance >>**]→enter the required password→[**Cal. Touchscreen**].
2.  will, in turn, appear at different positions of the screen.
3. Select each  as it appears on the screen.
4. After the calibration is completed, the message [**Screen Calibration Completed!**] is displayed. Select [**Ok**] to confirm the completion of the calibration.

39.10 Electrical Safty Tests

Refer to ***E Electrical Safty Inspection***.

39.11 Setting up IP Address

1. Select [**Main Menu**]→[**Maintenance >>**]→[**User Maintenance** >>]→enter the required password→[**Network Setup >>**] and then select [**Monitor Network Setup >>**] from the popup menu.
2. If your monitor is equipped with a wireless AP, you can set [**Network Type**] to [**WLAN**] in the [**Monitor Network Setup**] menu. Otherwise, the default setting is [**LAN**].
3. Set [**IP Address**].

If the patient monitor is connected to a CMS, its IP address should be set up. The user should not change the patient monitor's IP address randomly. If you want to know details about IP address setup, contact the technical personnel in charge of the CMS.

39.12 Entering/Exiting Demo Mode

To enter the Demo mode:

1. Select [**Main Menu**]→[**Maintenance >>**].
2. Select [**Demo >>**]. Enter the required password and then select [**Ok**].

To exit the Demo mode:

1. Select [**Main Menu**]→[**Maintenance >>**].
2. Select [**Exit Demo**] and then select [**Ok**].
3. The patient monitor exits the Demo mode.

WARNING

- **The Demo mode is for demonstration purpose only. To avoid that the simulated data are mistaken for the monitored patient's data, you must not change into Demo mode during monitoring. Otherwise, improper patient monitoring and delayed treatment could result.**

40 Accessories

The accessory material that contacts the patients has undertaken the bio-compatibility test and is verified to be in compliance with ISO 10993-1. For details about the accessories, refer to the instructions for use provided with the accessory.

⚠WARNING

- **Use accessories specified in this chapte r. Using other accessories may cause damage to the patient monitor or not meet the claimed specifications.**
- **Single-use accessories are not designed to be reused. Reuse may cause a risk of contamination and affect the measurement accuracy.**
- **Check the accessories and their packages for any sign of damage. Do not use them if any damage is detected.**
- **Use the accessories before the expiry date if their expiry date is indicated.**
- **The disposable accessories shall be disposed of according to hospital's regulations.**

40.1 ECG Accessories

ECG Electrodes

Model	Quantity	Patient Category	Part No.
210	10 pieces	Adult	0010-10-12304
2245	50 pieces	Pediatric	9000-10-07469
H124SG	3 pieces	Neonate	900E-10-04880

12-Pin Trunk Cables

Leadwire supported	Compatible with	Type	Patient Category	Part No.
3-leadwire	AHA, IEC	Defibrillation-proof	Pediatric, neonate	0010-30-42720
3-leadwire	AHA, IEC	ESU-proof		0010-30-42724
3/5-leadwire	AHA, IEC	Defibrillation-proof	Adult, pediatric	0010-30-42719
3/5-leadwire	AHA, IEC	Defibrillation-proof		009-004728-00
3/5-leadwire	AHA, IEC	ESU-proof		0010-30-42723
10-leadwire	AHA	Defibrillation-proof		0010-30-42721
10-leadwire	IEC	Defibrillation-proof		0010-30-42722

Cable Sets

3-Electrode Cable Sets						
Type	**Compatible with**	**Model**	**Patient Category**	**Part No.**	**Length**	**Remark**
Clip	IEC	EL6304A	Adult, pediatric	0010-30-42732	1m	Long
		EL6306A	Neonate	0010-30-42897	1m	Long
	AHA	EL6303A	Adult, pediatric	0010-30-42731	1m	Long
		EL6305A	Neonate	0010-30-42896	1m	Long
Snap	IEC	EL6302B	Adult, pediatric	0010-30-42733	1m	Long
	AHA	EL6301B	Adult, pediatric	0010-30-42734	1m	Long

5-Electrode Cable Sets						
Type	**Compatible with**	**Model**	**Patient Category**	**Part No.**	**Length**	**Remark**
Clip	IEC	EL6502A	Adult, pediatric	0010-30-42728	0.6m	/
		EL6504A		0010-30-42730	1m to 1.4m	Long
	AHA	EL6501A		0010-30-42727	0.6m	/
		EL6503A		0010-30-42729	1m to 1.4m	Long
Snap	IEC	EL6502B		0010-30-42736	1.4m for F and N; 1m for others	Long
				009-004730-00		
	AHA	EL6501B		0010-30-42735	1.4m for RL and LL; 1m for others	Long
				009-004729-00		

10-Electrode Cable Sets						
Type	**Compatible with**	**Model**	**Patient Category**	**Part No.**	**Length**	**Remark**
Clip	IEC	EL6802A	Adult, pediatric	0010-30-42903	0.8m	Limb
		EL6804A		0010-30-42905	0.6m	Chest
	AHA	EL6801A		0010-30-42902	0.8m	Limb
		EL6803A		0010-30-42904	0.6m	Chest
Snap	IEC	EL6802B	Adult, pediatric	0010-30-42907	0.8m	Limb
		EL6804B		0010-30-42909	0.6m	Chest
	AHA	EL6801B		0010-30-42906	0.8m	Limb
		EL6803B		0010-30-42908	0.6m	Chest

40.2 SpO_2 Accessories

Extension Cable

Module type	Remarks	Part No.
Mindray SpO_2 Module	/	0010-20-42710
	7 pins	009-004600-00
Masimo SpO_2 Module	8 pins, purple connector	040-000332-00
	7 pins, white connector	0010-30-42738
Nellcor SpO_2 Module	/	0010-20-42712

SpO_2 Sensors

The SpO_2 sensor material that patients or other staff will come into contact with have undertaken the bio-compatibility test and is verified to be in compliance with ISO 10993-1.

Mindray SpO_2 Module				
Type	**Model**	**Patient Category**	**Part No.**	**Application Site**
Disposable	MAXAI	Adult (>30Kg)	0010-10-12202	Finger
	MAXPI	Pediatric (10 to 50Kg)	0010-10-12203	Finger
	MAXII	Infant (3 to 20Kg)	0010-10-12204	Toe
	MAXNI	Neonate (<3Kg) Adult (>40Kg)	0010-10-12205	Foot Finger
	520A	Adult	520A-30-64101	Finger
	520A		009-005087-00	
	521A		009-005091-00	
	520P	Pediatric	520P-30-64201	Finger
	520P		009-005088-00	
	521P		009-005092-00	
	520I	Infant	520I-30-64301	Toe
	520I		009-005089-00	
	521I		009-005093-00	
	520N	Neonate	520N-30-64401	Foot
	520N		009-005090-00	
	521N		009-005094-00	
Reusable	DS-100A	Adult	9000-10-05161	Finger
	OXI-P/I	Pediatric, infant	9000-10-07308	Finger
	OXI-A/N	Adult Neonate	9000-10-07336	Finger Foot
	518B	Adult Pediatric Neonate	518B-30-72107	Finger Finger Foot
	512E	Adult (Finger type)	512E-30-90390	Finger
	512E		115-027653-00	
	512F		512F-30-28263	
	512G	Pediatric (Finger type)	512G-30-90607	Finger
	512H		512H-30-79061	

Masimo SpO_2 Module				
Type	**Model**	**Patient Category**	**Part No.**	**Application Site**
Disposable	LNCS-NeoPt-L	Pediatric Neonate	0010-10-42626	Finger Foot
	LNCS-Neo-L	Neonate	0010-10-42627	Foot
	LNCS-Inf-L	Infant	0010-10-42628	Toe
	LNCS-Pdt	Pediatric	0010-10-42629	Finger
	LNCS-Adt	Adult	0010-10-42630	Finger
Reusable	LNCS DC-I	Adult	0010-10-42600	Finger
	LNCS-DCIP	Pediatric	0010-10-42634	Finger
	LNCS YI	Adult Pediatric Neonate	0010-10-43016	Finger Finger Foot

Nellcor SpO_2 Module				
Type	**Model**	**Patient Category**	**Part No.**	**Application Site**
Disposable	MAXAI	Adult (>30Kg)	0010-10-12202	Finger
	MAXPI	Pediatric (10 to 50Kg)	0010-10-12203	Finger
	MAXII	Infant (3 to 20Kg)	0010-10-12204	Toe
	MAXNI	Neonate (<3Kg) Adult (>40Kg)	0010-10-12205	Foot Finger
Reusable	DS-100A	Adult	9000-10-05161	Finger
	OXI-P/I	Pediatric Infant	9000-10-07308	Finger Toe
	OXI-A/N	Adult Neonate	9000-10-07336	Finger Foot

- Wavelength emitted by the sensors is between 600 nm and 1000 nm.
- The maximum photic output consumption of the sensor is less than 18 mW.

The information about the wavelength range and maximum photic output consumption can be especially useful to clinicians (for example, when photodynamic therapy is performed).

40.3 NIBP Accessories

Tubing

Type	Patient Category	Part No.
Reusable	Adult, pediatric	6200-30-09688
	Neonate	6200-30-11560

Reusable Cuff

Model	Patient Category	Measurement Site	Limb Circumference (cm)	Bladder Width (cm)	Part No.
CM1201	Infant	Arm	10 to 19	9.2	0010-30-12157
CM1202	Pediatric		18 to 26	12.2	0010-30-12158
CM1203	Adult		24 to 35	15.1	0010-30-12159
CM1204	Large adult		33 to 47	18.3	0010-30-12160
CM1205	Thigh	Thigh	46 to 66	22.5	0010-30-12161
CM1300	Small infant	Arm	7 to 13	5.8	040-000968-00
CM1301	Infant		10 to 19	9.2	040-000973-00
CM1302	Pediatric		18 to 26	12.2	040-000978-00
CM1303	Adult		24 to 35	15.1	040-000983-00
CM1304	Large adult		33 to 47	18.3	040-000988-00
CM1305	Adult	Thigh	46 to 66	22.5	040-000993-00
CM1306	Adult	Arm	24 to 35	15.1	115-015930-00
CM1307	Large adult	Arm	33 to 47	18.3	115-015931-00

Disposable Cuff

Model	Patient Category	Measurement Site	Limb Circumference (cm)	Bladder Width (cm)	Part No.
CM1500A	Neonate	Arm	3.1 to 5.7	2.2	001B-30-70692
CM1500B			4.3 to 8.0	2.9	001B-30-70693
CM1500C			5.8 to 10.9	3.8	001B-30-70694
CM1500D			7.1 to 13.1	4.8	001B-30-70695
CM1501	Infant		10 to 19	7.2	001B-30-70697
CM1502	Pediatric		18 to 26	9.8	001B-30-70698
CM1503	Adult		25 to 35	13.1	001B-30-70699
CM1504	Large adult		33 to 47	16.5	001B-30-70700
CM1505	Adult	Thigh	46 to 66	20.5	001B-30-70701
CM1506	Adult	Arm	25 to 35	13.1	115-016969-00
CM1507	Adult		33 to 47	16.5	115-016709-00
M1872A	Neonate		7.1 to 13.1	5.1	900E-10-04873
M1870A			5.8 to 10.9	4.3	900E-10-04874
M1868A			4.3 to 8.0	3.2	900E-10-04875
M1866A			3.1 to 5.7	2.5	900E-10-04876

40.4 Temp Accessories

Extension Cable

Type	Model	Temp probe	Part No.
Reusable	MR420B	MR411, MR412	0011-30-37391

Temp Probes

Type	Model	Patient Category	Measurement Site	Part No.
Reusable	MR401B	Adult	Esophageal/Rectal	0011-30-37392
	MR403B		Skin	0011-30-37393
	MR402B	Pediatric, neonate	Esophageal/Rectal	0011-30-37394
	MR404B		Skin	0011-30-37395
Disposable	MR411	Adult, pediatric, neonate	Esophageal/Rectal	0011-30-37398
	MR412		Skin	0011-30-37397

40.5 IBP/ICP Accessories

Accessories Kit No.	Components	Part No.
6800-30-50876 (Hospira)	IM2201 12Pin IBP Cable	001C-30-70759
	Disposable Transducer	0010-10-42638
	Steady Rest for IBP Transducer and Clamp	M90-000133---
	Steady Rest for IBP Transducer and Clamp	M90-000134---
6800-30-50877 (BD)	IM2202 12Pin IBP Cable	001C-30-70757
	Disposable Pressure Transducer	6000-10-02107
	Transducer/Manifold Mount	0010-10-12156
115-020884-00 (Mindray)	IBP accessory kit, 12 pin	/
ICP		
Model	**Material**	**Part No.**
Gaeltec TYPE.S13	12Pin ICP cable	0010-30-42742
Gaeltec ICT/B	Intracranial Pressure Transducer	0010-10-12151
/	ICP cable kit (connecting Camino monitor)	115-025257-00
82-6653	ICP sensor kit, disposable	040-002336-00

It is proved through tests that the following accessories are compatible with the patient monitor. Only the accessories proceeded by "*" are available from our company. If you want to purchase other accessories, contact respective manufacturers and make sure if these accessories are approved for sale in local.

Manufacturer	Accessories
Smith Medical (Medex)	MX961Z14 Logical Cable, to be used in connection with the Adapter Cable (0010-20-42795) MX960 Reusable Transducer Kit MX9605A Logical 84in(213cm) Single Monitoring Kit MX960 Logical Tranducer Mounting Plate MX261 Logical Clamp For Transducer Bracket MX262 Logical Clamp For 2 Transducer Mount Plates (More Logical Clamps are available from Medex. For detailed information, contact Medex.)
Braun	IBP Reusable Cable (REF: 5203511), to be used in connection with the Adapter Cable (0010-20-42795) Combitrans Monitoring Set (contact Braun for detailed information) Combitrans Attachment Plate Holder (REF:5215800) Combitrans Attachment Plate (contact Braun for detailed information)
Memscap	*Truck cable (0010-21-43082) SP844 Physiological Pressure Transducer 844-26 Monitoring Line Set 84X-49 Mounting Bracket
Utah	Reusable Blood Pressure Monitor Interface Cable (REF: 650-206) Deltran Disposable Pressure Transducer System (More Deltran sensors are available from Utah. For detailed information, contact Utah.) Pole Mount Unit (ERF: 650-150) Deltran Three Slot Organizer, Attaches to I.V. Pole Mount (REF: 650-100) Deltran Four Slot Organizer, Attaches to I.V. Pole Mount (REF: 650-105)
Edwards	* IBP Truwave Reusable Cable (0010-21-12179) Pressure Monitoring Kit With Truwave Disposable Pressure Transducer. (More Truwave sensors are available from Edwards. For detailed information, contact Edwards.) DTSC IV Pole Clamp for Model DTH4 Backplate Holder DTH4 Disposable Holder for DPT

40.6 C.O. Accessories

Model	Material	Part No.
COC-001-SL	12Pin C.O. cable.	0010-30-42743
SP4042	TI Sensor	6000-10-02079
SP5045	TI Sensor Housing	6000-10-02080
MX387	12CC Control Syringe W/1CC Stop W/Rotator	6000-10-02081
131HF7	Dilution Hose	6000-10-02183
9850A	Cable kit with TI Sensor	0012-00-1519

40.7 CCO/SvO_2 Accessories

Material	PN
CCO/SvO_2 cable	009-000259-00

40.8 CO_2 Accessories

Sidestream CO_2 module

Material	Patient Category	Remark	Part No.
DRYLINE Watertrap	Adult, pediatric	Reusable	9200-10-10530
DRYLINE Watertrap	Neonate		9200-10-10574
DRYLINE Ⅱ Water Trap	Adult, pediatric		100-000080-00
DRYLINE Ⅱ Water Trap	Neonate		100-000081-00
Sampling Line, Adult 2.5m	Adult, pediatric	Disposable	9200-10-10533
Sampling Line, Neonate, 2.5m	Neonate		9200-10-10555
Adult Nasal CO_2 Sample Cannula	Adult		M02A-10-25937
Pediatric Nasal CO_2 Sample Cannula	Pediatric		M02A-10-25938
Infant Nasal CO_2 Sample Cannula	Infant		M02B-10-64509
DRYLINE Airway Adapter	Adult, pediatric	Disposable, straight	9000-10-07486
DRYLINE Airway Adapter	Neonate		040-001187-00
DRYLINE Airway Adapter	Adult, pediatric	Disposable, elbow	9000-10-07487

Microstream CO_2 Module

Disposable Airway Sampling Line			
Model	**Patient Category**	**Remark**	**Part No.**
XS04620	Adult, pediatric	/	0010-10-42560
XS04624		Humidified	0010-10-42561
007768		Long	0010-10-42563
007737		Long, humidified	0010-10-42564
006324	Infant, Neonate	Humidified	0010-10-42562
007738		Long, humidified	0010-10-42565

Disposable Nasal Sampling Line			
Model	**Patient Category**	**Remark**	**Part No.**
009818	Adult, intermediate	/	0010-10-42566
009822		Plus O_2	0010-10-42568
009826		Long, plus O_2	0010-10-42570
008174	Adult	/	0010-10-42577
008177		Humidified	0010-10-42572
008180		Humidified, plus O_2	0010-10-42575
007266	Pediatric	/	0010-10-42567
008175		/	0010-10-42578
008178		Humidified	0010-10-42573
008181		Humidified, plus O_2	0010-10-42576
007269		Plus O_2	0010-10-42569
007743		Long, plus O_2	0010-10-42571
008179	Infant, Neonate	Humidified	0010-10-42574

Mainstream CO_2 Module

Material	Model	Patient Category	Remark	Part No.
Airway adapter	6063	Adult	Disposable	0010-10-42662
	6421		Disposable, with mouthpiece	0010-10-42663
	6312	Neonate	Disposable	0010-10-42664
Mask	9960STD	Adult	/	0010-10-42670
	9960LGE		Adult large	0010-10-42671
	9960PED	Pediatric	/	0010-10-42669
Cable management straps	/	/	/	0010-10-42667
Sensor holding clips	/	/	/	0010-10-42668
Sensor	/	Adult, pediatric, neonate	Reusable	6800-30-50760

40.9 AG Accessories

Material	Patient Category	Remark	Part No.
DRYLINE Ⅱ Water Trap	Adult, pediatric	Reusable	100-000080-00
	Neonate		100-000081-00
Sampling line	Adult, pediatric	Disposable	9200-10-10533
	Neonate		9200-10-10555
Airway adapter	Adult, pediatric, neonate	Disposable, straight	9000-10-07486
	Adult, pediatric, neonate	Disposable, elbow	9000-10-07487
	Neonate	Disposable, straight	040-001187-00

40.10 ICG Accessories

Material	Model	Part No.
ICG patient cable (normal)	N1301-3	100-000149-00
ICG patient cable (inverted)	N1301-4	100-000150-00
ICG sensor	N1201	100-000148-00

40.11 BIS Accessories

Material	Patient Category	Part No.
BIS Cable	Adult, pediatric	6800-30-50761
BISx4 Cable	Adult, pediatric	115-005707-00

*If you need to purchase BIS Quatro, Pediatric, SRS, and CLICK sensors, please contact Covidien.

40.12 RM Accessories

Material	Patient Category	Model	Part No.	Remark
Flow sensor	Adult	MR4412	040-001947-00	Disposable, 1.8 m
	Adult	MR4413	040-001949-00	Disposable, 3.3m
	Pediatric, neonate	MR4414	040-001948-00	Disposable, 1.8m
	Pediatric, neonate	MR4415	040-001950-00	Disposable, 3.3m

40.13 PiCCO Accessories

Material	Model	Part No.	Remark
12Pin IBP Y Cable	IM2203	040-000815-00	/
12Pin PiCCO Cable	CO7701	040-000816-00	/
2Pin Injectate Temperature Sensor Cable	040-000436-00	040-000817-00	/
Arterial Thermodilution Catheter	PV2015L20	/	Contact, germfree
	PV2013L07	/	Contact, germfree
PiCCO Monitoring Kits	PV8115	/	Contact, germfree

40.14 $ScvO_2$ Accessories

Material	Part No.	Remark
8Pin $ScvO_2$ Module and Cable	115-008191-00	/
CeVOX Probe	/	Contact, germfree
	/	Contact, germfree

40.15 BeneLink Accessories

Material	Part No.
ID Adapter	115-008545-00
Serial port adapting cable, type A	009-001767-00
Serial port adapting cable, type B	009-001768-00
Serial port adapting cable, type C	009-001769-00
Serial port adapting cable, type D	009-002943-00
RJ45 connecting cable	009-001770-00

40.16 EEG Accessories

EEG Cable

Material	Patient Category	Part No.
EEG Patient cable	Adult, Pediactic, Neonate	040-001594-00

EEG Electrodes

Material	Patient Category	Remark	Part No.
EEG accessory kit (Needle electrode)	Adult, Pediactic	Disposable	115-018153-00
EEG accessory kit, with 10mm Ag/AgCl (Cup electrode)	Adult, Pediactic	Reusable	115-018154-00
EEG accessory kit, with 6 mm Ag/AgCl (Cup electrode)	Pediactic ,Neonate	Reusable	115-018155-00

40.17 NMT Accessories (for Mindray NMT module)

Material	Model	Part No.
NMT cable	NM13101	040-001462-00
NMT sensor cable	NM13401	040-001463-00
NMT stimulation cable	NM13701	040-001464-00
ECG electrode	2245-50	9000-10-07469
Bandage for NMT sensor	/	040-002258-00

40.18 Others

Material	Part No.
Lithium battery, LI23S002A	M05-010002-06
	022-000008-00
Power cord (India)	0000-10-10903
Power cord (America)	DA8K-10-14452
Three-wire power cord (Britain)	DA8K-10-14453
Three-wire power cord (Europe)	DA8K-10-14454
Grounding cable	1000-21-00122
Defibrillator synchronization cable	6800-20-50781
Nurse call cable (≤60W, ≤2A, ≤36VDC, ≤25VAC)	009-003436-00
Satellite module rack wall mount bracket	0010-30-42867
Keyboard wall mount bracket	0010-30-42868
Main unit wall mount bracket	0010-30-42955
Display wall mount bracket	0010-30-42956
Roll stand	0010-30-42943
Trolley-Mount Bracket	0010-30-42944
DVI-VGA adapter box	115-004861-00
Cable protecting tube	009-003648-00
Accessories management tape	009-003903-00
Barcode scanner	023-001158-00
Display, 19"	023-001129-00

FOR YOUR NOTES

A Product Specifications

NOTE

- **For the specifications of BeneView T1, refer to BeneView T1 Operating Manual.**

A.1 Monitor Safety Specifications

A.1.1 Classifications

The patient monitor is classified, according to IEC60601-1:

Components	Degree of protection against electrical shock	Type of protection against electrical shock	Degree of protection against harmful ingress of water	Degree of protection against hazards of explosion	Mode of operation
Main unit	Not marked	I	IPX1	Not suitable	Continuous
Secondary display	Not marked				
MPM	CF(*)	NA			
IBP module					
SpO_2 module					
Temp module					
C.O. module					
PiCCO module					
NMT module					
EEG module					
BIS module	BF(*)				
AG module					
CO_2 module					
ICG module					
RM module					
$ScvO_2$ module					
BeneLink module	Not marked				
SMR	Not marked				
CCO/SvO_2 module	Not marked				

- I: Class I equipment
- BF: Type BF applied part. (*Defibrillator-proof protection against electric shock.)
- CF: Type CF applied part. (*Defibrillator-proof protection against electric shock.)
- NA: Not applicable
- IPX1: Protection against vertically falling water drops.

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

A.1.2 Environmental Specifications

WARNING

- **The equipment may not meet the performance specifications if stored or used outside the specified temperature and humidity ranges.**

NOTE

- **The environmental specification of unspecified parameter modules are the same as those of the main unit.**

Main unit		
Item	**Operating conditions**	**Storage conditions**
Temperature (°C)	0 to 40	-20 to 60
Relative humidity (noncondensing)	15% to 95%	10% to 95%
Barometric (mmHg)	427.5 to 805.5	120 to 805.5

Microstream CO_2 module		
Item	**Operating conditions**	**Storage conditions**
Temperature (°C)	0 to 40	-20 to 60
Relative humidity (noncondensing)	15% to 95%	10% to 95%
Barometric (mmHg)	430 to 790	430 to 790

Sidestream CO_2 module		
Item	**Operating conditions**	**Storage conditions**
Temperature (°C)	5 to 40	-20 to 60
Relative humidity (noncondensing)	15% to 95%	10% to 95%
Barometric (mmHg)	430 to 790	430 to 790

Mainstream CO_2 module		
Item	**Operating conditions**	**Storage conditions**
Temperature (°C)	0 to 40	-20 to 60
Relative humidity (noncondensing)	10% to 90%	10% to 90%
Barometric (mmHg)	427.5 to 805.5	400 to 805.5

AG module		
Item	**Operating conditions**	**Storage conditions**
Temperature (°C)	10 to 40	-20 to 60
Relative humidity (noncondensing)	15% to 95%	10% to 95%
Barometric (mmHg)	525 to 805.5	525 to 805.5

RM module		
Item	**Operating conditions**	**Storage conditions**
Temperature (ºC)	5 to 40	-20 to 60
Relative humidity (noncondensing)	15% to 95%	10% to 95%
Barometric (mmHg)	427.5 to 805.5	120 to 805.5

ICG module		
Item	**Operating conditions**	**Storage conditions**
Temperature (ºC)	10 to 40	0 to 50
Relative humidity (noncondensing)	15% to 95%	15% to 95%
Barometric (mmHg)	427.5 to 805.5	120 to 805.5

PiCCO module		
Item	**Operating conditions**	**Storage conditions**
Temperature (ºC)	10 to 40	-20 to 60
Relative humidity (noncondensing)	15% to 75%	10% to 90%
Barometric (mmHg)	427.5 to 805.5	120 to 805.5

$ScvO_2$ module		
Item	**Operating conditions**	**Storage conditions**
Temperature (ºC)	10 to 40	-20 to 60
Relative humidity (noncondensing)	15% to 75%	10% to 90%
Barometric (mmHg)	427.5 to 805.5	120 to 805.5

A.1.3 Power requirements

Line voltage	100 to 240 VAC
Current	2.5 to 1.4 A (BeneView T5) 2.8 to 1.6 A (BeneView T8/BeneView T9)
Frequency	50/60 Hz
Fuse	Time-lag 250V T3.15A (BeneView T5) Time-lag 250V T4A (BeneView T8/BeneView T9)

A.2 Physical Specifications

Components	Weight	Size	Equipment type
Main unit (BeneView T5)	<6.6 kg	297×336×187 mm	Without modules, batteries, and recorder
Main unit (BeneView T8)	<9.9 kg	400×370×193 mm	Without modules, batteries, and recorder
Main unit (BeneView T9)	<12 kg	435×404×202.5 mm	Without modules, batteries, and recorder
SMR	<1.8 kg	142×402×151 mm	With no module inserted
MPM	<0.63 kg	136.5×80.5×102 mm	
SpO_2 module	<0.26 kg	136.5×40×102 mm	
Temp module	<0.24 kg	136.5×40×102 mm	

Components	Weight	Size	Equipment type
IBP module	<0.25 kg	136.5×40×102 mm	
C.O. module	<0.25 kg	136.5×40×102 mm	
Sidestream CO_2 module(2 slots)	<0.48 kg	136.5×80.5×102 mm	
Sidestream CO_2 module(1 slot)	<0.60 kg	136.5×40×102 mm	
Microstream CO_2 module	<0.37 kg	136.5×40×102 mm	
Mainstream CO_2 module	<0.50 kg	136.5×40×102 mm	
AG module	<1.03 kg	136.5×80.5×102 mm	Without O_2 and BIS modules
AG module	<1.15 kg	136.5×80.5×102 mm	With O_2 and BIS modules
AG module	<1.03 kg	136.5×80.5×102 mm	With O_2 module
ICG module	<0.30 kg	136.5×40×102 mm	
BIS module	<0.25 kg	136.5×40×102 mm	
RM module	<0.38 kg	136.5×40×102 mm	
CCO/SvO_2 module	<0.25 kg	136.5×40×102 mm	
PiCCO Module	<0.28 kg	136.5×40×102 mm	
$ScvO_2$ Module	<0.26 kg	136.5×40×102 mm	
BeneLink Module	<0.35kg	136.5×40×102 mm	
EEG Module	<0.25kg	136.5×40×102 mm	
NMT module	<0.30 kg	136.5×40×102 mm	

A.3 Hardware Specifications

A.3.1 Display

Host display	
Screen type	Color TFT LCD
Screen Size (diagonal)	12.1"(BeneView T5); 17"(BeneView T8); 19"(BeneView T9)
Resolution	800×600 pixels(BeneView T5); 1280×1024 pixels(BeneView T8/BeneView T9)
External display	
Screen type	Medical-grade TFT LCD
Screen Size	15", 17" 19" (BeneView T5) 17", 19" (BeneView T8/BeneView T9)
Resolution	800×600 pixels (BeneView T5); 1280×1024 pixels (BeneView T8/BeneView T9)
EMC	MPR II, CISPR 11B
Third certificate	UL, C-UL, TUV, CE, FCC

A.3.2 Recorder

Method	Thermal dot array
Horizontal resolution	16 dots/mm (25 mm/s paper speed)
Vertical resolution	8 dots/mm
Paper width	50 mm
Paper length	20 m
Paper speed	25 mm/s, 50 mm/s
Number of waveform channels	Maximum 3

A.3.3 Battery

Size	147.5×60.4×23.8 mm
Weight	350 g
Number of batteries	1 or 2 (BeneView T5); 2 (BeneView T8/ BeneView T9)
Battery Type	Chargeable Lithium-Ion
Voltage	11.1 VDC
Capacity	4500 mAh
Run time	BeneView T5: 330 minutes when powered by two new fully-charged batteries (25℃, ECG, SpO_2, Auto NIBP measurements at intervals of 15 minutes) BeneView T8/BeneView T9: 120 minutes when powered by two new fully-charged batteries (25℃, ECG, SpO_2, Auto NIBP measurements at intervals of 15 minutes)
Charge time	nearly 5.5 h to 90% nearly 6 h to 100%
Shutdown delay	at least 5 min (after a low battery alarm first occurs)

A.3.4 LEDs

Alarm lamp	1 (two color coded: yellow and red)
Technical alarm lamp	1 (blue)
Power on LED	1 (green)
AC power LED	1 (green)
Battery LED	1 (green)

A.3.5 Audio Indicator

Speaker	Give alarm tones (45 to 85 dB), key tones, QRS tones; support PITCH TONE and multi-level tone modulation; alarm tones comply with IEC60601-1-8.

A.3.6 Monitor Interface Specifications

Power	1 AC power input connector
Wired network	1 RJ45 connector, 100 Base-TX, IEEE 802.3(BeneView T5) 2 RJ45 connector, 100 Base-TX, IEEE 802.3(BeneView T8/BeneView T9)
USB	4 connectors, USB 1.1(BeneView T5) up to 10 connectors, USB 1.1(BeneView T8/BeneView T9)
SMR connector	1 connector, not standard USB
CF	50-pin CF revision 2.0 connector
Video interface	1 connector, standard DVI-D
Nurse call	1 connector, standard BNC
Equipotential Grounding Terminal	1
Micro-D connector	1 connector, It outputs ECG, IBP and defibrillator synchronization signals simultaneously
CIS box connector (BeneView T5)	1 connector, for connecting the CIS box.

A.3.7 Outputs

Auxiliary Output	
Standard	Meets the requirements of IEC60601-1 for short-circuit protection and leakage current
ECG Analog Output	
Bandwidth (-3dB; reference frequency: 10Hz)	Diagnostic mode: 0.05 to 150 Hz Monitor mode: 0.5 to 40 Hz Surgical mode: 1 to 20 Hz ST mode: 0.05 to 40 Hz
QRS delay	≤25 ms (in diagnostic mode, and non-paced)
Sensitivity	1V/mV ±5%
PACE rejection/enhancement	Pace enhancement Signal amplitude: Voh≥2.5V Pulse width: 10ms±5% Signal rising and falling time: ≤100μs
IBP Analog Output	
Bandwidth (-3dB; reference frequency:1Hz)	DC to 50 Hz
Max transmission delay	30 ms (with Notch off)
Sensitivity	1 V/100 mmHg ±5%
Nurse Call Signal	
Amplitude	High level: 3.5 to 5 V, providing a maximum of 10 mA output current; Low level: < 0.5 V, receiving a maximum of 5 mA input current.
Rising and falling time	⩽1 ms
Defib Sync Pulse	
Output impedance	≤100Ω
Max time delay	35 ms (R-wave peak to leading edge of pulse)
Amplitude	High level: 3.5 to 5 V, providing a maximum of 10 mA output current; Low level: < 0.5 V, receiving a maximum of 5 mA input current.
Pulse width	100 ms ±10%
Rising and falling time	≤1 ms
Digital video output (DVI-D connector)	
Video signals	Single Link TMDS
DDC signals	Signals 12C compliant
Alarm output (Network connector)	
Alarm delay time from BeneView patient monitor to remote equipment	The alarm delay time from the patient monitor to remote equipment is ≤2 seconds, measured at the BeneView signal output connector.

A.4 Data Storage

Trends	Trends: 120 hours, at 1 min resolution Mid-length trends: 8 hours, at 5 s resolution Minitrends: 1 hour, at 1 s resolution
Parameter alarms	100 alarms and manual events and related parameter waveforms. The waveform recording length can be 8s.
Arrh. events	100 arrhythmia events and relate waveforms and parameters. The waveform recording length can be 8s.
NIBP measurements	1000 sets
Interpretation of resting 12-lead ECG results	20 sets
Full-disclosure waveforms	48 hours at maximum. The specific storage time depends on the waveforms stored and the number of stored waveforms.

A.5 Wireless Network

Standards	WB45NBT Wireless Module: IEEE 802.11a/b/g/n, support Wi-Fi	
Operating frequency	IEEE 802.11b/g/n (2.4G): ETSI:2.4 GHz - 2.483 GHz FCC:2.4 GHz - 2.483 GHz MIC:2.4 GHz - 2.495 GHz KC:2.4 GHz - 2.483 GHz	IEEE 802.11a/n (5G): ETSI: 5 .15 GHz - 5.35 GHz, 5.47 GHz - 5.725 GHz FCC: 5 .15 GHz - 5.35 GHz, 5.47- 5.725 GHz， 5.725 GHz - 5.825 GHz MIC: 5.15 GHz - 5.35GH, 5.47- 5.725 GHz KC: 5 .15 GHz - 5.35 GHz, 5.47- 5.725 GHz, 5.725 GHz - 5.825 GHz
Output power	< 30 dBm (Peak Power) < 20 dBm (Average Power)	

A.6 Measurement Specification

The adjustable range of alarm limits is the same with the measurement range of signals unless otherwise specified.

A.6.1 ECG

ECG	
Standards	Meet standards of IEC60601-2-27 and IEC60601-2-25
Lead set	3-lead: I, II, III 5-lead: I, II, III, aVR, aVL, aVF, V 12-lead: I, II, III, aVR, aVL, aVF, V1 to V6
ECG standard	AHA, IEC
Display sensitivity	1.25 mm/mV (X0.125), 2.5 mm/mV (X0.25), 5 mm/mV (X0.5), 10 mm/mV (X1), 20 mm/mV (X2), 40 mm/mV (X4), Auto
Sweep speed	6.25 mm/s, 12.5 mm/s, 25 mm/s, 50 mm/s
Bandwidth (-3dB)	Diagnostic mode: 0.05 to 150 Hz Monitor mode: 0.5 to 40 Hz Surgical mode: 1 to 20 Hz ST mode: 0.05 to 40 Hz

Common mode rejection ratio (with Notch off)	Diagnostic mode:	>90 dB
	Monitor mode:	>105 dB
	Surgical mode:	>105 dB
	ST mode:	>105 dB(with Notch on)
Notch	50/60 Hz Monitor and surgical mode: Notch turns on automatically. Diagnostic mode: Notch is turned on/off manually	
Differential input impedance	≥5 MΩ	
Input signal range	±8 mV (peak-to-peak value)	
Accuracy of reappearing input signal	Use A and D methods based on IEC 60601-2-25 to determine frequency response.	
Electrode offset potential tolerance	±500 mV	
Lead-off detection current	Measuring electrode: <0.1 μA Drive electrode: <1 μA	
Input offset current	≤0.1 μA	
Defibrillation protection	Enduring 5000V (360 J) charge without data loss or corruption Baseline recovery time: <5 s (after defibrillation) Polarization recovery time: <10 s Defibrillation energy absorption: <10% (100Ω load)	
Patient leakage current	<10 uA	
Calibration signal	1mV (peak-to-peak value)	
ESU protection	Cut mode: 300 W Coagulate mode: 100 W Recovery time: ≤10 s In compliance with the requirements in clause 202.6.2.101 of IEC 60601-2-27	
Pace Pulse		
Pace pulse markers	Pace pulses meeting the following conditions are labelled with a PACE marker:	
	Amplitude:	±2 to ±700 mV
	Width:	0.1 to 2 ms
	Rise time:	10 to 100 μs
Pace pulse rejection	When tested in accordance with the IEC60601-2-27: 201.12.1.101.13, the heart rate meter rejects all pulses meeting the following conditions.	
	Amplitude:	±2 to ±700 mV
	Width:	0.1 to 2 ms
	Rise time:	10 to 100 μs
Sampling rate	500 samples/s (A/D) 500 samples/s (ECG algorithm)	
Accuracy	2.44μV/LSB	

Mindray algorithm

HR			
Measurement range	3-, 5-, and 12-lead ECG	Neonate: Pediatric: Adult:	15 to 350 bpm 15 to 350 bpm 15 to 300 bpm
Resolution	1 bpm		
Accuracy	3-, 5-, and 12-lead ECG: ±1 bpm or ±1%, whichever is greater.		
Sensitivity	200μV (lead II)		
HR averaging method	In compliance with the requirements in Clause 201.7.9.2.9.101 b) 3) of IEC60601-2-27, the following method is used: If the last 3 consecutive RR intervals are greater than 1200 ms, the 4 most recent RR intervals are averaged to compute the HR. Otherwise, heart rate is computed by subtracting the maximum and minimum ones from the most recent 12 RR intervals and then averaging them. The HR value displayed on the monitor screen is updated every second.		
Response to irregular rhythm	In compliance with the requirements in Clause 201.7.9.2.9.101 b) 4) of IEC60601-2-27, the heart rate after 20 seconds of stabilization is displayed as follows: Ventricular bigeminy (3a): -80±1 bpm Slow alternating ventricular bigeminy (3b): -60±1 bpm Rapid alternating ventricular bigeminy (3c): -120±1 bpm Bidirectional systoles (3d): -90±2 bpm		
Response time to heart rate change	Meets the requirements of IEC60601-2-27: Clause 201.7.9.2.9.101 b) 5). From 80 to 120 bpm: less than 11 s From 80 to 40 bpm: less than 11 s		
Time to alarm for tachycardia	Meets the requirements of 201.7.9.2.9.101 b) 6).		
	Waveform 4ah - range: 4a - range: 4ad - range: Waveform 4bh - range: 4b - range: 4bd - range:	 11 s 11 s 11 s 11 s 11 s 11 s	
Tall T-wave rejection capability	When the test is performed based on Clause 201.7.9.2.9.101 b) 2)of IEC60601-2-27, the heart rate meter will reject all 100 ms QRS complexes with less than 1.2 mV of amplitude, and T waves with T-wave interval of 180 ms and those with Q-T interval of 350 ms.		
Arrhythmia Analysis Classifications	Asystole, VFib/VTac, Vtac, Vent. Brady, Extreme Tachy, Extreme Brady, PVC, Couplet, Bigeminy, Trigeminy, R on T, Run PVCs, PVCs, Tachy, Brady, Missed Beats, Vent. Rhythm, PNP, PNC, Multif. PVC, Nonsus. Vtac, Pause, Irr. Rhythm., Afib		
ST Segment Analysis			
Measurement range	-2.0 to 2.0 mV		
Accuracy	-0.8 to 0.8 mV: ±0.02 mV or ±10%, whichever is greater.		

	Beyond this range: Not specified.
Refreshing rate	10 s
QT/QTc Analysis	
Measurement range	QT: 200 to 800 ms QTc: 200 to800 ms QT-HR: 15 to 150 bpm for adult, 15 to 180 bpm for pediatric and neonate
QT Accuracy	±30 ms
Resolution	QT: 4 ms QTc: 1 ms

Mortara algorithm

Only the differences from the Mindray algorithm are listed.

HR	
HR averaging method	In compliance with the requirements in Clause 201.7.9.2.9.101 b) 3) of IEC60601-2-27, the following method is used: Heart rate is computed by averaging the most recent 16 RR intervals, unless the HR by averaging the most recent 4 heart beats is less than or equals to 48. The HR value displayed on the monitor screen is updated every second.
Time to alarm for tachycardia	Meets the requirements of 201.7.9.2.9.101 b) 6). Waveform 4ah – range: 11 s 4a – range: 11 s 4ad – range: 11 s 4bh – range: 11 s 4b – range: 11 s 4bd – range: 11 s
Arrhythmia Analysis Classifications	Asystole, Vfib, Vtac, Vent. Rhythm, Couplet, Run PVCs, Bigeminy, Trigeminy, R on T, Multif. PVC, Irr. Rhythm, Tachy, Brady, Missed Beats, PNP, PNC
ST Segment Analysis	
Refreshing rate	per 16 heartbeats

Alarm limit	**Range**	**Step**
HR High	(low limit + 2) to 300 bpm	1 bpm
HR Low	15 to (high limit – 2) bpm	
ST High	(low limit +0.2) to 2.0 mV	0.1 mV
ST Low	-2.0 to (high limit – 0.2) mV	
QTc High	200 to 800 ms	10 ms
∆ QTc High	30 to 200 ms	

A.6.2 Resp

Technique	Trans-thoracic impedance	
Lead	Options are lead I and II. The default is lead II.	
Respiration excitation waveform	<300 μA RMS, ,62.8 kHz (±10%)	
Respiration impedance range	0.3 to 5Ω	
Baseline impedance range	200 to 2500Ω (using an ECG cable with 1kΩ resistance)	
Differential input impedance	>2.5 MΩ	
Bandwidth	0.2 to 2 Hz (-3 dB)	
Sweep speed	3mm/s, 6.25 mm/s, 12.5 mm/s, 25 mm/s or 50.0 mm/s	
Respiration Rate		
Measurement range	0 to 200 rpm	
Resolution	1 rpm	
Accuracy	0 to 120 rpm: ±1 rpm 121 to 200 rpm: ±2 rpm	
Apnea alarm time	10 s, 15 s, 20 s, 25 s, 30 s, 35 s, 40 s	
Alarm limit	**Range (rpm)**	**Step (rpm)**
RR High	Adult, pediatric: (low limit + 2) to 100 Neonate: (low limit + 2) to 150	1
RR Low	0 to (high limit – 2)	

A.6.3 SpO_2

Alarm limit	Range (%)	Step (%)
SpO_2 High	(low limit + 2) to 100	1
SpO_2 Low	Mindray, Masimo: Desat to (high limit – 2) Nellcor: Desat or 20 (whichever is greater) to (high limit – 2)	
Desat	0 to (high limit – 2)	

Mindray SpO_2 Module

Standards	Meet standards of ISO80601-2-61
*Measurement accuracy verification: The SpO_2 accuracy has been verified in human experiments by comparing with arterial blood sample reference measured with a CO-oximeter. Pulse oximeter measurement are statistically distributed and about two-thirds of the measurements are expected to come within the specified accuracy range compared to CO-oximeter measurements.	
Measurement range	0 to 100%
Resolution	1%
Response time	≤ 30 s (PI > 0.3, no disturbance, SpO_2 value sudden change within 70% - 100%)
Accuracy	70 to 100%: ±2% (adult/pediatric mode) 70 to 100%: ±3% (neonate mode) 0% to 69%: Not specified.

*Studies were performed to validate the accuracy of Pulse Oximeter with neonatal SpO_2 sensors by contrast with a CO-Oximeter. Some neonates aged from 1 day to 30 days with a gestation age of 22 weeks to full term were involved in this study. The statistical analysis of data of this study shows the accuracy (Arms) is within the stated accuracy specification. Please see the following table.

Sensor type	Totally neonates	Data	Arms
518B	97 (51 male & 46 female)	200 pairs	2.38%
520N	122 (65 male & 57 female)	200 pairs	2.88%

The Pulse Oximeter with neonatal SpO_2 sensors was also validated on adult subjects.	
Refreshing rate	≤ 2 s
SpO_2 averaging time	7 s (When the sensitivity is set to High) 9 s (When the sensitivity is set to Medium) 11 s (When the sensitivity is set to Low)

Masimo SpO_2 Module

SpO_2	
Measurement range	1 to 100%
Resolution	1%
Response time	≤ 20 s (PR 75 bpm, average time 8 s, SpO_2 value rises from 60% to 95%)
Accuracy[1]	70 to 100%: ±2% (measured without motion in adult/pediatric mode) 70 to 100%: ±3% (measured without motion in neonate mode) 70 to 100%: ±3% (measured with motion) 1% to 69%: Not specified.
Refreshing rate	≤ 2 s
SpO_2 averaging time	2-4 s, 4-6 s, 8 s, 10 s, 12 s, 14 s, 16 s
Low perfusion conditions	Pulse amplitude: >0.02% Light penetration: >5%
Low perfusion SpO_2 accuracy[2]	±2%

[1] The Masimo pulse oximeter with sensors have been validated for no motion accuracy in human blood studies on healthy adult volunteers in induced hypoxia studies in the range of 70% to 100% SpO_2 against a laboratory co-oximeter and ECG monitor. This variation equals plus or minus one standard deviation. Plus or minus one standard deviation encompasses 68% of the population. One percent was added to the accuracies for neonatal sensors to account for accuracy variation due to properties of fetal hemoglobin.
The Masimo pulse oximeter with sensors has been validated for motion accuracy in human blood studies on healthy adult volunteers in induced hypoxia studies while performing rubbing and tapping motions at 2 to 4 Hz. At an amplitude of 1 to 2 cm and non-repetitive motion between 1 to 5 Hz. At an amplitude of 2 to 3 cm in induced hypoxia studies in the range of 70% to 100% SpO_2 against a laboratory co-oximeter and ECG monitor. This variation equals plus or minus one standard deviation. Plus or minus one standard deviation encompasses 68% of the population.

[2] The Masimo pulse oximeter has been validated for low perfusion accuracy in bench top testing against a Biotek Index 2 simulator and Masimo's simulator with signal strengths of greater than 0.02% and a % transmission of greater than 5% for saturations ranging from 70 to 100%. This variation equals plus or minus one standard deviation. Plus or minus one standard deviation encompasses 68% of the population.

Nellcor SpO_2 Module

Measurement range	0 to 100%
Resolution	1%
Response time	≤ 30 s (PI > 0.3, no disturbance, SpO_2 value sudden change within 70% - 100%)
Accuracy	70 to 100%: ±2% (adult/pediatric) 70 to 100%: ±3% (neonate) 0% to 69%: Not specified.
When the SpO_2 sensor is applied for neonatal patients as indicated, the specified accuracy range is increased by ±1%, to compensate for the theoretical effect on oximeter measurements of fetal hemoglobin in neonatal blood.	

Information of the Test Subjects of the Clinical Study Report:

Skin color	Gender	Number	Age (years)	Health
Black	Male	1	28.2±9.19	Healthy
	Female	1		
Yellow	Male	3		
	Female	9		

A.6.4 PR

Alarm limit	Range (bpm)	Step (bpm)
PR High	(low limit +2) to 300	1
PR Low	15 to (high limit-2)	

PR from Mindray SpO_2 Module

Measurement range	20 to 300 bpm
Resolution	1 bpm
Response time	≤ 30 s (PI > 0.3, no disturbance, PR value sudden change within 25 – 250 bpm)
Accuracy	±3 bpm
Refreshing rate	1 s
SPO_2 averaging time	7 s (when sensitivity is set to High) 9 s (when sensitivity is set to Medium) 11 s (when sensitivity is set to Low)

PR from Masimo SpO_2 Module

Measurement range	25 to 240 bpm
Resolution	1 bpm
Response time	≤ 30 s (PI > 0.3, no disturbance, PR value sudden change within 25 – 240 bpm)
Accuracy	±3 bpm (measured without motion) ±5 bpm (measured with motion)
Refreshing rate	1 s
SPO_2 averaging time	2-4 s, 4-6 s, 8 s, 10 s, 12 s, 14 s, 16 s
Low perfusion conditions	Pulse amplitude: >0.02% Light penetration: >5%
Low perfusion PR accuracy	±3 bpm

PR from Nellcor SpO_2 Module

Measurement range	20 to 300 bpm
Resolution	1 bpm
Response time	≤ 30 s (PI > 0.3, no disturbance, PR value sudden change within 25 – 250 bpm)
Accuracy	20 to 250 bpm: ±3 bpm 251 to 300 bpm, not specified
Refreshing rate	1 s

PR from IBP Module

Measurement range	25 to 350 bpm
Resolution	1 bpm
Accuracy	±1 bpm or ±1%, whichever is greater
Refreshing rate	1 s

A.6.5 NIBP

Standards	Meet standards of IEC60601-2-30			
Technique	Oscillometry			
Mode of operation	Manual, Auto and STAT			
Auto mode repetition intervals	1, 2, 2.5, 3, 5, 10, 15, 20, 30, 60, 90, 120, 180, 240 or 480 min			
STAT mode cycle time	5 min			
Max measurement time	Adult, pediatric: 180 s Neonate: 90 s			
Heart rate range	40 to 240 bpm			
Measurement ranges (mmHg)		Adult	Pediatric	Neonate
	Systolic:	25 to 290	25 to 240	25 to 140
	Diastolic:	10 to 250	10 to 200	10 to 115
	Mean:	15 to 260	15 to 215	15 to 125
Accuracy	Max mean error: ±5 mmHg Max standard deviation: 8 mmHg			
Resolution	1mmHg			
Initial cuff inflation pressure range (mmHg)	Adult: 80 to 280 Pediatric: 80 to 210 Neonate: 60 to 140			
Default initial cuff inflation pressure (mmHg)	Adult: 160 Pediatric: 140 Neonate: 90			
Software overpressure protection	Adult: 297±3 mmHg Pediatric: 297±3 mmHg Neonate: 147±3 mmHg			
Static pressure measurement range	0 mmHg to 300 mmHg			
Static pressure measurement accuracy	±3 mmHg			
PR				
Measurement range	30 to 300 bpm			
Resolution	1 bpm			
Accuracy	±3bpm or ±3%, whichever is greater			
Alarm limit	**Range (mmHg)**			**Step (mmHg)**
Sys High	Adult: (low limit+5) to 270 Pediatric: (low limit+5) to 200 Neonate: (low limit+5) to 135			NIBP ≤ 50: 1 NIBP > 50: 5
Sys Low	40 to (high limit-5)			
Mean High	Adult: (low limit+5) to 230 Pediatric: (low limit+5) to 165 Neonate: (low limit+5) to 110			
Mean Low	20 to (high limit-5)			
Dia High	Adult: (low limit+5) to 210 Pediatric: (low limit+5) to 150 Neonate: (low limit+5) to 100			
Dia Low	10 to (high limit-5)			

*Measurement accuracy verification: In adult and pediatric modes, the blood pressure measurements measured with this device are in compliance with the Standard for Non-invasive sphygmomanometers (ISO 81060-2)in terms of mean error and stardard deviation by comparing with intra-arterial or auscultatory measurements (depending on the configuration) in a typical patient population. For auscultatory reference, the 5th Korotkoff sound was used to determine the diastolic pressure.

In neonatal mode, the blood pressure measurements measured with this device are in compliance with the American National Standard for Non-invasive sphygmomanometers (ISO 81060-2) in terms of mean error and stardard deviation by comparing with intra-arterial measurements (depending on the configuration) in a typical patient population.

A.6.6 Temp

Standards	Meet standard of ISO 80601-2-56	
Technique	Thermal resistance	
Operating mode	Direct mode	
Measurement range	0 to 50 ℃ (32 to 122 ℉)	
Resolution	0.1 ℃	
Accuracy	±0.1 ℃ or ±0.2 ℉ (without probe)	
Refreshing rate	1 s	
Minimum time for accurate measurement	Body surface: <100 s Body cavity: <80 s	
Minimum time between measurements	Body surface probe: <100 s Body cavity probe: <80 s	
Alarm limit	**Range**	**Step**
T1/T2 High	(low limit +1) to 50 ℃ (low limit +1.8) to 122 ℉	0.1 ℃ 0.1 ℉
T1/T2 Low	0 to (high limit -1) ℃ 32 to (high limit -1.8) ℉	
TD High	0 to 50 ℃ 0 to 90 ℉	

A.6.7 IBP

Standards	Meet standard of IEC60601-2-34.
Technique	Direct invasive measurement
IBP	
Measurement range	-50 to 360 mmHg
Resolution	1 mmHg
Accuracy	±2% or ±1 mmHg, whichever is greater (without sensor)
Refreshing rate	1 s
PPV	
Measurement range	0% ~ 50%
Pressure transducer	
Excitement voltage	5 VDC, ±2%
Sensitivity	5 μV/V/mmHg
Zero adjustment range	±200 mmHg

Impedance range	300 to 3000Ω
Volume displacement (ABBOTT)	<0.04 mm^3 /100 mmHg

Alarm limit	**Range (mmHg)**	**Step (mmHg)**
Sys High	(low limit + 2) to 360	1
Mean High		
Dia High		
Sys Low	-50 to (high limit – 2)	
Mean Low		
Dia Low		

A.6.8 C.O.

Measurement method	Thermodilution method	
Measurement range	C.O.:	0.1 to 20 L/min
	TB:	23 to 43 ℃
	TI:	0 to 27 ℃
Resolution	C.O.: TB, TI:	0.1 L/min 0.1 ℃
Accuracy	C.O.: TB, TI:	±5% or ±0.1 L /min, whichever is greater ±0.1 ℃ (without sensor)
Repeatability	C.O.:	±2% or ±0.1 L/min, whichever is greater
Alarm range	TB:	23 to 43 ℃

Alarm limit	**Range**	**Step**
TB High	(low limit + 1) to 43 ℃ (low limit + 1.8) to 109.4℉	0.1 ℃ 0.1 ℉
TB Low	23 to (high limit - 1) ℃ 73.4 to (high limit - 1.8) ℉	

A.6.9 CCO

Operating mode	Interfaces with Edwards Vigilance II® monitor, Vigileo™ monitor, or EV1000 monitor
Measured parameter	Consistent with CCO-related parameters outputted by Vigilance II® monitor, Vigileo™ monitor, or EV1000 monitor
Parameter alarm	Vigilance II®: CCO/CCI,EDV/EDVI,SVR/SVRI,SV/SVI,RVEF VigileoTM: CCO/CCI, SV/SVI, SVV EV1000: CCO/CCI, SVR/SVRI, SV/SVI, SVV

Signal Outputs for Vigilance II® monitor	
Standard	Meets the requirements of IEC 60601-1 for short-circuit protection and leakage current
Output impedance	1000Ω
Isolation voltage	1500 VAC
ECG Analog Output	

Bandwidth (-3dB; reference frequency: 10Hz)	ST mode: 0.05~40Hz Diagnostic mode: 0.05~150Hz Monitor mode: 0.5~40Hz Surgical mode: 1~20Hz
Sensitivity	2V/mV ±5%
MAP Analog Signal Output	
Output voltage	0 to 5V (0 to 500mmHg)
Output voltage error	±5%
CVP Analog Signal Output	
Output voltage	0 to 5V (0 to 100mmHg)
Output voltage error	±5%

Signal Outputs for Vigileo™ monitor	
Standard	Meets the requirements of IEC 60601-1 for short-circuit protection and leakage current
Output impedance	1000Ω
Isolation voltage	1500 VAC
CVP Analog Signal Output	
Output voltage	0 to 5V (0 to 100mmHg)
Output voltage error	±5%

CCO-related Parameters Outputted by Vigilance II® Monitor		
Name	**Range**	**Resolution**
CCO	1 to 20 L/min	0.1
CCI	0 to 20 L/min/m^2	0.1
CO	1 to 20 L/min	0.1
CI	0 to 20 L/min/m^2	0.1
EDV	40 to 800 ml	1
EDVI	20 to 400 ml/m^2	1
SVR	0 to 3000 DS/cm^5	1
SVRI	0 to 6000 DS·m2/cm^5	1
SV	0 to 300 ml	1
SVI	0 to 200 ml/m^2	1
BT	25 to 45 ℃	0.1
RVEF	10 to 60%	1
ESV	10 to 700 ml	1
ESVI	5 to 400 ml/m^2	1
HRavg	30 to 250 bpm	1
CVP	0 to 100 mmHg	1
MAP	0 to 500 mmHg	1

CCO-related Parameters Outputted by Vigileo™ Monitor		
Name	**Range**	**Resolution**
CCO	1 to 20 L/min	0.1
CCI	0 to 20 L/min/m^2	0.1
SVR	0 to 3000 DS/cm^5	1
SVRI	0 to 6000 DS·m^2/cm^5	1
SV	0 to 300 ml	1
SVI	0 to 200 ml/m^2	1
SVV	0 to 99%	0.1
CVP	0 to 100 mmHg	1

CCO-related Parameters Outputted by EV1000 Monitor		
Name	**Range**	**Resolution**
CCO	1 to 20 L/min	0.1
CCI	0 to 20 L/min/m^2	0.1
C.O.	1 to 20 L/min	0.1
C.I.	0 to 20 L/min/m^2	0.1
SV	0 to 300 ml	1
SVI	0 to 200 ml/m^2	1
GEF	1 to 99%	1
CFI	1 to 15 L/min	0.1
GEDV	40 to 4800 ml	1
GEDI	80 to 2400 ml/m^2	1
ITBV	50 to 6000 ml	1
ITBI	100 to 3000 ml/ m^2	1
SVV	0 to 99%	0.1
CVP	-50 to 300 mmHg	1
SVR	0 to 3000 DS/cm^5	1
	0 to 300 kPa-s/l	0.1
SVRI	0 to 6000 DS·m^2/cm^5	1
	0 to 600 kPa-s-m^2/l	0.1
MAP	-50 to 300 mmHg	1
EVLW	10 to 5000 ml	1
ELWI	0 to 50 ml/kg	0.1
PVPI	0.1 to 9.9	0.1
TB	15 to 45°C	0.1
	59 to 113°F	0.1

Alarm Limit	Range	Step
CCO High	(Low limit+0.1) to 20 L/min	0.1 L/min
CCO Low	0 to(high limit-0.1)L/min	
CCI High	(Low limit+0.1) to 20 L/min/m^2	0.1 L/min/m^2
CCI Low	0 to(high limit-0.1)L/min/m^2	

Alarm Limit	Range	Step
EDV High	(Low limit+10)to 800 ml	10 ml
EDV Low	0 to (high limit-10)ml	
EDVI High	(Low limit+10) to 400 ml/m^2	10 ml/m^2
EDVI Low	0 to (high limit-10)ml/m^2	
SVR High	(Low limit+20) to 5000 DS/cm^5 or (low limit+2) to 500 kPa-s/l	20 DS/cm^5 or2 kPa-s/l
SVR Low	0 to (high limit-20)DS/cm^5 or 0 to (high limit-2)kPa-s/l	
SVRI High	(Low limit+50) to 9950 DS·m^2/cm^5 or(low limit+5) to 995 kPa-s-m^2/l	50 DS·m^2/cm^5 or 5 kPa-s-m^2/l
SVRI Low	0 to(high limit-50)DS·m^2/cm^5 or 0 to(high limit-5)kPa-s-m^2/l	
SV High	(Low limit+5) to 300 ml	5 ml
SV Low	0 to (high limit-5)ml	
SVI High	(Low limit+5) to 200 ml/m^2	5 ml/m^2
SVI Low	0 to(high limit-5)ml/m^2	
RVEF High	(Low limit+5) to 100 %	5 %
RVEF Low	0 to(High limit-5)%	
SVV High	(Low limit+1) to 100 %	1%
SVV Low	0 to (high limit-1)%	

A.6.10 SvO_2

Operating mode	Interfaces with Edwards Vigilance II®, Vigileo™ monitor, or EV1000 monitor
Measured parameter	Consistent with CCO-related parameters outputted by Vigilance II®, Vigileo™ monitor, or EV1000 monitor
Parameter alarm	SvO_2, $ScvO_2$

Signal Output for Vigilance II® monitor	
Standard	Meets the requirements of IEC 60601-1 for short-circuit protection and leakage current
Output impedance	1000Ω
Isolation voltage	1500 VAC
SpO_2 Analog Signal Output	
Output voltage	0 to 10V (0 to 100%)
Output voltage error	±5%

SvO_2-related Parameters Outputted by Vigilance II® Monitor		
Name	**Measurement Range**	**Resolution**
SaO_2	40 to 100%	1
VO_2	0 to 999 ml/min	1
O_2EI	0.0 to 99.9%	0.1
SNR	-10 to +20 dB	0.1
DO_2	0 to 2000 ml/min	1
SvO_2	0 to 99%	1
$ScvO_2$	0 to 99%	1
SQI	1 to 4	1

SvO_2-related Parameters Outputted by Vigileo™ Monitor		
Name	**Measurement Range**	**Resolution**
SvO_2	0 to 99%	1
$ScvO_2$	0 to 99%	1
SQI	1 to 4	1

SvO_2-related Parameters Outputted by EV1000 Monitor		
Name	**Measurement Range**	**Resolution**
SvO_2	0 to 99%	1
$ScvO_2$	0 to 99%	1
DO_2	0 to 2000 ml/min	1
DO_2I	10 to 5000 ml/min/m^2	1
VO_2	0 to 999 ml/min	1
VO_2I	10 to 5000 ml/min/m^2	1
VO_2e	0 to 999 ml/min	1
VO_2Ie	10 to 999 ml/min/m^2	1
Hb	2 to 31.8 g/L, g/dl or mmol/L	0.1
SpO_2	0 to 100 %	1

Alarm Limit	**Range(%)**	**Step (%)**
SvO_2 /$ScvO_2$ High	(Low limit+1) to 99	1
SvO_2 /$ScvO_2$ Low	0 to (High limit-1)	

A.6.11 PiCCO

Measured parameters	**Measurement range**	**Coefficient of variation***
CCO	0.25 l/min to 25.0 l/min	≤2%
C.O.	0.25 l/min to 25.0 l/min	≤2%
GEDV	40ml to 4800 ml	≤3%
SV	1ml to 250 ml	≤2%
EVLW	10ml to 5000 ml	≤6%
ITBV	50ml to 6000 ml	≤3%
Alarm Limit	**Range**	**Step**

CCO/C.O. High	(Low limit+0.1 L/min) to 25.0 L/min	0.1 L/min
CCO/C.O. Low	0.3 L/min to (High limit-0.1 L/min)	
CCI/C.I. High	(Low limit+0.1 L/min/m^2) to 15.0 L/min/m^2	0.1 L/min/m^2
CCI/C.I. Low	0.1 L/min/m^2 to (High limit-0.1 L/min/m^2)	
pArt-M/pArt-D/pArt-S High	(Low limit+2 mmHg) to 300 mmHg	1mmHg
pArt-M/pArt-D/pArt-S Low	-50 mmHg to (High limit-2 mmHg)	
pCVP High	(Low limit+2 mmHg) to 300 mmHg	1mmHg
pCVP Low	-50 mmHg to (High limit-2 mmHg)	

* Coefficient of variation is measured using synthetic and/or database wave forms (laboratory testing). Coefficient of variation= SD/mean error.

A.6.12 $ScvO_2$

Measured parameters	**Measurement range**	**Measurement accuracy**
$ScvO_2$	0 to 99%	50% to 80%: ±3% Other ranges: Not specified.
Alarm Limit	**Range**	**Step**
$ScvO_2$ High	(Low limit+1%) to 99%	1%
$ScvO_2$ Low	0% to (High limit-1%)	

A.6.13 CO_2

Measurement mode	Sidestream, microstream, mainstream	
Technique	Infrared absorption	
Apnea time	10 s, 15 s, 20 s, 25 s, 30 s, 35 s, 40 s	
Alarm limit	**Range**	**Step**
$EtCO_2$ High	(low limit + 2) to 99 mmHg	1 mmHg
$EtCO_2$ Low	1 to (high limit - 2)mmHg	
$FiCO_2$ High	1 to 99 mmHg	
EtO_2/FiO_2 High	(low limit + 2 %) to 100%	1%
EtO_2/FiO_2 Low	18% to (high limit - 2 %)	
awRR High	Adult, pediatric: (low limit + 2) to 100 rpm Neonate: (low limit + 2) to 150 rpm	1 rpm
awRR Low	0 to (high limit - 2) rpm	

Sidestream CO_2 Module

Standard	Meet standard of ISO 80601-2-55
CO_2 measurement range	0 to 99 mmHg
CO_2 accuracy*	0 to 40 mmHg: ±2 mmHg 41 to 76 mmHg: ±5% of the reading 77 to 99 mmHg: ±10% of the reading
*Inaccuracy specifications are affected by the breath rate and I:E. The $EtCO_2$ accuracy is within specification for breath rate ≤ 60 rpm and I/E ratio≤ 1:1, or breath rate ≤ 30 rpm and I/E ratio ≤ 2:1.	
CO_2 resolution	1 mmHg
O_2 measurement range	0 to 100%
O_2 absolute accuracy	0≤O_2 concentration≤25%: ±1% 25<O_2 concentration≤80%: ± 2% 80<O_2 concentration≤100%: ± 3%
O_2 resolution	0.1%
Accuracy drift	Meet the requirement for measurement accuracy within 6 hours
Sample flowrate (module PN: 115-020189-00)	Adult: 70 ml/min, 100 ml/min, 120 ml/min, 150 ml/min Pediatric, neonate: 70 ml/min, 100 ml/min
Sample flowrate (module PN: 115-027545-00)	Connected a DRYLINE II watertrap for adult and pediatric patient: 120 ml/min Connected a DRYLINE II watertrap for neonatal patient: 90 ml/min
Sample flowrate tolerance	± 15% or ± 15 ml/min, whichever is greater.
Warm-up time	<1 min, enter the iso accuracy mode After 1 min, enters the full accuracy mode
Response time (module PN: 115-020189-00)	Measured with a neonatal watertrap and a 2.5-meter neonatal sampling line: <3.5 s @ 100 ml/min <4 s @ 70 ml/min Measured with an adult watertrap and a 2.5-meter adult sampling line: <4.5 s @ 150 ml/min <5.5 s @ 120 ml/min <5.5 s @ 100 ml/min <7 s @ 70 ml/min
Response time (module PN: 115-027545-00)	For CO_2 measurements: Measured with a DRYLINE II neonatal watertrap and a 2.5-meter neonatal sampling line: <4.5 s @ 90 ml/min Measured with a DRYLINE II adult watertrap and a 2.5-meter adult sampling line: <5.5 s @ 120 ml/min For O_2 measurements: <5 s @ 90 ml/min <5.5 s@120 ml/min
Rise time (module PN: 115-020189-00)	Measured with a neonatal watertrap and a 2.5-meter neonatal sampling line, or measured with an adult watertrap and a 2.5-meter adult sampling line: <240 ms @ 150 ml/min <300 ms @ 120 ml/min

	<330 ms @ 100 ml/min <400 ms @ 70 ml/min
Rise time (module PN: 115-027545-00)	For CO_2 measurements: Measured with a DRYLINE II neonatal watertrap and a 2.5-meter neonatal sampling line: <330 ms@90 ml/min. Measured with a DRYLINE II adult watertrap and a 2.5-meter adult sampling line: <300 ms@120 ml/min For O_2 measurements: Measured with a DRYLINE II neonatal watertrap and a 2.5-meter neonatal sampling line: <800 ms@90 ml/min. Measured with a DRYLINE II adult watertrap and a 2.5-meter adult sampling line: <750 ms@120 ml/min
awRR measurement range	0 to 120 rpm
awRR measurement precision	±2 rpm

Effect of interference gases on CO_2 measurements		
Gas	**Concentration (%)**	**Quantitive effect***
O_2	≤100	±1 mmHg
N_2O	≤60	
Hal	≤4	
Sev	≤5	
Iso	≤5	
Enf	≤5	
Des	≤15	±2 mmHg
*: means an extra error should be added in case of gas interference when CO_2 measurements are performed between 0-40mmHg.		

Microstream CO_2 Module

Standard	Meet standard of ISO 80601-2-55
CO_2 Measurement range	0 to 99 mmHg
Accuracy*	0 to 38 mmHg: ±2 mmHg 39 to 99 mmHg: ±5% of the reading+0.08% of (the reading-38)
Accuracy drift	Meet the requirement for measurement accuracy within 6 hours
* Accuracy applies for respiration rate up to 80 rpm. For respiration rate above 80 rpm and $EtCO_2$ exceeding 18 mmHg, the accuracy is 4 mmHg or ±12% of the reading, whichever is greater. For respiration rate above 60 rpm, the above accuracy can be achieved by using the CapnoLine H Set for Infant/Neonatal. In the presence of interfering gases, the above accuracy is maintained to within 4%.	
Resolution	1 mmHg
Sample flow rate	$50^{-7.5}_{+15}$ ml/min
Initialization time	30 s (typical)
Response time	2.9 s (typical) (The response time is the sum of the rise time and the delay time when using a

	FilterLine of standard length) Rise time: <190 ms (10% to 90%) Delay time: 2.7 s (typical)
awRR measurement range	0 to 150 rpm
awRR measurement accuracy	0 to 70 rpm: ±1 rpm 71 to 120 rpm: ±2 rpm 121 to 150 rpm: ±3 rpm

Mainstream CO_2 Module

Standard	Meet standard of ISO 80601-2-55
CO_2 Measurement range	0 to 150 mmHg
Accuracy	0 to 40 mmHg: ±2 mmHg 41 to 70 mmHg: ±5% of the reading 71 to 100 mmHg: ±8% of the reading 101 to 150 mmHg: ±10% of the reading
Accuracy drift	Meet the requirement for measurement accuracy within 6 hours
Resolution	1 mmHg
Rise time	<60 ms
awRR measurement range	0 to 150 rpm
awRR measurement accuracy	1 rpm

A.6.14 tcGas

Operating mode	Interfaces with TCM CombiM or TCM TOSCA monitor	
Parameters	**Measurement range**	**Measurement accuracy**
tcpCO2	5 to 200 mmHg (0.7 to 26.7 kPa)	TOSCA Sensor 92, tc Sensor 54: 1 % CO_2: better than 1 mmHg (0.13 kPa) 10 % CO_2: better than 1 mmHg (0.13 kPa) 33 % CO_2: better than 3 mmHg (0.4 kPa) tc Sensor 84: 1 % CO_2: better than 1 mmHg (0.13 kPa) 10 % CO_2: better than 1 mmHg (0.13 kPa) 33 % CO_2: better than 5 mmHg (0.67 kPa)
tcpO2	0 to 800 mmHg (0.0 to 99.9 kPa)	tc Sensor 84: 0 % O_2: better than 1 mmHg (0.13 kPa) 21 % O_2: better than 3 mmHg (0.4 kPa) 50 % O_2: better than 5 mmHg (0.67 kPa) 90 % O_2: better than 25 mmHg (3.33 kPa)
SpO2	0 to 100 %	70 % to 100 %: ±3 %
PR	25 bpm to 240 bpm	±3 bpm
Power	0 to 1000 mW	±20 % of reading

A.6.15 AG

Standards	Meet standard of ISO 80601-2-55		
Technique	Infrared absorption		
Warm-up time	Iso accuracy mode:	45 s	
	Full accuracy mode:	10 min	
Sample flow rate	Adult, pediatric:	120, 150, 200 ml/min	
	Neonate:	70, 90, 120 ml/min	
	Accuracy:	±10 ml/min or ±10%, whichever is greater	
Measurement range	CO_2:	0 to 30%	
	O_2:	0 to 100%	
	N_2O:	0 to 100%	
	Des:	0 to 30%	
	Sev:	0 to 30%	
	Enf:	0 to 30%	
	Iso:	0 to 30%	
	Hal:	0 to 30%	
	awRR:	2 to 100 rpm	
Resolution	CO_2:	1 mmHg	
	awRR:	1 rpm	
Iso accuracy	CO_2:	$\pm 0.3\%_{ABS}$	
	N_2O:	$\pm(8\%_{REL}+2\%_{ABS})$	
	Other anesthetic gases:	$8\%_{REL}$	
Full accuracy	Gases	Range ($\%_{REL}$)[1]	Accuracy ($\%_{ABS}$)
	CO_2	0 to 1	±0.1
		1 to 5	±0.2
		5 to 7	±0.3
		7 to 10	±0.5
		>10	Not specified
	N_2O	0 to 20	±2
		20 to 100	±3
	O_2	0 to 25	±1
		25 to 80	±2
		80 to 100	±3
	Des	0 to 1	±0.15
		1 to 5	±0.2
		5 to 10	±0.4
		10 to 15	±0.6
		15 to 18	±1
		>18	Not specified
	Sev	0 to 1	±0.15
		1 to 5	±0.2
		5 to 8	±0.4
		>8	Not specified

	Enf, Iso, Hal	0 to 1 1 to 5 >5	±0.15 ±0.2 Not specified
	awRR	2 to 60 rpm >60 rpm	±1 rpm Not specified
	Note [1]: The highest GAS LEVEL for a single halogenated anaesthetic gas in a gas mixture that is concealed when the anaesthetic concentration falls is 0.15/0.3% (Full/ISO accuracy).		
Accuracy drift	Meet the requirement for measurement accuracy within 6 hours		
Apnea alarm time	10 s, 15 s, 20 s, 25 s, 30 s, 35 s, 40 s		
Refreshing rate	1 s		
Rise time (10 % ~ 90%)	gas sample flow rate 120ml/min, using the DRYLINE™ watertrap and neonatal DRYLINE™ sampling line (2.5m): CO_2 ≤250 ms (fall time: 200ms) N_2O ≤250 ms O_2 ≤600 ms Hal, Iso, Sev, Des ≤300 ms Enf ≤350 ms		
	gas sample flow rate 200ml/min, using the DRYLINE™ water trap and adult DRYLINE™ sampling line (2.5m): CO_2 ≤250 ms (fall time: 200 ms) N_2O ≤250 ms O_2 ≤500 ms Hal, Iso, Sev, Des ≤300 ms Enf ≤350 ms		
Delay time	<4 s		
Response time	Measured with a neonatal watertrap and a 2.5-meter neonatal sampling line: 120 ml/min: CO_2: ≤4s N_2O: ≤4.2s O_2: ≤4s HAL、ISO、SEV、DES、ENF: ≤4.4s		
Anesthetic agent limit	Primary anesthetic agent In full accuracy mode: 0.15%, In ISO accuracy mode: 0.4%		
	Second anesthetic agent: In full accuracy mode: 0.3% or 5% REL (10% REL for Isoflurane) of primary agent if primary agent is greater than 10% In ISO accuracy mode: 0.5%		
Inaccuracy specifications are affected by the breath rate and I:E change. The end-tidal gas reading is within specification for breath rate below 15BPM and I:E ratio smaller than 1:1 relative to the gas readings without breath; Add ±6%REL to inaccuracy for HAL and O_2 for breath rate larger than 15 BPM; Add ±6%REL to inaccuracy for all gases for breath rate larger than 30 BPM (inaccuracy for HAL and O_2 are unspecified in this case); inaccuracy is unspecified for breath rate larger than 60 BPM.			
Effect of interference gases on AG measurements			
Gas	**Concentration(%)**	**Quantitive effect(%ABS)3)**	

		CO_2	N_2O	Agent 1)	O_2
CO_2	/	/	0.1	0	0.2
N_2O	/	0.1	/	0.1	0.2
Agent [1) 2)]	/	0.1	0.1	0.1	1
Xenon	<100%	0.1	0	0	0.5
Helium	<50%	0.1	0	0	0.5
Ethanol	<0.1%	0	0	0	0.5
Acetone	<1%	0.1	0.1	0	0.5
Methane	<1%	0.1	0.1	0	0.5
Saturated Isopropanol vapour	/	0.1	0	0	0.5
Metered dose inhaler propellants,	/	Unspecified	Unspecified	Unspecified	0.5

1) Agent represents one of Des, Iso, Enf, Sev, and Hal.

2) Multiple agent interference on CO_2, N_2O and O_2 is typically the same as single agent interference.

3) For CO_2, N_2O and Agents, maximum interference from each gas at concentrations within specified accuracy ranges for each gas. The total interference of all gases is never larger than 5%$_{REL}$.

Alarm limit	Range	Step
$EtCO_2$ High	(low limit + 2) to 228 mmHg	1 mmHg
$EtCO_2$ Low	0 to (high limit - 2)mmHg	
$FiCO_2$ High	0 to 228 mmHg	
$FiCO_2$ Low	0 to (high limit - 2)mmHg	
awRR High	Adult, pediatric: (low limit + 2) to 100 rpm Neonate: (low limit + 2) to 150 rpm	1 rpm
awRR Low	0 to (high limit - 2)rpm	
EtO_2 High	(low limit + 2%) to 100 %	1%
EtO_2 Low	18% to (high limit - 2)%	
FiO_2 High	(low limit + 2%) to 100 %	
FiO_2 Low	18% to (high limit - 2)%	
EtN_2O High	(low limit + 2) to 100 %	1%
EtN_2O Low	0 to (high limit - 2)%	
FiN_2O High	(low limit + 2) to 100 %	
FiN_2O Low	0 to (high limit - 2)%	
EtHal/Enf/Iso High	(low limit + 0.2) to 5.0 %	0.1%
EtHal/Enf/Iso Low	0 to (high limit - 0.2)%	
FiHal/Enf/Iso High	(low limit + 0.2) to 5.0 %	
FiHal/Enf/Iso Low	0 to (high limit - 0.2)%	
EtSev High	(low limit + 0.2) to 8.0 %	0.1%
EtSev Low	0 to (high limit - 0.2)%	
FiSev High	(low limit + 0.2) to 8.0 %	
FiSev Low	0 to (high limit - 0.2)%	
EtDes High	(low limit + 0.2) to 18.0 %	0.1%

EtDes Low	0 to (high limit - 0.2)%	
FiDes High	(low limit + 0.2) to 18.0 %	
FiDes Low	0 to (high limit - 0.2)%	

A.6.16 ICG

Technique	Thoracic electrical bioimpedance (TEB);	
Measurement range	SV: 5 to 250 ml HR: 44 to 200 bpm C.O.: 1.0 to 15 L/min	
Accuracy	SV: Not specified. HR: ±2 bpm C.O.: Not specified.	
Alarm limit	**Range**	**Step**
C.I. High	(low limit + 1.0) to 15.0 L/min/m^2	0.1 L/min/m^2
C.I. Low	1.4 to (high limit - 1.0)L/min/m^2	
TFC High	(low limit + 1) to 125/kΩ	1 /kΩ
TFC Low	19 to (high limit - 1)/kΩ	

A.6.17 BIS

Standards	Meet standard of IEC 60601-2-26	
Technique	Bispectral index	
Measured parameters	EEG BIS, BIS L, BIS R：0 to 100	
Calculated parameters	SQI, SQI L, SQI R:0 to 100% EMG, EMG L, EMG R:0 to 100 dB SR, SR L, SR R:0 to 100% SEF, SEF L, SEF R:0.5 to 30.0 Hz TP, TP L, TP R:40 to 100 dB BC, BC L, BC R:0 to 30 sBIS L, sBIS R:0 to 10.0 sEMG L, sEMG R:0 to 10.0 ASYM:0 to 100%	
Impedance range	0 to 999 kΩ	
Sweep speed	6.25 mm/s, 12.5 mm/s, 25 mm/s or 50 mm/s	
Input impedance	>5 MΩ	
Noise (RTI)	<0.3 μV (0.25 to 50 Hz)	
Input signal range	±1 mV	
EEG bandwidth	0.25 to 100 Hz	
Patient leakage current	<10 μA	
Alarm limit	**Range**	**Step**
BIS High	(low limit + 2) to 100	1
BIS Low	0 to (high limit – 2)	

A.6.18 NMT

NMT from Mindray NMT module

Stimulation output	Pulse width	100, 200, or 300 μs; monophasic rectangle pulse Accuracy: ±10%
	Current range	0 - 60 mA in increments of 5 mA Accuracy: ± 5% or ± 2 mA, whichever is greater
	Max. skin impedance	3 kΩ @ 60 mA, 5 kΩ @ 40 mA
	Max. output voltage	300 V
ST mode	ST-Ratio	0 - 200%
	Measurement interval	Manual, 1 s, 10 s, 20 s
TOF mode	TOF-Count	0 - 4
	TOF-Ratio	5 - 160%
	Measurement interval	Manual, 12s, 15s, 20s, 30s, 1min, 5min, 15min, 30min, 60min
PTC mode	PTC	0 - 20
	Measurement interval	Manual
DBS mode	Measurement interval	Manual, 15s, 20s, 30s, 1min, 5min, 15min, 30min, 60min
	DBS-Count	0 - 2
	DBS-Ratio	5 - 160%
NMT message	**Threshold**	
Block Recovery	Off, 1, 2, 3, 4, 5%, 10%, 20%, 30%, 40%, 50%, 60%, 70%, 80%, 90%, 100%	

A.6.19 NMT from TOF-Watch® SX monitor

Operating mode	Interfaces with TOF-Watch® SX monitor
Parameters	**Measurement range**
TOF-Ratio	1%～160%
TOF-Count	0～4
Single	0%～160%
PTC	0～15
Tskin	20.0℃～41.5℃

A.6.20 RM

Technique	Flow sensor
Frequency response	≥30 Hz
Dead space	≤11 ml
Flow	
Measurement range	Adult/pediatric*: ± (2 to 120) L/min Infant: ± (0.5 to 30) L/min
Accuracy	Adult/pediatric*: 1.5 L/min or ±10% of the reading, whichever is greater Infant: 0.5 L/min or ±10% of the reading, whichever is greater
Resolution	0.1 L/min
Paw	
Measurement range	-20 to 120 cmH_2O
Accuracy	±3%
Resolution	0.1 cmH_2O
MVe/MVi	
Measurement range	Adult/Pediatric*: 2 to 60 L/min Infant: 0.5 to 15 L/min
Accuracy	±10%×reading
TVe/TVi	
Measurement range	Adult/Pediatric*: 100 to 1500 ml Infant: 20 to 500 ml
Resolution	1 ml
Accuracy	Adult/pediatric*: ±10% or 15 ml, whichever is greater Infant: ±10% or 6 ml, whichever is greater
RR (RM)	
Measurement range	4 to 120 rpm
Accuracy	4 to 99 rpm ±1 rpm 100 to 120 rpm ±2 rpm

*Pediatric in this form does not include neonate and infant.

Calculated Parameters

Parameters	Measurement range	Measurement accuracy
I:E	4:1 to 1:8	Not specified.
FEV1.0%	0 to 100%	Not specified.
Pmean	0 to 120 cmH_2O	±10%×reading
TV	20 to 1500 ml	Adult/pediatric: ±10% or ±25 ml, whichever is greater. Infant: ±10% or ±6 ml, whichever is greater.
MV	2 to 60 L	±10%×reading
PEEP	0 to 120 cmH_2O	Not specified.
PEF	2 to 120 L/min	±10% ×reading
PIF	2 to 120 L/min	±10% × reading
PIP	0 to 120 cmH_2O	±10% ×reading
Pplat	0 to 120 cmH_2O	Not specified.
Compl	0 to 200 ml/cmH_2O	

RSBI	0 to 4095 rpm/L	
NIF	-20 to 0 cmH_2O	
WOB	0.00 to 10.00J/L	
RAW	0 to 100cmH_2O/L/s	

Specifications of parameters monitored when using with the sidestream CO_2 module or AG module

Parameters	Measurement range	Measurement accuracy
VCO_2	0 to 200 ml	±15% or ±15 ml, whichever is greater
VO_2	0 to 200 ml	±15% or ±15 ml, whichever is greater

Parameters	Resolution	Parameters	Resolution	Parameters	Resolution
VCO_2	1 ml	$MVCO_2$	1 ml/ml	EE	1 kCal/day
VO_2	1 ml	MVO_2	1 ml/ml	RQ	0.01

Alarm limit	Range	Step
RR High	Adult, pediatric: (low limit + 2) to 100 rpm Neonate: (low limit + 2) to 150 rpm	1 rpm
RR Low	0 to (high limit -2) rpm	
PEEP High	(low limit +1) to 120 cmH_2O	1 cmH_2O
PEEP Low	0 to (high limit -1) cmH_2O	
PIP High	(low limit +1) to 120 cmH_2O	1 cmH_2O
PIP Low	0 to (high limit -1) cmH_2O	
MVe High	Adult and pediatric: (low limit +1.0) to 60.0 L/min Infant:(low limit +1.0) to 15.0	0.5 L/min
MVe Low	Adult and pediatric: 2.0 to (high limit -1.0) Infant:0.5 to (high limit -1.0)	

A.6.21 EEG

Standards	Meet standard of IEC 60601-2-26
Channels and Leads	Four-channel bipolar mode: 9 Leads Four-channel referential mode: 6 Leads
Analog Bandwidth	0.5 to 110 Hz
Input Signal Range	± 2 mVac
Measurement Bandwidth	0.5 to 30 Hz
Max. Input DC Offset	± 500 mV DC
Common Mode Rejection Ratio	≥100 dB @50 Hz
Noise	≤0.5 uV rms (0.5 to 70 Hz)
Input Differential Impedance	≥15 MΩ @10 Hz
Sampling Frequency	1024 Hz

Electrode Impedance	Range: 1 to 100KΩ, Resolution: 1 KΩ
Low Filter Frequencies	0.16 Hz, 0.5 Hz, 1.0 Hz, and 2.0 Hz
High Filter Frequencies	15 Hz, 30 Hz, 50 Hz, and 70 Hz

Measured Parameters		
	Measurement range	**Resolution**
SEF, MF, PPF	0.5 to 30 Hz	0.5 Hz
TP	40 to 100 dB	1 dB
EMG	0 to 100 dB	
Delta, Theta, Alpha, Beta	0 to 100% (±1%)	1%
SR	0 to 100%	1%

FOR YOUR NOTES

B EMC and Radio Regulatory Compliance

B.1 EMC

The device meets the requirements of IEC 60601-1-2: 2014.

⚠WARNING

- **Use of accessories, transducers and cables other than those specified or provided by the manufacturer of this device could result in increased electromagnetic emissions or decreased electromagnetic immunity of this device and result in improper operation.**
- **Use of this device adjacent to or stacked with other device should be avoided because it could result in improper operation. If such use is necessary, this device and the other device should be observed to verify that they are operating normally.**
- **Portable RF communications equipment (including peripherals such as antenna cables and external antennas) should be used no closer than 30 cm (12 inches) to any part of the this device, including cables specified by the manufacturer. Otherwise, degradation of the performance of this device could result.**
- **The non-ME EQUIPMENT (e.g. ITE) that is a part of an ME SYSTEM may be disrupted by the electromagnetic interference of nearby equipment. It may be necessary to take mitigation measures, such as re-orienting or relocating the non-ME EQUIPMENT or shielding the location.**
- **This device is intended for use in professional healthcare facility EMC environment. If it is used in special environment, such as magnetic resonance imaging environment, the equipment/ system may be disrupted by the operation of nearby equipment.**

Guidance and Declaration - Electromagnetic Emissions		
The device is intended for use in the electromagnetic environment specified below. The customer or the user of the device should assure that it is used in such an environment.		
Emission test	**Compliance**	**Electromagnetic environment - guidance**
Conducted and radiated RF EMISSIONS CISPR 11	Group 1	The device uses RF energy only for its internal function. Therefore, its RF emissions are very low and are not likely to cause any interference in nearby electronic device.
Conducted and radiated RF EMISSIONS CISPR 11	Class A	The device is suitable for use in all establishments other than domestic and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.
Harmonic distortion IEC 61000-3-2	Class A	The device is suitable for use in all establishments, including domestic establishments and those directly

Voltage fluctuations and flicker IEC 61000-3-3	Complies	connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.

NOTE

- **The device needs special precautions regarding EMC and needs to be installed and put into service according to the EMC information provided in appendix B.**
- **Other devices may affect this device even though they meet the requirements of CISPR.**
- **When the inputted signal is below the minimum amplitude provided in technical specifications, erroneous measurements could result.**
- **The EMISSIONS characteristics of this device make it suitable for use in industrial areas and hospitals (CISPR 11 class A). If it is used in a residential environment (for which CISPR 11 class B is normally required) this device might not offer adequate protection to radio-frequency communication services. The user might need to take mitigation measures, such as relocating or re-orienting the device.**
- **If the essential performance is lost or degraded, it may be necessary to take mitigation measures, such as re-orienting or relocating the ME EQUIPMENT or ME SYSTEM or shielding the location or stopping using the monitor and contact the service personnel.**

If the device is operated within the electromagnetic environment listed in Table **Guidance and Declaration —Electromagnetic Immunity**, the system will remain safe and provide the following essential performance:

- **Operating mode**
- **Accuracy**
- **Function**
- **Accessories identification**
- **Data stored**
- **Alarm**
- **Detect for connection**

Guidance and Declaration - Electromagnetic Immunity			
The device is intended for use in the electromagnetic environment specified below. The customer or the user of the device should assure that it is used in such an environment.			
Immunity test	**IEC 60601 test level**	**Compliance level**	**Electromagnetic environment - guidance**
Electrostatic discharge (ESD) IEC 61000-4-2	±8 kV contact ±15kV air	±8 kV contact ±15kV air	Floors should be wood, concrete or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30%.
Electrical fast transient/burst IEC 61000-4-4	±2 kV for power supply lines ±1 kV for input/output lines (length greater than 3 m)	±2 kV for power supply lines[a] ±1 kV for input/output lines (length greater than 3 m)	Mains power quality should be that of a typical commercial or hospital environment.
Surge IEC 61000-4-5	±1 kV line(s) to line(s) ±2 kV line(s) to earth	±1 kV line(s) to line(s) ±2 kV line(s) to earth	
Voltage dips and Voltage interruptions IEC 61000-4-11	0 % U_T for 0,5 cycle 0 % U_T for 1 cycle and 70 % U_T for 25/30 cycles 0 % U_T for 250/300 cycle	0 % U_T for 0,5 cycle 0 % U_T for 1 cycle and 70 % U_T for 25/30 cycles 0 % U_T for 250/300 cycle	Mains power quality should be that of a typical commercial or hospital environment. If the user of our product requires continued operation during power mains interruptions, it is recommended that our product be powered from an uninterruptible power supply or a battery.
RATED power frequency magnetic fields IEC 61000-4-8	30 A/m 50 Hz / 60 Hz	30 A/m 50 Hz / 60 Hz	Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment.
Note: U_T is the A.C. mains voltage prior to application of the test level. [a] Within 30 s after the transient electromagnetic phenomena are discontinued, the ICG module shall resume normal operation without operator intervention, without loss of any operator settings or stored data and shall provide basic safety and essential performance.			

<table>
<tr><th colspan="4">Guidance and Declaration - Electromagnetic Immunity</th></tr>
<tr><td colspan="4">The device is intended for use in the specified electromagnetic environment. The customer or the user of the device should assure that it is used in such an environment as described below.</td></tr>
<tr><th>Immunity test</th><th>IEC 60601 Test level</th><th>Compliance level</th><th>Electromagnetic environment - guidance</th></tr>
<tr><td rowspan="2">Conducted disturbances induced by RF fields IEC61000-4-6</td><td>3 Vrms
150 kHz to 80 MHz</td><td>3 Vrms
(ICG:1Vrms
)</td><td rowspan="5">Portable and mobile RF communications equipment should be used no closer to any part of the device, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter. Recommended separation distance:
$d = \left[\frac{3.5}{V}\right]\sqrt{P}$ 150k to 80 MHz
$d = \left[\frac{3.5}{E}\right]\sqrt{P}$ 80 MHz to 800 MHz
$d = \left[\frac{7}{E}\right]\sqrt{P}$ 800 MHz to 2.7 GHz
where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer and d is the recommended separation distance in meters (m).
Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey[b], should be less than the compliance level in each frequency range[c].
Interference may occur in the vicinity of equipment marked with the following symbol:
  </td></tr>
<tr><td>6 Vrms
in ISM bands[a] between 0,15 MHz and 80 MHz</td><td>6 Vrms
(ICG:1Vrms
)</td></tr>
<tr><td>Radiated RF EM fields IEC61000-4-3</td><td>3V/m
80 MHz to 2.7 GHz</td><td>3V/m</td></tr>
<tr><td rowspan="3">Proximity fields from RF wireless communications equipment IEC61000-4-3</td><td>27 V/m
380–390 MHz</td><td>27 V/m</td></tr>
<tr><td>28 V/m
430–470 MHz,
800–960 MHz,
1700–1990 MHz,
2400–2570 MHz</td><td>28 V/m</td></tr>
<tr><td>9 V/m
704–787 MHz,
5100–5800 MHz</td><td>9 V/m</td></tr>
<tr><td colspan="4">Note 1: At 80 MHz and 800 MHz, the higher frequency range applies.
Note 2: These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.</td></tr>
<tr><td colspan="4">[a] 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. The amateur radio bands 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, 18,07 MHz to 18,17 MHz, 21,0 MHz to 21,4 MHz, 24,89 MHz to 24,99 MHz, 28,0 MHz to 29,7 MHz and 50,0 MHz to 54,0 MHz.
[b] Field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land</td></tr>
</table>

mobile radios, amateur radio, AM and FM radio broadcast and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the device is used exceeds the applicable RF compliance level above, the device should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as re-orienting or relocating the device.

[c] Over the frequency ranges 150 kHz to 80 MHz, field strengths should be less than 3V/m.

Recommended Separation Distances between Portable and Mobile RF, Communications Equipment and This Equipment

The equipment is intended for use in an electromagnetic environment in which radiated RF disturbance are controlled. The customer or the user of the device can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the device as recommended below, according to the maximum output power of the communication equipment.

Rated Maximum Output power of Transmitter Watts (W)	**Separation Distance According to Frequency of Transmitter (m)**		
	150 kHz to 80 MHz $d = \left[\frac{3.5}{V}\right]\sqrt{P}$	80 MHz to 800 MHz $d = \left[\frac{3.5}{E}\right]\sqrt{P}$	800 MHz to 2.7 GHz $d = \left[\frac{7}{E}\right]\sqrt{P}$
0.01	0.12 (ICG: 0.35)	0.12	0.23
0.1	0.38 (ICG: 1.11)	0.38	0.73
1	1.2 (ICG: 3.50)	1.2	2.3
10	3.8 (ICG: 11.07)	3.8	7.3
100	12 (ICG: 35.00)	12	23

For transmitters at a maximum output power not listed above, the recommended separation distanced in meters (m) can be determined using the equation applicable to the frequency of the transmitter, where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer.

Note 1: At 80 MHz and 800 MHz, the higher frequency range applies.

Note 2: These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.

B.2 Radio Regulatory Compliance

RF parameter (WB45NBT Module)

Type of Radio	IEEE 802.11b/g/n (2.4G)	IEEE 802.11a/n (5G)
Modulation mode	DSSS and OFDM	OFDM
Operating frequency	ETSI:2.4 GHz - 2.483 GHz FCC:2.4 GHz - 2.483 GHz MIC:2.4 GHz - 2.495 GHz KC:2.4 GHz - 2.483 GHz	ETSI: 5 .15 GHz - 5.35 GHz, 5.47 GHz - 5.725 GHz FCC: 5 .15 GHz - 5.35 GHz, 5.47- 5.725 GHz， 5.725 GHz - 5.825 GHz MIC: 5.15 GHz - 5.35GH, 5.47- 5.725 GHz KC: 5 .15 GHz - 5.35 GHz, 5.47- 5.725 GHz, 5.725 GHz - 5.825 GHz
Output power	< 30 dBm (Peak Power) < 20 dBm (Average Power)	

CE

The radio device used in this product is in compliance with the essential requirements and other relevant provisions of Directive 2014/53/EU.

This device complies with part 15 of the FCC Rules and with RSS-210 of Industry Canada. Operation is subject to the condition that this device does not cause harmful interference.

This device must accept any interference received, including interference that may cause undesired operation.

⚠ WARNING

- **Changes or modifications not expressly approved by the party responsible compliance could void the user's authority to operate the equipment.**

C Default Configurations

This chapter lists some of the most important factory default settings for each department in configuration management. You cannot change the factory default configuration itself. However, you can make changes to the settings from the factory default configuration and then save the changed configuration as a user configuration. The last column of the following tables is for your notes and review.

Note: In this chapter, O.M means the monitor's operating mode. Column C refers to the settings that can be changed in configuration management. Column M refers to the settings that can be changed in monitoring mode.

C.1 Parameters Configuration

C.1.1 ECG

ECG Setup

Item Name		O.M		General	OR	ICU	NICU	CCU	User Defaults
		C	M						
Lead Set		*	*	Auto (if auto lead detection is available); 5-lead (if auto lead detection is not available)					
Alm Source		*	*	HR					
Alarm		*	*	On					
Alm Lev		*	*	Med					
HR/PR High	Adu	*	*	120					
	Ped			160					
	Neo			200					
HR/PR Low	Adu	*	*	50					
	Ped			75					
	Neo			100					
Sweep		*	*	25 mm/s					
Beat Vol		*	*	2		1			
Paced			*	No					
Notch Filter		*	*	Weak					
Gain		*	*	X1					
Filter		*	*	Monitor	Surgery	Monitor		Diagnostic	
ECG Display		*	*	Normal					
Pacemaker Rate			*	60					
Minimum QRS Threshold			*	0.16 mV					

Glasgow resting 12-lead ECG analysis

Item Name	O.M		General	OR	ICU	NICU	CCU	User Defaults
	C	M						
Filter		*	Diagnostic					
Baseline Drift Removal		*	On					
Tachy High		*	100					
Brady Low		*	50					
QTc Formula		*	Hodges					
Waveform Layout		*	Standard					
Report Format		*	3×4+1					
Median Complex		*	Off					
Measurements		*	On					
Interpretation		*	On					
Interpretation Summary		*	On					

ST Analysis

Item Name	O.M		General	OR	ICU	NICU	CCU	User Defaults
	C	M						
ST Analysis	*	*	Off				On	
Alarm	*	*	Off					
Alm Lev	*	*	Med					
ST-X High	*	*	when ST Unit is mV: 0.20 when ST Unit is mm: 2.0					
ST-X Low	*	*	when ST Unit is mV: -0.20 when ST Unit is mm: -2.0					
ISO	*	*	-80 ms					
J			48 ms					
ST			J + 60 ms					

X represents I, II, III, aVR, aVL, aVF, V, V1, V2, V3, V4, V5 or V6.

QT/QTc Analysis

Item Name	O.M		General	OR	ICU	NICU	CCU	User Defaults
	C	M						
QT Analysis	*	*	Off					
QTc Formula	*	*	Hodges					
Analysis Lead	*	*	All					

Arrh. Analysis

Item Name	Algorithm	O.M		Genral	OR	ICU	NICU	CCU	User Defaults
		C	M						
Arrhythmia Threshold Settings									
PVCs High	Mindray	*	*	Adu, Ped: Neo:	10 N/A				
Tachy		*	*	Adu: Ped: Neo:	120 160 N/A				
Brady		*	*	Adu: Ped: Neo:	50 75 N/A				
Asys. Delay		*	*	Adu, Ped: Neo:	5 N/A				
Vtac Rate		*	*	Adu, Ped: Neo:	130 N/A				
Vtac PVCs		*	*	Adu, Ped: Neo:	6 N/A				
Multif. PVC's Window		*	*	Adu, Ped: Neo:	15 N/A				
Extreme Tachy		*	*	Adu: Ped: Neo:	160 180 N/A				
Extreme Brady		*	*	Adu: Ped: Neo:	35 50 N/A				
Vbrd Rate		*	*	Adu, Ped: Neo:	40 N/A				
Vbrd PVCs		*	*	Adu, Ped: Neo:	5 N/A				
Pause Time		*	*	Ad, Ped: Neo:	2 N/A				
PVCs High	Mortara	*	*	Adu, Ped: Neo:	10 N/A				
Asys. Delay		*	*	Adu, Ped: Neo:	5 N/A				
Vtac Rate		*	*	Adu, Ped: Neo:	130 N/A				
Vtac PVCs		*	*	Adu, Ped: Neo:	6 N/A				
Multif. PVC's Window		*	*	Adu, Ped: Neo:	15 N/A				

Item Name	Algorithm	O.M		Genral	OR	ICU	NICU	CCU	User Defaults
		C	M						
Tachy		*	*	Adu: Ped: Neo:	120 160 N/A				
Brady		*	*	Adu: Ped: Neo:	50 75 N/A				
Arrhythmia Alarm Settings									
PVCs/min Alarm		*	*	Off				On	
R on T Alarm		*	*	Off				On	
Nonsus. Vtac Alarm		*	*	Off				On	
Vent. Rhythm Alarm		*	*	Off				On	
Bigeminy Alarm		*	*	Off				On	
Trigeminy Alarm		*	*	Off				On	
Afib Alarm		*	*	Off				On	
Asystole Alarm		*	*	On					
VFib/VTac Alarm		*	*	On					
Vtac Alarm		*	*	On					
Vent. Brady Alarm		*	*	On					
Extreme Tachy Alarm		*	*	On					
Extreme Brady Alarm		*	*	On					
X Alarm		*	*	Off					
Asystole Alm Lev	Mindray	*	*	High					
VFib/VTac Alm Lev		*	*	High					
Vtac Alm Lev		*	*	High					
Vent. Brady Alm Lev		*	*	High					
Extreme Tachy Alm Lev		*	*	High					
Extreme Brady Alm Lev		*	*	High					
Run PVCs Alm Lev		*	*	Low					
Pause Alm Lev		*	*	Low					
Couplet Alm Lev		*	*	Prompt					
PVC Alm Lev		*	*	Prompt					
Irr. Rhythm Alm Lev		*	*	Prompt					
PNP Alm Lev		*	*	Prompt					
PNC Alm Lev		*	*	Prompt					
Missed Beats Alm Lev		*	*	Prompt					

Item Name	Algorithm	O.M		Genral	OR	ICU	NICU	CCU	User Defaults
		C	M						
Afib Alm Lev		*	*	Prompt					
X Alm Lev		*	*	Med					
X Alm Rec		*	*	Off					
PVCs/min Alarm		*	*	Off				On	
R on T Alarm		*	*	Off				On	
Vent. Rhythm Alarm		*	*	Off				On	
Bigeminy Alarm		*	*	Off				On	
Trigeminy Alarm		*	*	Off				On	
Asystole Alarm				On					
VFib Alarm				On					
VTac Alarm				On					
X Alarm		*	*	On					
Asystole Alm Lev		*	*	High					
VFib Alm Lev	Mortara	*	*	High					
VTac Alm Lev		*	*	High					
Run PVCs Alm Lev		*	*	Low					
Couplet Alm Lev		*	*	Prompt					
PVC Alm Lev		*	*	Prompt					
Irr. Rhythm Alm Lev		*	*	Prompt					
PNP Alm Lev		*	*	Prompt					
PNC Alm Lev		*	*	Prompt					
Missed Beats Alm Lev		*	*	Prompt					
X Alm Lev		*	*	Med					
X Alm Rec		*	*	Off					

X represents a certain arrhythmia event. Refer to the Specifications chapter for details. The X in "X Alm Lev" refers to all arrhythmia events except for those specially marked ones.

C.1.2 RESP

Item Name	O.M		General	OR	ICU	NICU	CCU	User Defaults
	C	M						
Alarm	*	*	On					
Alm Lev	*	*	Med					
Sweep	*	*	6.25 mm/s					
Lead	*	*	Adu, Ped: Auto Neo: II					
Gain	*	*	X2					
RR High	*	*	Adu, Ped: 30 Neo: 100					
RR Low	*	*	Adu, Ped: 8 Neo: 30					

Apnea Delay	*	*	Adu, Ped: 20 Neo: 15	
Detection Mode	*	*	Auto	
RR Source		*	Auto	

C.1.3 PR

Item Name		O.M		General	OR	ICU	NICU	CCU	User Defaults
		C	M						
Alarm		*	*	On					
Alm Lev		*	*	Med					
HR/PR High	Adu	*	*	120					
	Ped			160					
	Neo			200					
HR/PR Low	Adu	*	*	50					
	Ped			75					
	Neo			100					
PR Source		*	*	SpO_2					
Beat Vol		*	*	2		1			

C.1.4 SpO_2

Item Name	O.M		General	OR	ICU	NICU	CCU	User Defaults
	C	M						
Alarm	*	*	On					
Alm Lev	*	*	Med					
SpO_2 High	*	*	Adu, Ped: 100 Neo: 95					
SpO_2 Low	*	*	90					
Desat Limit	*	*	80					
Sweep	*	*	25 mm/s					
NIBP Simul		*	Off					
Sensivity（Mindray）	*	*	Med					
Sensivity（Masimo）	*	*	Normal					
Averaging（Masimo）	*	*	8 s					
Sat-Seconds（Nellcor）	*	*	0 s					
PI Zoom	*	*	No					

C.1.5 ΔSpO₂

Item Name	O.M		General	OR	ICU	NICU	CCU	User Defaults
	C	M						
Alarm	*	*	Off					
Alm Lev	*	*	Mediate					
ΔSpO₂ High	*	*	10 %					
PI Zoom	*	*	No					

C.1.6 Temp

Item Name	O.M		General	OR	ICU	NICU	CCU	User Defaults
	C	M						
Alarm	*	*	On					
Alm Lev	*	*	Med					
T1/T2 High（℃）	*	*	38.0					
T1/T2 Low（℃）	*	*	35.0					
TD High（℃）	*	*	2.0					

C.1.7 NIBP

Item Name		O.M		General	OR	ICU	NICU	CCU	User Defaults
		C	M						
Alarm		*	*	On					
Alm Lev		*	*	Med					
Interval		*	*	15 min	5 min	15 min	30 min	15 min	
NIBP End Tone		*	*	Off					
Clock		*	*	On					
Cuff Press.（mmHg）	Adu	*	*	80					
	Ped			60					
	Neo			40					
Initial Pressure（mmHg）	Adu	*	*	160					
	Ped			140					
	Neo			90					
Alarm Limits									
NIBP-S High（mmHg）	Adu	*	*	160					
	Ped			120					
	Neo			90					
NIBP-S Low（mmHg）	Adu	*	*	90					
	Ped			70					
	Neo			40					

NIBP-M High （mmHg）	Adu	*	*	110	
	Ped			90	
	Neo			70	
NIBP-M Low （mmHg）	Adu	*	*	60	
	Ped			50	
	Neo			25	
NIBP-D High （mmHg）	Adu	*	*	90	
	Ped			70	
	Neo			60	
NIBP-D Low （mmHg）	Adu	*	*	50	
	Ped			40	
	Neo			20	

C.1.8 IBP

Item Name	O.M		General	OR	ICU	NICU	CCU	User Defaults
	C	M						
Alarm	*	*	On					
Alm Lev	*	*	Med					
Alm Rec		*	Off					
P1 Measure	*	*	All					
P2 Measure	*	*	All					
P3 Measure	*	*	Mean					
P4 Measure	*	*	Mean					
PPV Measurement	*	*	Off					
PPV Source	*	*	Auto					
Sensitivity	*	*	Med					
Sweep	*	*	25 mm/s					
Sweep (PAWP measurement window)	*	*	12.5 mm/s					
Filter	*		12.5 Hz					
Gridline	*	*	Off					
IBP Label Order Setup	*	*	Art, pArt, CVP, pCVP, ICP, PA, AO, UAP, FAP, BAP, LV, LAP, RAP, UVP, P1, P2, P3, P4					
Art, Ao, UAP, BAP, FAP, LV, P1-P2 Arterial Pressure Alarm Limits								
IBP-S High （mmHg）	Adu	*	*	160				
	Ped			120				
	Neo			90				
IBP-S Low （mmHg）	Adu	*	*	90				
	Ped			70				
	Neo			55				
IBP-M High （mmHg）	Adu	*	*	110				
	Ped			90				
	Neo			70				
IBP-M Low	Adu	*	*	70				

Item Name		O.M		General	OR	ICU	NICU	CCU	User Defaults
		C	M						
（mmHg）	Ped			50					
	Neo			35					
IBP-D High （mmHg）	Adu	*	*	90					
	Ped			70					
	Neo			60					
IBP-D Low （mmHg）	Adu	*	*	50					
	Ped			40					
	Neo			20					
PA Alarm Limits									
PA-S High （mmHg）	Adu	*	*	35					
	Ped			60					
	Neo			60					
PA-S Low （mmHg）	Adu	*	*	10					
	Ped			24					
	Neo			24					
PA-M High （mmHg）	Adu	*	*	20					
	Ped			26					
	Neo			26					
PA-M Low （mmHg）	Adu	*	*	0					
	Ped			12					
	Neo			12					
PA-D High （mmHg）	Adu	*	*	16					
	Ped			4					
	Neo			4					
PA-D Low （mmHg）	Adu	*	*	0					
	Ped			-4					
	Neo			-4					
CVP, LAP, RAP, ICP, UVP, P3-P4 Venous Pressure Alarm Limits									
IBP-M High （mmHg）	Adu	*	*	10					
	Ped			4					
	Neo			4					
IBP-M Low （mmHg）	Adu	*	*	0					
	Ped			0					
	Neo			0					
CPP Alarm Limits									
CPP High (mmHg)	Adu	*	*	130					
	Ped			100					
	Neo			90					
CPP Low (mmHg)	Adu	*	*	50					
	Ped			40					
	Neo			30					
Art, Ao, BAP, FAP, LV, P1-P2 Arterial Pressure Scale									
Scale（mmHg）		*	*	0-160					

Item Name	O.M		General	OR	ICU	NICU	CCU	User Defaults
	C	M						
PA Scale								
Scale（mmHg）	*	*	0-30					
CVP, LAP, RAP, ICP, UVP Scale								
Scale（mmHg）	*	*	0-20					
UAP, P3-P4 Venous Pressure Scale								
Scale（mmHg）	*	*	0-80					
IBP Overlap Left Scale								
Scale（mmHg）	*	*	0-160					
IBP Overlap Right Scale								
Scale（mmHg）	*	*	0-20					

C.1.9 C.O.

Item Name	O.M		General	OR	ICU	NICU	CCU	User Defaults
	C	M						
Alarm	*	*	On					
Alm Lev	*	*	Med					
TB High（ºC）	*	*	39.0					
TB Low（ºC）	*	*	36.0					
Comp. Const	*	*	0.542					
Auto TI	*	*	Auto					
Manual TI（ºC）	*	*	2.0					
Measuring mode	*	*	Manual					

C.1.10 CCO/SvO_2 Setup (Vigilance II)

Item Name	O.M		General	OR	ICU	NICU	CCU	User Defaults
	C	M						
Alarm	*	*	On					
Alm Lev	*	*	Med					
Primary Parameter	*	*	C.O./CCO					
Secondary Parameters	*	*	SVR, EDV, SV					
CCO High	*	*	14					
CCO Low	*	*	2					
CCI High	*	*	7					
CCI Low	*	*	1					
EDV High	*	*	300					
EDV Low	*	*	80					
EDVI High	*	*	150					
EDVI Low	*	*	60					
SVR High	*	*	1500 DS/cm^5					
SVR Low	*	*	500 DS/cm^5					

Item Name	O.M		General	OR	ICU	NICU	CCU	User Defaults
	C	M						
SVRI High	*	*	3000 DS·m²/ cm⁵					
SVRI Low	*	*	1000 DS·m²/ cm⁵					
RVEF High	*	*	50					
RVEF Low	*	*	0					
SV High	*	*	120					
SV Low	*	*	20					
SVI High	*	*	60					
SVI Low	*	*	10					
SvO_2 High	*	*	99					
SvO_2 Low	*	*	10					
$ScvO_2$ High	*	*	99					
$ScvO_2$ Low	*	*	10					

C.1.11 CCO/SvO_2 Setup (Vigileo)

Item Name	O.M		General	OR	ICU	NICU	CCU	User Defaults
	C	M						
Alarm	*	*	On					
Alm Lev	*	*	Med					
Primary Parameter	*	*	CCO					
Secondary Parameters	*	*	SV, SVR, SVV					
CCO High	*	*	14					
CCO Low	*	*	2					
CCI High	*	*	7					
CCI Low	*	*	1					
SV High	*	*	120					
SV Low	*	*	20					
SVI High	*	*	60					
SVI Low	*	*	10					
SVV High	*	*	30					
SVV Low	*	*	0					
SVR High	*	*	1500 DS/cm⁵					
SVR Low	*	*	500 DS/cm⁵					
SVRI High	*	*	3000 DS·m²/ cm⁵					
SVRI Low	*	*	1000 DS·m²/ cm⁵					
SvO_2 High	*	*	99					
SvO_2 Low	*	*	10					
$ScvO_2$ High	*	*	99					
$ScvO_2$ Low	*	*	10					

C.1.12 CCO/SvO_2 Setup (EV1000)

Item Name	O.M		General	OR	ICU	NICU	CCU	User Defaults
	C	M						
Alarm	*	*	Off					
Alarm Level	*	*	Med					
Parameter Display (when the EV1000 is in the None or VolumeView mode)	*	*	Indexed					
Secondary Parameters (when the EV1000 is in the None or VolumeView mode)	*	*	GEDI, SVRI, ELWI					
Parameter Display (when the EV1000 is in the FloTrac or ClearSightmode)	*	*	Indexed					
Secondary Parameters (when the EV1000 is in the FloTrac or ClearSightmode)	*	*	SVI, SVV, SVRI					
CCO High	*	*	14					
CCO Low	*	*	2					
CCI High	*	*	10					
CCI Low	*	*	1					
SV High	*	*	120					
SV Low	*	*	20					
SVI High	*	*	60					
SVI Low	*	*	10					
SVV High	*	*	30					
SVV Low	*	*	0					
SVR High	*	*	1500 DS/cm^5					
SVR Low	*	*	500 DS/cm^5					
SVRI High	*	*	3000 DS·m^2/ cm^5					
SVRI Low	*	*	1000 DS·m^2/ cm^5					
SvO_2 High	*	*	90					
SvO_2 Low	*	*	40					
$ScvO_2$ High	*	*	90					
$ScvO_2$ Low	*	*	40					

C.1.13 PiCCO

Item Name	O.M		General	OR	ICU	NICU	CCU	User Defaults
	C	M						
Inj. Volume		*	Adu: 15ml Ped: 10ml					
pCVP Measure		*	Auto					
pCVP		*	5 mmHg					
C.O. Measure		*	Auto					
PiCCO Parameters								
Parameter Display	*	*	Indexed					
Secondary Parameter	*	*	Indexed: GEDI、ELWI、SVRI Absolute: GEDV、EVLW、SVR					
pArt/pCVP Setup								
Scale (mmHg)	*	*	pArt：0～160mmHg pCVP：0～20mmHg					
Sweep	*	*	25 mm/s					

C.1.14 CO_2

Item Name	O.M		General	OR	ICU	NICU	CCU	User Defaults
	C	M						
Alarm	*	*	On					
Alm Lev	*	*	Med					
Operating Mode	*	*	Measure					
Sweep	*	*	6.25 mm/s					
Scale（mmHg）	*	*	50					
Apnea Delay	*	*	Adu, Ped: 20 Neo: 15					
RR Source		*	Auto					
Sidestream CO_2 Setup								
Flow Rate	*	*	Adu: 120 ml/min					
			Ped: 100 ml/min					
			Neo: 70 ml/min					
BTPS Compen	*	*	Off					
N_2O Compen	*	*	0					
O_2 Compen	*	*	21	100	21			
Des Compen	*	*	0					
Microstream CO_2 Setup								
BTPS Compen		*	Off					
Max Hold	*	*	20 s					
Auto Standby (min)	*	*	0					
Mainstream CO_2 Setup								
Max Hold	*	*	10 s					
O_2 Compen	*	*	Off					

Balance Gas	*	*	Room Air	
AG Compen	*	*	0	
Alarm Limits				
$EtCO_2$ High（mmHg）	*	*	Adu, Ped: 50 Neo: 45	
$EtCO_2$ Low（mmHg）	*	*	Adu, Ped: 25 Neo: 30	
$FiCO_2$ High（mmHg）	*	*	Adu, Ped, Neo: 4	
RR High	*	*	Adu, Ped: 30 Neo: 100	
RR Low	*	*	Adu, Ped: 8 Neo: 30	

C.1.15 tcGas

Item Name	O.M		General	OR	ICU	NICU	CCU	User Defaults
	C	M						
Alarm Sound	*	*	Off					
Change Secondary Parameters	*	*	SpO_2, PR, Power					

C.1.16 AG

Item Name	O.M		General	OR	ICU	NICU	CCU	User Defaults
	C	M						
Alarm	*	*	On					
Alm Lev	*	*	Med					
Sweep	*	*	6.25 mm/s					
O_2 Compen	*	*	Off	On	Off			
Operating Mode	*	*	Measure					
Flow Rate	*	*	Adu, Ped: 120 ml/min Neo: 70 ml/min					
Auto Standby	*	*	Off					
Apnea Time	*	*	20 s					
RR Source		*	Auto					
CO_2 Setup								
Wave Type	*	*	Draw					
Scale	*	*	when unit is mmHg: 50 when unit is % or KPa: 7.0					
$EtCO_2$ High（mmHg）	*	*	Adu, Ped: 50 Neo: 45					
$EtCO_2$ Low（mmHg）	*	*	Adu, Ped: 25 Neo: 30					
$FiCO_2$ High（mmHg）	*	*	4					

Item Name	O.M		General	OR	ICU	NICU	CCU	User Defaults
	C	M						
RR High	*	*	Adu, Ped: 30 Neo: 100					
RR Low	*	*	Adu, Ped: 8 Neo: 30					
Gas Setup								
Agent	*	*	AA					
N_2O Scale	*	*	50					
O_2 Scale	*	*	when unit is mmHg: 400 when unit is % or KPa: 50					
AA Scale	*	*	9.0					
Hal/Enf/Iso Scale	*	*	2.5					
Des Scale	*	*	9.0					
Sev Scale	*	*	4.0					
EtO_2 High	*	*	88					
EtO_2 Low	*	*	18					
FiO_2 High	*	*	Adu, Ped: 100 Neo: 90					
FiO_2 Low	*	*	18					
EtN_2O High	*	*	55					
EtN_2O Low	*	*	0					
FiN_2O High	*	*	53					
FiN_2O Low	*	*	0					
EtHal/Enf/Iso High	*	*	3.0					
EtHal/Enf/Iso Low	*	*	0.0					
FiHal/Enf/Iso High	*	*	2.0					
FiHal/Enf/Iso Low	*	*	0.0					
EtSev High	*	*	6.0					
EtSev Low	*	*	0.0					
FiSev High	*	*	5.0					
FiSev Low	*	*	0.0					
EtDes High	*	*	8.0					
EtDes Low	*	*	0.0					
FiDes High	*	*	6.0					
FiDes Low	*	*	0.0					

C.1.17 ICG

Item Name	O.M		General	OR	ICU	NICU	CCU	User Defaults
	C	M						
Alarm	*	*	On					
Alm Lev	*	*	Med					
Averaging	*	*	30					
Update Rate	*	*	10					
Sweep	*	*	12.5 mm/s					
Secondary Parameters	*	*	C.O., SVR, TFC					
C.I. High	*	*	5.0					
C.I. Low	*	*	1.5					
TFC High	*	*	60					
TFC Low	*	*	10					

C.1.18 BIS

Item Name	O.M		General	OR	ICU	NICU	CCU	User Defaults
	C	M						
Alarm	*	*	On					
Alm Lev	*	*	Med					
Smoothing Rate	*	*	15 s			Adu: 15s Ped: 15s Neo: N/A	15 s	
Display	*	*	EEG			Adu: EEG Ped: EEG Neo: N/A	EEG	
Filters	*	*	On			Adu: On Ped: On Neo: N/A	On	
Scale	*	*	100 μ V			Adu: 100 μ V Ped: 100 μ V Neo: N/A	100 μ V	
Sweep	*	*	25mm/s			Adu: 25mm/s Ped: 25mm/s Neo: N/A	25mm/s	
Trend Length	*	*	60 min			Adu: 60 min Ped: 60 min Neo: N/A	60 min	
Secondary Parameters	*	*	SR, SEF			Adu, Ped: SR, SEF Neo: N/A	SR,SEF	

Item Name	O.M		General	OR	ICU	NICU	CCU	User Defaults
	C	M						
Display	*	*	BIS Trend			Adu:BIS Trend Ped:BIS Trend Neo:N/A	BIS Trend	
EEG Waveforms	*	*	All			Adu: All Ped: All Neo: N/A	All	
Parameter 1	*	*	BIS L			Adu: BIS L Ped: BIS L Neo: N/A	BIS L	
Parameter 2	*	*	EMG			Adu: EMG Ped: EMG Neo: N/A	EMG	
BIS High	*	*	70					
BIS Low	*	*	70					

C.1.19 NMT

NMT from Mindray NMT module

Item Name	O.M		General	OR	ICU	NICU	CCU	User Defaults
	C	M						
Stimulation mode	*	*	TOF					
Interval	*	*	TOF, DBS：1 min ST：0.1 Hz					
Stimulation Current	*	*	Supra					
Pulse Width	*	*	200 μs					
Stimulation Beep Volume	*	*	2					
Block Recovery	*	*	Off					
DBS	*	*	DBS 3.3					
NMT parameter switch		*	On					

NMT from TOF-Watch® SX monitor

Item Name	O.M		General	OR	ICU	NICU	CCU	User Defaults
	C	M						
Alarm Sound	*	*	Off					

C.1.20 RM

Item Name	O.M		General	OR	ICU	NICU	CCU	User Defaults
	C	M						
Alarm	*	*	On					
Alm Lev	*	*	Med					
Apnea Delay	*	*	Adu, Ped: 20 s Neo: 15 s					
Sensor Type		*	Disposable					
TV/MV	*	*	TV					
Flow/Vol	*	*	Flow					
Sweep	*	*	6.25 mm/s					
RR Source		*	Auto					
Paw Scale	*	*	Adu, Ped: 40 Neo: N/A					
Flow Scale	*	*	Adu, Ped: 60 Neo: N/A					
Vol Scale	*	*	Adu, Ped: 1200 Neo: N/A					
Display Loop		*	PV Loop					
Reference Loop		*	On					
RR High	*	**	Adu, Ped: 30 Neo: 100					
RR Low	*	*	Adu, Ped: 8 Neo: 30					
PEEP High	*	*	10					
PEEP Low	*	*	0					
PIP High	*	*	40					
PIP Low	*	*	1					
MVe High	*	*	30.0					
MVe Low	*	*	2.0					

C.1.21 EEG

Item Name	O.M		General	OR	ICU	NICU	CCU	User Defaults
	C	M						
Scale	*	*	100 μV					
Sweep	*	*	25 mm/s					
Low Filter	*	*	0.5 Hz					
High Filter	*	*	30 Hz					
Notch Filter	*	*	On					
Montage	*	*	Montage 1					
Montage Type	*	*	Bipolar Mode					
EEG Channels	*	*	EEG 1: Fp1-T3 EEG 2: Fp2-T4 EEG3: C3-O1 EEG 4: C4-O2 PGND: Fpz NE: Cz					
Primary Parameter	*	*	SR					
Secondary Parameters	*	*	SEF, MF, EMG and Theta					
Display in EEG Expand View	*	*	DSA					

C.2 Routine Configuration

C.2.1 Alarm

Item Name	O.M		General	OR	ICU	NICU	CCU	User Defaults
	C	M						
Alm Volume	*	*	2	1	2			
Reminder Vol	*	*	Low					
Recording Length	*	*	16 s					
Apnea Delay	*	*	Adu, Ped: 20 s Neo: 15 s					
Alarm Delay	*	*	6 s					
ST Alarm Delay	*	*	30 s					

C.2.2 Screens

Item Name		O.M		General	OR	ICU	NICU	CCU	User Defaults
		C	M						
Choose Screen		*	*	Normal Screen					
Display the ST segments on ECG screen		*	*	Unselected					
Select Wave Sequence for Normal Screen	1	*	*	ECG1					
	2			ECG2					

Item Name		O.M		General	OR	ICU	NICU	CCU	User Defaults
		C	M						
	3			SpO_2+PR					
	4			Any IBP					
	5			Any IBP					
	6			CO_2					
	7			Paw					
	8			Flow/Vol					
	9			ICG					
	10			BIS					
	11			Resp					
Select Parameters for Big Numerics Screen	Parameter 1	*	*	ECG					
	Parameter 2			SpO_2+PR					
	Parameter 3			Resp					
	Parameter 4			NIBP					

Item Name		Select QuickKeys (BeneView T5/T5 OR)
O.M	C	*
	M	
General		NIBP Measure→Stop All→Zero IBP→Review→Standby→Screens→Patient Setup→Manual Event→Realtime Print→Volume Setup
OR (BeneView T5)		NIBP Measure→Stop All→Zero IBP→Review→Standby→Screens→Patient Setup→Manual Event→Realtime Print→Volume Setup
OR (BeneView T5 OR)		NIBP Measure→Stop All→Zero IBP→Intubation→BOA→Review→Standby→CPB Mode→Manual Event→Realtime Print
ICU		NIBP Measure→Stop All→Zero IBP→Review→Standby→Screens→Patient Setup→Manual Event→Realtime Print→Volume Setup
NICU		NIBP Measure→Stop All→oxyCRG→Review→Standby→Screens→Patient Setup→Manual Event→Realtime Print→Volume Setup
CCU		NIBP Measure→Stop All→Zero IBP→Review→Standby→Screens→Patient Setup→Manual Event→Realtime Print→Volume Setup
User Defaults		

Item Name		Select QuickKeys (BeneView T8)
O.M	C	*
	M	
General		NIBP Measure→Stop All→Zero IBP→Screens→Patient Setup→Manual Event→Realtime Print→Print Setup→Minitrends→Volume Setup→Load Configuration→Privacy Mode
OR		NIBP Measure→Stop All→Zero IBP→Screens→Patient Setup→Manual Event→Realtime Print→Print Setup→Minitrends→Volume Setup→Load Configuration→PAWP
ICU		NIBP Measure→Stop All→Zero IBP→Screens→Patient Setup→Manual Event→Realtime Print→Print Setup→Minitrends→Volume Setup→Load Configuration→Privacy Mode
NICU		NIBP Measure→Stop All→oxyCRG→Screens→Patient Setup→Manual Event→Realtime Print→Minitrends→Zero IBP→Volume Setup→Load Configuration→Privacy Mode

CCU	NIBP Measure→Stop All→Zero IBP→Screens→Patient Setup→Manual Event→Realtime Print→Print Setup→Minitrends→Volume Setup→Load Configuration→Privacy Mode
User Defaults	

Item Name		**Select QuickKeys (BeneView T9/T9 OR)**
O.M	**C**	*
	M	
General		NIBP Measure→Stop All→Zero IBP→Screens→Patient Setup→Manual Event→Realtime Print→Print Setup→Minitrends→Volume Setup→Load Configuration→Privacy Mode
OR (BeneView T9)		NIBP Measure→Stop All→Zero IBP→Screens→Patient Setup→Manual Event→Realtime Print→Print Setup→Minitrends→Volume Setup→Load Configuration→PAWP
OR (BeneView T9 OR)		NIBP Measure→Stop All→Zero IBP→Intubation→BOA→CPB Mode→Patient Setup→Manul Event→Realtime Print→Print Setup→Volume Setup→PAWP
ICU		NIBP Measure→Stop All→Zero IBP→Screens→Patient Setup→Manual Event→Realtime Print→Print Setup→Minitrends→Volume Setup→Load Configuration→Privacy Mode
NICU		NIBP Measure→Stop All→oxyCRG→Screens→Patient Setup→Manual Event→Realtime Print→Minitrends→Zero IBP→Volume Setup→Load Configuration→Privacy Mode
CCU		NIBP Measure→Stop All→Zero IBP→Screens→Patient Setup→Manual Event→Realtime Print→Print Setup→Minitrends→Volume Setup→Load Configuration→Privacy Mode
User Defaults		

C.2.3 Parameter/Wave Color

Item Name		**O.M**		**General**	**OR**	**ICU**	**NICU**	**CCU**	**User Defaults**
		C	**M**						
Parameter/ Wave Colour	ECG		*	Green					
	NIBP			White					
	SpO_2			Cyan					
	SpO_2b			Purple					
	ΔSpO_2			Yellow					
	PR			Cyan					
	TEMP			White					
	Art/Ao/UAP/FAP /BAP/LV/P1~P4 (arterial pressure)			Red					
	PA			Yellow					
	CVP/ICP/P1~P4 (venous pressure)			Blue					
	LAP			Purple					
	RAP			Orange					
	UVP			Cyan					
	CO_2/tcpCO_2			Yellow					
	RESP			Yellow					

Item Name		O.M		General	OR	ICU	NICU	CCU	User Defaults
		C	M						
	AA			Yellow					
	N_2O			Blue					
	O_2 /$tcpO_2$			Green					
	Hal			Red					
	Enf			Orange					
	Iso			Purple					
	Des			Cyan					
	Sev			Yellow					
	C.O.			White					
	Paw			Blue					
	Flow/Vol								
	EEG L/BIS L Trend			Yellow					
	EEG R/BIS R Trend			Blue					
	ICG			Purple					
	SvO_2			Cyan					
	$ScvO_2$			Purple					
	CCO			Yellow					
	NMT			White					
	EEG1			Red					
	EEG 2			Blue					
	EEG 3			Yellow					
	EEG 4			Green					

X represents a waveform label, such as ECG, RESP, CO_2 and so forth. The ECG waveform cannot be set off.

C.2.4 Review

Item Name		O.M		General	OR	ICU	NICU	CCU	User Defaults
		C	M						
Tabular Trends	Interval	*	*	30 min	5min	30 min			
	Trend Group	*	*	Standard					
Graphic Trends	Trend Group	*	*	Standard					
Minitrend Length			*	2 h					
Full Disclosure	Save Waves	*	*	Save ECG1 by default.					

C.2.5 Event

Item Name	O.M		General	OR	ICU	NICU	CCU	User Defaults
	C	M						
Waveform 1		*	II					
Waveform 2		*	I			Pleth	I	
Waveform 3		*	Pleth			Resp	Pleth	

C.2.6 Record

Item Name		O.M		General	OR	ICU	NICU	CCU	User Defaults
		C	M						
Length			*	8 s					
Interval			*	Off					
Paper Speed			*	25 mm/s					
IBP Overlap			*	Off					
Alm Rec	X		*	Off					

X represents a parameter label.

C.2.7 Print

Item Name		O.M		General	OR	ICU	NICU	CCU	User Defaults
		C	M						
Paper Size			*	A4					
ECG Reports	Amplitude		*	10 mm/mV					
	Sweep		*	25 mm/s					
	Auto Interval		*	Off					
	12-Lead Format		*	12X1					
Tabular Trends Reports	Set as End Case Report		*	Unselected					
	Back		*	Auto					
	Spacing		*	Auto					
	Report Layout		*	Parameter Oriented					
	Currently Displayed Trended Parameters		*	Selected					
	Standard Parameter Group		*	Unselected					
	Custom		*	Unselected					
Graphic Trends Reports	Set as End Case Report		*	Unselected					
	Back		*	Auto					
	Zoom		*	Auto					
Realtime Report	Set as End Case Report		*	Unselected					
	Sweep		*	Auto					
	Select Wave		*	Current					

C.2.8 Others

Item Name	O.M		General	OR	ICU	NICU	CCU	User Defaults
	C	M						
Brightness		*	5					
Key Volume		*	2					

C.3 User Maintenance Items

Item Name	O.M		General	OR	ICU	NICU	CCU	User Defaults
	C	M						
Changing Bed No.		*	Protected					
Atmospheric Pressure		*	760 mmHg					
Height Unit		*	cm					
Weight Unit		*	kg					
ST Unit		*	mV					
Press. Unit		*	mmHg					
CVP Unit		*	cmH_2O					
CO_2 Unit		*	mmHg					
O_2 Unit		*	%					
Hb Unit		*	g/dl					
$tcpCO_2$ / $tcpO_2$ Unit		*	mmHg					
Temp Unit		*	℃					
Network Type		*	LAN					
Address Type		*	Manual					
Select CMS (for T5 only)		*	On					
ADT Query		*	On					
Latching Alarms	*	*	No					
Alarm Pause Time	*	*	2 min					
Max. Alarm Pause 15min		*	Disable					
High Alarm Interval (s)		*	10					
Med Alarm Interval (s)		*	20					
Low Alarm Interval (s)		*	20					
Alarm Light on Alarm Reset		*	On					
Reset Other Bed's Alarms		*	Off					
Alarm Reset By Other Bed		*	On					
Minimum Alarm Volume	*	*	2	1	2			
Alarm Sound		*	ISO					
Reminder Tone		*	On					
Reminder Interval		*	3 min					
ECGLeadOff Lev.		*	Low					
SpO_2SensorOff Lev.		*	Low					
IBPSensorOff Lev.		*	Med					
Lethal Arrh. OFF		*	Disable					
Extended Arrh.		*	Enable					
Alarm Delay		*	6 s					
ST Alarm Delay		*	30 s					
Intubation Mode Period		*	2min					
Other Bed Disconnection Alm		*	On					
Wave Line		*	Mediate					
Primary Button		*	Left					

Item Name		O.M		General	OR	ICU	NICU	CCU	User Defaults
		C	M						
ECG Standard			*	AHA					
Notch Freq.			*	50 Hz					
Data Transfer Method			*	Off					
Transferred Data Length			*	4 h					
Data transfer strategy			*	Always Ask					
Apply Module Settings			*	On					
Para Switch Authority			*	Unprotected					
Parameter Switch		*	*	■ When [**Para Switch Authority**] is set to [**Protected**]: Unselected ■ When [**Para Switch Authority**] is set to [**Unprotected**]: Selected					
SpO_2 Tone			*	Mode 1					
Nurse Call	Signal Type		**	Continuous					
	Contact Type		*	Normally Closed					
	Alm Lev	*	*	High, Med, Low					
	Alarm Cat.	*	*	Phys., Tech.					

FOR YOUR NOTES

D Alarm Messages

This chapter lists only the most important physiological and technical alarm messages. Some messages appearing on your monitor may not be included.

In this chapter:

- The "I" column indicates how indications of technical alarms perform after the alarm system is reset: "A" means that some technical alarms are cleared; "B" indicates that some technical alarms are changed to the prompt messages; and "C" indicates that a " √ " appears before the alarm message, appears in the alarm symbol area, and the indication of the alarm lamp depends on the alarm light setting. Refer to ***section 7.8 Resetting Alarms*** for details.
- The "L" field indicates the alarm level: H means high, M means medium and L means low. "*" means the alarm level is user-adjustable.
- XX represents a measurement or parameter label, such as ECG, NIBP, HR, ST-I, PVCs, RR, SpO_2, PR, etc.

In the "Cause and Solution" column, corresponding solutions are given instructing you to troubleshoot problems. If the problem persists, contact your service personnel.

D.1 Physiological Alarm Messages

Measurement	Alarm messages	L	Cause and solution
XX	XX Too High	M*	XX value has risen above the high alarm limit or fallen below the low alarm limit. Check the patient's condition and check if the patient category and alarm limit settings are correct.
	XX Too Low	M*	
ECG	ECG Weak Signal	H	The ECG signal is so weak that the monitor can't perform ECG analysis. Check the patient's condition and the ECG connections.
	Asystole	H	Arrhythmia has occurred to the patient. Check the patient's condition and the ECG connections.
	VFib/VTac	H	
	Vtac	H	
	Vent. Brady	H	
	Extreme Tachy	H	
	Extreme Brady	H	
	R on T	M*	
	RunPVCs	L*	
	PVCs/min	M*	
	Bigeminy	M*	
	Trigeminy	M*	
	Tachy	M*	
	Brady	M*	
	Vent. Rhythm	M*	
	Multif. PVC	M*	

Measurement	Alarm messages	L	Cause and solution
	Nonsus. Vtac	M*	
	Pause	L*	
Resp	Resp Apnea	H	The respiration signal was so weak that the monitor cannot perform respiration analysis. Check the patient's condition and the Resp connections.
	Resp Artifact	H	The patient's heartbeat has interfered with his respiration. Check the patient's condition and the Resp connections.
SpO_2	SpO_2 Desat	H	The SpO_2 or SpO_2b value has fallen below the desaturation alarm limit. Check the patient's condition and check if the alarm limit settings are correct.
	SpO_2b Desat		
	No Pulse	H	The pulse signal was so weak that the monitor cannot perform pulse analysis. Check the patient's condition, SpO_2 sensor and measurement site.
CO_2	CO_2 Apnea	H	The patient stops breathing, or the respiration signal was so weak that the monitor cannot perform respiration analysis. Check the patient's condition and the RM connections.
AG	AG Apnea	H	
RM	RM Apnea	H	
AG	FiO_2 Too Low	H	Check the patient's condition, the ventilated O_2 content and the AG connections.
	Mixed Agent and MAC ≥ 3	M	The mixed anaesthetic gases concentration is too high. Adjust the anaesthetic gases concentration.
tcGas	+tcpCO_2 Alarm	M*	Parameter value has risen above the high alarm limit or fallen below the low alarm limit. Check the patient's condition and check if the patient category and alarm limit settings are correct.
	+tcpO_2 Alarm	M*	
	+SpO_2 Alarm	M*	
	+PR Alarm	M*	
NMT	TOF Alarm	M*	TOF value has risen above the high alarm limit or fallen below the low alarm limit. Check the patient's condition and check if the patient category and alarm limit settings are correct.

D.2 Technical Alarm Messages

Measurement	Alarm message	L	I	Cause and solution
XX	XX SelfTest Err	H	C	An error occurred to the XX module, or there is a problem with the communications between the module and the monitor. Re-plug the module and restart the monitor, or plug the module into another monitor.
	XX Init Err	H	A	
	XX Init Err N(N is between 1 to 8)	H	A	
	XX Comm Err	H	A	
	XX Comm Stop	H	C	
	XX Limit Err	L	C	XX parameter limit is accidentally changed. Contact your service personnel.
	XX Overrange	L	C	The measured XX value is not within the specified range for XX measurement. Contact your service personnel.
MPM	MPM 12V Err	H	C	An error occurred to the power supply part of the MPM module. Contact your service personnel.
	MPM 5V Err	H	C	
T1	T1 battery to be protected and not work.	H	C	The battery will be soon protected and will not supply power. If you are going to use T1 for patient transport, please replace the battery.
	T1 battery aged. Replace the battery	L	C	Replace the battery.
	T1 No Battery	H	C	T1 has no battery. Install a battery for T1.
	PWR interrupted. Check meas. state	L	A	Power supply failed accidently. Check the measurements when the monitor restarts.
	High Technical Alarm	H	C	T1 has a high/mediate/low technical alarm. Check the T1 monitor for the alarm.
	Mediate Technical Alarm	M	C	
	Low Technical Alarm	L	C	
ECG	ECG Lead Off	L*	B	The electrode has become detached from the patient or the lead wire has become disconnected from the adapter cable. Check the connections of the electrodes and leadwires.
	ECG YY Lead Off	L*	B	
	Note: YY represents the leadwires, V (V1, V2, V3, V4, V5, V6,), LL, LA, RA, as per AHA standard, or C (C1, C2, C3, C4, C5, C6), F, L and R as per IEC standard.			
	ECG Noisy	L	A	The ECG signal is noisy. Check for any possible sources of signal noise around the cable and electrode, and check the patient for great motion.
	ECG Artifact	L	A	Artifacts are detected on the ECG analysis lead and as a result heart rate cannot be calculated and Asystole, Vfib and Vtac cannot be analyzed. Check the connections of the electrodes and leadwires and check for any possible source of interference around the cable and electrode. Check the patient's condition and check the patient for great motion.

Measurement	Alarm message	L	I	Cause and solution
	ECG Low Freq. Noise	L	A	Low frequency signals are detected on the ECG analysis lead. Check for any possible source of interference around the cable and electrode.
	ECG Amplitude Too Small	L	C	The ECG amplitude didn't reach the detected threshold. Check for any possible source of interference around the cable and electrode.
	ECG Config. Err	L	C	ECG configuration is wrongly downloaded. Check the downloaded configuration and re-download the correct configuration.
Temp	Temp Cal. Err/Tempb Calib Err	H	C	A calibration failed. Restart the monitor.
	YY Sensor Off	L	A	The temperature sensor has become detached from the patient or the module. Check the sensor connections.
	YY represents a temperature label.	L	A	
	Tempb Power Error	H	C	There is a problem with the power supply. Re-plug the module or restart the monitor.
SpO_2	SpO_2 Sensor Off	L*	B	The SpO_2 sensor has become detached from the patient or the module, or there is a fault with the SpO_2 sensor, or an unspecified SpO_2 sensor has been used. Check the sensor application site and the sensor type, and make sure if the sensor is damaged. Reconnect the sensor or use a new sensor.
	SpO_2b Sensor Off			
	SpO_2 Sensor Fault	L	C	
	SpO_2b Sensor Fault			
	SpO_2 No Sensor	L	B	
	SpO_2b No Sensor			
	SpO_2 Unknown Sensor	L	C	
	SpO_2b Unknown Sensor			
	SpO_2 Sensor Incompatible	L	C	
	SpO_2b Sensor Incompatible			
	SpO_2 Too Much Light	L	C	There is too much light on the SpO_2 sensor. Move the sensor to a place with lower level of ambient light or cover the sensor to minimize the ambient light.
	SpO_2b Too Much Light			
	SpO_2 Low Signal	L	C	The SpO_2 signal is too low. Check the patient's condition and change the sensor application site. If the error persists, replace the sensor.
	SpO_2 b Low Signal			
	SpO_2 No Pulse	L	C	The SpO_2 sensor failed to obtain pulse signal. Check the patient's condition and change the sensor application site. If the error persists, replace the sensor.
	SpO_2b No Pulse			
	SpO_2 Interference	L	C	The SpO_2 signal has been interfered. Check for any possible sources of signal noise around the sensor and check the patient for great motion.
	SpO_2b Interference			
	SpO_2 Comm abnormal	H	A	An error occurred to the SpO_2 measurement module, or there is a problem with the communications between the module and the monitor. Re-plug the module and restart the monitor, or plug the module into another monitor.
	SpO_2b Comm abnormal			

Measurement	Alarm message	L	I	Cause and solution
	SpO_2 Board Fault	L	C	There is a problem with the SpO_2 measurement board. Do not use the module and contact your service personnel.
	SpO_2b Board Fault			
	SpO_2b has been closed	H	C	Different types of SpO_2 measurement modules are applied. Use the same type of SpO_2 measurement modules.
NIBP	NIBP Loose Cuff	L	A	The NIBP cuff is not properly connected, or there is a leak in the airway.
	NIBP Air Leak	L	A	
	NIBP Pneumatic Leak	L	A	Check the NIBP cuff and pump for leakages.
	NIBP Cuff Type Wrong	L	A	The cuff type applied mismatches the patient category. Verify the patient category and replace the cuff.
	NIBP Air Pressure Err	L	A	An error occurred to the air pressure. Verify that the monitor application site meets the environmental requirements and check if there is any source that affects the air pressure.
	NIBP Weak Signal	L	A	The patient's pulse is weak or the cuff is loose. Check the patient's condition and change the cuff application site. If the error persists, replace the cuff.
	NIBP Signal Saturated	L	A	The NIBP signal is saturated due to excess motion or other sources.
	NIBP Overrange	L	A	The measured NIBP value exceeds the module measurement range.
	NIBP-XX Over Upper Limit	L	A	The measured pressure is greater than the specified NIBP measurement upper limit.
	NIBP-XX Over Lower Limit	L	A	The measured pressure is lower than the specified NIBP measurement lower limit.
	XX represents diastolic pressure, mean pressure, or systolic pressure.			
	NIBP Excessive Motion	L	A	Check the patient's condition and reduce the patient motion.
	NIBP Cuff Overpress.	L	A	The NIBP airway may be occluded. Check the airway and measure again.
	NIBP Equip Err	H	A	An error occurred during NIBP measurement and therefore the monitor cannot perform analysis correctly. Check the patient's condition and NIBP connections, or replace the cuff.
	NIBP Timeout	L	A	
	NIBP Measure Failed	L	A	
	NIBP Illegally Reset	L	A	An illegal reset occurred during NIBP measurement. Check if the airway is occluded.
IBP	YY Sensor Off	M*	A	Check the sensor connection and reconnect the sensor.

Measurement	Alarm message	L	I	Cause and solution
	YY Disconnected	H	C	The liquid way is disconneted from the patient, or the three-way valve is open to the air. Check the connection of the liquid way, or check the valve is open to the patient. If the problem remains, contact the Customer Services Dept. for help.
	YY Sensor Fault	M	C	Replace the sensor.
	YY No Pulse	L	A	The catheter may be occluded. Please flush the catheter.
	YY represents an IBP label.			
C.O.	TB Sensor Off	L	A	Check the sensor connection and reconnect the sensor.
PiCCO	Invalid/Faulty PiCCO catheter	L	C	Erroneous or invalid catheter is used. Please use the proper catheter.
	TB Sensor Off	L	A	Check the sensor connections.
	TI Sensor Off	L	A	Check the sensor connections.
	Invalid CCO calibration	M	A	The measurement of pArt, PR or pCVP is invalid, or exceeds the corresponding measurement range.
	PiCCO Comm Abnormal	H	A	Abnormal communication occurred between the PiCCO module and the system. Remove/connect the module again or restart the machine. If the problem remains, contact the Customer Services Dept. for help.
	PiCCO Comm Err	H	A	Erroneous communication occurred between the PiCCO module and the system. Remove/connect the module again or restart the machine. If the problem remains, contact the Customer Services Dept. for help.
	PiCCO Init Err	H	A	An error occurred to the module during the power-on self-test. Remove/connect the module again or restart the machine. If the problem remains, contact the Customer Services Dept. for help.
	Inject Temp. Sensor Err	L	C	An error occurred to the injectate temperature sensor or the sensor cable. Check/replace the sensor or the sensor cable.
	PiCCO Comm Stop	H	A	Remove/connect the module again or restart the machine. If the problem remains, contact the Customer Services Dept. for help.
$ScvO_2$	Optical Module Err	L	C	Check the module connection. Change a module if necessary.
	$ScvO_2$ Signal Too High	L	C	Check the sensor and reposition the catheter, then recalibrate the sensor.
	$ScvO_2$ Signal Too Low	L	C	
	$ScvO_2$ Too Much Light	L	C	Check and reposition the catheter, then recalibrate the sensor. Avoid the backlight which is excessively strong.

Measurement	Alarm message	L	I	Cause and solution
	Optical Module Disconnected	L	A	Connect the optical module.
	$ScvO_2$ Comm Abnormal	H	A	Remove/connect the module again or restart the machine. If the problem remains, contact the Customer Services Dept. for help.
	$ScvO_2$ Comm Err	H	A	
	$ScvO_2$ Init Err	H	A	Remove/connect the module again. If the problem remains, contact the Customer Services Dept. for help.
	Unsupported CeVOX version	H	A	The module version is not compatible with the system. Please contact the Customer Services Dept. for help.
	$ScvO_2$ Comm Stop	H	A	Remove/connect the module again or restart the machine. If the problem remains, contact the Customer Services Dept. for help.
CO_2	CO_2 Sensor High Temp	L	C	Check, stop using or replace the sensor.
	CO_2 Sensor Low Temp	L	C	Check, stop using or replace the sensor.
	CO_2 Temp Overrange	L	C	The operating temperature of the CO_2 module goes beyond the specified range. After it restores within the specified range, the module will restart automatically.
	CO_2 Airway High Press.	L	C	An error occurred in the airway pressure. Check the patient connection and patient circuit, and then restart the monitor.
	CO_2 Airway Low Press.	L	C	
	CO_2 High Barometric Press.	L	C	Check the CO_2 connections, make sure that the monitor application site meets the requirements, and check for special sources that affect the ambient pressure. Restart the monitor.
	CO_2 Low Barometric Press.	L	C	
	CO_2 FilterLine Occluded	L	C	The airway or watertrap was occluded. Check the airway and remove the occlusion.
	CO_2 No Watertrap	L	B	Check the watertrap connections.
	CO_2 Check Adapter	L	A	There is a problem with the airway adapter. Check, clean or replace the adapter.
	CO_2 FilterLine Err	L	C	Check if there is a leak in the CO_2 sample line or the CO_2 sample line has been occluded.
	CO_2 Zero Failed	L	A	Check the CO_2 connections. After the sensor's temperature becomes stabilized, perform a zero calibration again.
	CO_2 System Err	L	A	Re-plug the module or restart the monitor.
	CO_2 Check Cal.	L	C	Perform a calibration.
	CO_2 Check Airway	L	C	An error occurred to the airway.

Measurement	Alarm message	L	I	Cause and solution
	CO_2 No Filterline	L	A	Make sure that the filterline is connected.
	CO_2 No Sensor	L	A	Make sure that the sensor is connected.
	CO_2 Main Board Err	H	C	There is a problem with the CO_2 module. Re-plug the module or restart the monitor.
	CO_2 Checking Sensor	L	C	
	CO_2 Replace Scrubber&Pump	L	C	
	CO_2 15V Overrange	H	C	
	CO_2 Hardware Err	H	C	
tcGas	tcGas Low Battery	M	C	Connect the TCM monitor or senTec monitoring system with AC mains.
	tcGas Battery Depleted	H	C	TCM monitor or senTec monitoring system has less than 5 minutes running time on battery. Connect the TCM monitor or senTec monitoring system with AC mains immediately.
	TCM Temperature Too High	H	C	The temperature in TCM CPU is too high. Please shut down TCM monitor immediately.
	TCM Alert	L	C	A TCM technical alarm is presented. Please check the TCM monitor to identify the cause of alarm.
AG	AG No Watertrap	L	B	Check the connections of the watertrap and re-connect it.
	AG Change Watertrap	L	A	Wait until the change is completed.
	AG Watertrap Type Wrong	L	A	Make sure that a correct watertrap has been used.
	O_2 Accuracy Unspecified	L	A	The measured value has exceeded the specified accuracy range.
	N_2O Accuracy Unspecified	L	A	
	CO_2 Accuracy Unspecified	L	A	
	Enf Accuracy Unspecified	L	A	
	Iso Accuracy Unspecified	L	A	
	Sev Accuracy Unspecified	L	A	
	Hal Accuracy Unspecified	L	A	
	Des Accuracy Unspecified	L	A	
	awRR Accuracy Unspecified	L	A	
	AG Hardware Err	H	A	Remove the AG module. Stop using the module and contact your service personnel.
	AG Airway Occluded	L	A	Check the airway and remove the occlusion.
	AG Zero Failed	L	A	Re-plug the module or restart the monitor, and then perform a zero calibration again.
RM	RM No Sensor	L	A	Check and reconnect the sensor.
	RM Zero Failed	L	C	Re-plug the module. If the problem remains, contact the Customer Services Dept. for help.
	RM Power Err	L	A	There is a problem with the power supply. Re-plug the module or restart the monitor.
BIS	BIS High Imped.	L	A	Check and reconnect the BIS sensor.

Measurement	Alarm message	L	I	Cause and solution
	BIS Sensor Off	L	A	
	BIS DSC Err	L	C	An error occurred to the DSC during receiving signals. Check the DSC.
	BIS DSC Malf	L	C	The DSC automatically shuts down as a result of malfunction. Check the DSC.
	BIS No Cable	L	A	Check the BIS cables.
	BISx Disconnected	L	A	Check the BISx module.
	BIS No Sensor	L	A	Check the BIS sensor.
	BIS Wrong Sensor Type	L	A	Check or replace the sensor.
	BIS Sensor Too Many Uses	L	A	Replace the sensor.
	SQI<50%	L	A	The SQI value is too low. Check the patient's condition and the sensor connections.
	SQI<15%	L	A	
	BIS Sensor Expired	L	A	Replace the sensor.
	BIS Sensor Fault	L	C	Re-attach or Replace BIS Sensor
	Disconnect/Reconnect BIS	L	C	Re-plug the BIS Module
ICG	ICG Low Quality Signal	L	A	Check and reconnect the sensor.
	L1 Sensor Off (Only available in normal patient cables)	L	A	
	R1 Sensor Off (Only available in normal patient cables)	L	A	
	L2/3 Sensor Off	L	A	
	R2/3 Sensor Off	L	A	
	L4 Sensor Off (Only available in inverted patient cables)	L	A	
	R4Sensor Off (Only available in inverted patient cables)	L	A	
	ICG No Sensor	L	A	
	ICG Sensor Off	L	A	
NMT (Mindray)	NMT No Main Cable	L	A	Check that NMT patient cable is properly connected to the NMT module.
	NMT Sensor Fault	L	C	The NMT sensor has a fault. Reconnect or replace the sensor.
	NMT No Sensor	L	A	Check that NMT sensor is properly connected to the NMT patient cable. If the alarm persists, replace the sensor.
	NMT Stimulation Electrode Off	L	A	Check that NMT sensor is properly connected to the NMT patient cable. If the alarm persists, check the application of electrodes.

Measurement	Alarm message	L	I	Cause and solution
	NMT Stimulation Current Over Limit	L	C	The output stimulation current exceeds the specification.
	NMT Power Err	H	A	Contact your service personnel.
	NMT Abnormal Reset	L	A	Take out the NMT module and plug it again in the module rack. Restart the patient monitor or test the monitor with another BeneView monitor. If the problem persists, contact your service personnel.
NMT (TOF-Watch® SX)	TWSX Low Battery	M	C	Replace the battery.
	TWSX Battery Depleted	H	C	Replace the battery.
	TWSX No Acceleration Sensor	L	B	Connect the acceleration sensor.
	TWSX No Temp Sensor	L	B	Connect the temperature sensor.
	TWSX No Stimulation Cable	L	B	Connect the stimulation cable.
	TWSX Bad Electrode Connection	L	B	Reattach the electrode.
	TWSX Technical Alarm	L	C	An NMT technical alarm is presented. Please check the TOF-Watch® SX monitor to identify the cause of alarm.
EEG	EEG Overcurrent	H	C	Remove the module from the monitor. Replug the module.
	EEG Comm Abnormal	H	A	An error occurred to the EEG module, or there is a problem with the communications between the module and the monitor. Re-plug the module and restart the monitor, or plug the module into another monitor.
	EEG Sensor Off	L	A	Check and reconnect the EEG sensor.
	EEG No Sensor	L	A	Check the EEG sensor.
	EEG Electrode X:Y Off (X=pole label, Y=lead label)	L	A	Check and reconnect the EEG electrode.
	EEG Electrode X:Y High Imped. (X=pole label, Y=lead label)	L	A	
	EEG Electrode X:Y Noise (X=pole label, Y=lead label)	L	A	The EEG signal is noisy. Check for any possible sources of signal noise around the cable and electrode, and check the patient for great motion.
Power	12V Too High	H	C	There is a problem with the system power supply. Restart the monitor.
	12V Too Low	H	C	
	5V Too High	H	C	
	5V Too Low	H	C	
	3.3V Too High	H	C	

Measurement	Alarm message	L	I	Cause and solution
	3.3V Too Low	H	C	
	Battery Too Low	H	C	Connect the monitor to an AC power source and allow the batteries to charge.
	Different Battery Voltages	M	C	The two batteries have different charge capacity, or the batteries unspecified have been used, or there is a problem with the batteries. Make sure that correct batteries are used and the batteries are not damaged, or replace the batteries.
	iView requires AC power	H	C	When batteries are used as the power source, iView system can not properly work. If you want to use iView system, please power the monitor with an AC power source.
	RT Clock Not Exist	H	C	Contact your service personnel.
Recorder	Recorder Init Err N	L	A	Restart the monitor.
	N is within 1 to 8.			
	Recorder SelfTest Err	L	A	Stop the recording and restart the monitor.
	Recorder Comm Err	L	A	
	Recorder S. Comm Err	L	A	
	Recorder Unavailable	L	A	
	Recorder Vlt High	L	C	An error occurred to the system power supply. Restart the monitor.
	Recorder Vlt Low	L	C	
	Recorder Head Hot	L	C	The recorder has been working for too long time. Stop the recording and resume the recording till the recorder's printhead cools down.
	Rec Paper Wrong Pos.	L	A	Re-load the recorder paper.
System	System Watchdog Err	H	C	An error occurred to the system. Restart the monitor.
	System Software Err	H	C	
	System CMOS Full	H	C	
	System CMOS Err	H	C	
	System FPGA Err	H	C	
	System Err N	H	C	
	N is within 2 to 12.			
	Storage Card Space Low	L	B	The CF card has abnormal data. Format the storage card.
	Other Bed Disconnected	L	A	Check network connection.
	No CMS	L	A	The monitor is disconnected from the CMS. Check network connection.

FOR YOUR NOTES

E Electrical Safety Inspection

The following electrical safety tests are recommended as part of a comprehensive preventive maintenance program. They are a proven means of detecting abnormalities that, if undetected, could prove dangerous to either the patient or the operator. Additional tests may be required according to local regulations.

All tests can be performed using commercially available safety analyzer test equipment. These procedures assume the use of a 601PROXL International Safety Analyzer or equivalent safety analyzer. Other popular testers complying with IEC 60601-1 used in Europe, such as Fluke, Metron, or Gerb, may require modifications to the procedure. Please follow the instructions of the analyzer manufacturer.

The electrical safety inspection should be periodically performed every two years .The safety analyzer also proves to be an excellent troubleshooting tool to detect abnormalities of line voltage and grounding, as well as total current loads.

E.1 Power Cord Plug

Test Item		Acceptance Criteria
The power plug	The power plug pins	No broken or bent pin. No discolored pins.
	The plug body	No physical damage to the plug body.
	The strain relief	No physical damage to the strain relief. No plug warmth for device in use.
	The power plug	No loose connections.
The power cord		No physical damage to the cord. No deterioration to the cord.
		For devices with detachable power cords, inspect the connection at the device.
		For devices with non-detachable power cords, inspect the strain relief at the device.

E.2 Device Enclosure and Accessories

E.2.1 Visual Inspection

Test Item	Acceptance Criteria
The enclosure and accessories	No physical damage to the enclosure and accessories.
	No physical damage to meters, switches, connectors, etc.
	No residue of fluid spillage (e.g., water, coffee, chemicals, etc.).
	No loose or missing parts (e.g., knobs, dials, terminals, etc.).

E.2.2 Contextual Inspection

Test Item	Acceptance Criteria
The enclosure and accessories	No unusual noises (e.g., a rattle inside the case).
	No unusual smells (e.g., burning or smoky smells, particularly from ventilation holes).
	No taped notes that may suggest device deficiencies or operator concerns.

E.3 Device Labelling

Check the labels provided by the manufacturer or the healthcare facilities are present and legible.

- Main unit label
- Integrated warning labels

E.4 Protective Earth Resistance

1. Plug the probes of the analyzer into the device's protective earth terminal and protective earth terminal of the AC power cord.
2. Test the earth resistance with a current of 25 A.
3. Verify the resistance is less than limits.

LIMITS

For all countries, R = 0.2 Ω Maximum

E.5 Earth Leakage Test

Run an Earth Leakage test on the device being tested before performing any other leakage tests.

The following outlet conditions apply when performing the Earth Leakage test:

- normal polarity(Normal Condition),
- reverse polarity(Normal Condition),
- normal polarity with open neutral(Single Fault Condition),
- reverse polarity with open neutral(Single Fault Condition)

LIMITS

For UL60601-1,

- 300 μA in Normal Condition
- 1000 μA in Single Fault Condition

For IEC60601-1,

- 500 μA in Normal Condition
- 1000 μA in Single Fault Condition

E.6 Patient Leakage Current

Patient leakage currents are measured between a selected applied part and mains earth. All measurements have a true RMS only

The following outlet conditions apply when performing the Patient Leakage Current test.

- normal polarity(Normal Condition);
- reverse polarity(Normal Condition),
- normal polarity with open neutral(Single Fault Condition);
- reverse polarity with open neutral(Single Fault Condition).
- normal polarity with open earth(Single Fault Condition);
- reverse polarity with open earth(Single Fault Condition).

LIMITS

For CF applied parts

- 10μA in Normal Condition
- 50μA in Single Fault Condition

For BF applied parts

- 100μA in Normal Condition
- 500μA in Single Fault Condition

E.7 Mains on Applied Part Leakage

The Mains on Applied Part test applies a test voltage, which is 110% of the mains voltage, through a limiting resistance, to selected applied part terminals. Current measurements are then taken between the selected applied part and earth. Measurements are taken with the test voltage (110% of mains) to applied parts in the normal and reverse polarity conditions

The following outlet conditions apply when performing the Mains on Applied Part test.

- Normal Polarity;
- Reversed Polarity

LIMITS

- For CF applied parts: 50 μA
- For BF applied parts: 5000 μA

E.8 Patient Auxiliary Current

Patient Auxiliary currents are measured between any selected Applied Part connector and the remaining Applied Part connector s. All measurements may have a true RMS only response.

The following outlet conditions apply when performing the Patient Auxiliary Current test.

- normal polarity(Normal Condition);
- reverse polarity(Normal Condition),
- normal polarity with open neutral(Single Fault Condition);
- reverse polarity with open neutral(Single Fault Condition).
- normal polarity with open earth(Single Fault Condition);
- reverse polarity with open earth(Single Fault Condition).

LIMITS

For CF applied parts,

- 10μA in Normal Condition
- 50μA in Single Fault Condition

For BF applied parts,

- 100μA in Normal Condition
- 500μA in Single Fault Condition

NOTE

- **Make sure the safety analyzer is authorized comply with requirement of IEC60601-1.**
- **Follow the instructions of the analyzer manufacturer.**

F Symbols and Abbreviations

F.1 Symbols

µA	microampere
µV	microvolt
µs	Microsecond
A	ampere
Ah	ampere hour
bpm	beat per minute
bps	bit per second
°C	centigrade
cc	cubic centimeter
cm	centimeter
dB	decibel
DS	dyne second
°F	fahrenheit
g	gram
GHz	gigahertz
GTT	gutta
h	hour
Hz	hertz
in	inch
kg	kilogram
kPa	kilopascal
L	litre
lb	pound
m	meter
mAh	milliampere hour
Mb	mega byte
mcg	microgram
mEq	milli-equivalents
mg	milligram
min	minute
ml	milliliter
mm	millimeter
mmHg	millimeters of mercury
cmH2O	centimeters of water
ms	millisecond
mV	millivolt
mW	milliwatt
MΩ	megaohm

nm	nanometer
rpm	breath per minute
s	second
V	volt
VA	volt ampere
Ω	ohm
W	watt

–	minus, negative
%	percent
/	per; divide; or
+	plus
=	equal to
<	less than
>	greater than
≤	less than or equal to
≥	greater than or equal to
±	plus or minus
×	multiply

F.2 Abbreviations

$AaDO_2$	alveolar-arterial oxygen gradient
AAMI	Association for Advancement of Medical Instrumentation
AC	alternating current
ACI	acceleration index
Adu	adult
AG	anaesthesia gas
AHA	American Heart Association
air cyl.	Air cylinder pressure
Air Flow	air flow
ANSI	American National Standard Institute
Ao	aortic pressure
Art	arterial
ATMP	Barometric pressure
aVF	left foot augmented lead
aVL	left arm augmented lead
aVR	right arm augmented lead
AVPU	Alert, Reacting to Voice, Reacting to Pain, Unresponsive
awRR	airway respiratory rate
BAP	brachial arterial pressure
Base Flow	base flow
btbHR	beat to beat heart rate
BC	burst count

BIS	bispectral index
BP	blood pressure
BPSK	binary phase shift keying
BSA	body surface area
BT	blood temperature
BTPS	body temperature and pressure, saturated
C.I.	cardiac index
CCI	Continuous Cardiac Index
Cdyn	dynamic compliance
CCO	Continuous Cardiac Output
CaO_2	arterial oxygen content
CCO	continuous cardiac output
CCU	cardiac (coronary) care unit
CE	Conformité Européenne
CFI	cardiac function index
CIS	Clinical Information System
CISPR	International Special Committee on Radio Interference
CMOS	complementary metal oxide semiconductor
CMS	central monitoring system
C.O.	cardiac output
CO_2	carbon dioxide
COHb	carboxyhemoglobin
Compl	compliance
CP	cardiopulmonary
CPI	cardiac power index
CPO	Cardiac Power Output
CSA	Compressed Spectral Array
Cstat	static compliance
CVP	central venous pressure
DBS	double burst stimulation
DC	direct current
Des	desflurane
Dia	diastolic
DPI	dot per inch
dPmx	left ventricular contractility
DVI	digital video interface
DO_2	oxygen delivery
DO_2I	oxygen delivery index
DSA	Density Spectral Array
ECG	electrocardiograph
EDV	end-diastolic volume
EE	Energy expenditure
EEC	European Economic Community
EEG	electroencephalogram
EMC	electromagnetic compatibility
EMG	electromyography

EMI	electromagnetic interference
Enf	enflurane
ESU	electrosurgical unit
Et	end-tidal
EtAA	End-tidal anesthetic agent
EtAA 2nd	2nd Exp. Agent
EtDes	
EtEnf	
EtHal	end-tidal anesthetic agent
EtIso	
EtSev	
$EtCO_2$	end-tidal carbon dioxide
EtN_2O	end-tidal nitrous oxide
EtO	ethylene oxide
EtO_2	end-tidal oxygen
ELWI	extravascular lung water index
EVLW	extravascular lung water
Exp%	inspiration termination level
Exp. Flow	expiratory flow
Exp. MAC	Expired minimum alveolar concentration
f	breath rate
FAP	femoral arterial pressure
fapnea	breath rate for apnea ventilation
FCC	Federal Communication Commission
fCMV	CMV frequency
FDA	Food and Drug Administration
FEV1.0%	first second forced expiratory volume ratio
FG	Fresh gas flow
Fi	fraction of inspired
FiAA	Inspired anesthetic agent
FiAA 2nd	2nd Insp. Agent
FiDes	
FiEnf	
FiHal	inspired anesthetic agent
FiIso	
FiSev	
$FiCO_2$	fraction of inspired carbon dioxide
FiN_2O	fraction of inspired nitrous oxide
FiO_2	fraction of inspired oxygen
Flow	flow
fmand	mandatory breathing frequency
FPGA	field programmable gate array
FRC	Fractional residual capacity
FreqMIN	minimum breath frequency
fsigh	sigh rate
fSIMV	frequency of SIMV

fspn	spontaneous breathing frequency
ftot	total breath rate
F-Trigger	inspiratory trigger level (flow trigger)
FV	flow-volume
GCS	Glasgow Coma Scale
GEDV	global end diastolic volume
GEDI	global end diastolic volume index
GEF	global ejection fraction
Hal	halothane
Hct	haematocrit
Hb	hemoglobin
Hb-CO	carbon mono-oxide hemoglobin
HbO_2	oxyhemoglobin
HR	heart rate
I:E	inspiratory-expiratory ratio
IBP	invasive brood pressure
IBW	ideal body weight
ICG	impedance cardiography
ICP	intracranial pressure
ICT/B	intracranial catheter tip pressure transducer
ICU	intensive care unit
ID	identification
I:E	inspiratory time: Expiratory time ratio
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronic Engineers
Ins	inspired minimum
Insp.Flow	inspiration flow
Insp. MAC	Inspired minimum alveolar concentration
△int.PEEP	intermittent PEEP
IP	internet protocol
IPS	Individual Parameter Score
Iso	isoflurane
IT	injectate temperature
ITBI	Intrathoracic Blood Volume Index
ITBV	Intrathoracic Blood Volume
LA	left arm
LAP	left atrial pressure
Lat	lateral
LCD	liquid crystal display
LCW	left cardiac work
LCWI	left cardiac work index
Leak Comp	leak compensation
LED	light emitting diode
LL	left leg
LVD	low voltage directive
LVDS	low voltage differential signal

LVET	left ventricular ejection time
LVSW	left ventricular stroke work
LVSWI	left ventricular stroke work index
MAC	minimum alveolar concentration
Art mean	mean arterial pressure
MDD	Medical Device Directive
MetHb	methemoglobin
MEWS	Modified Early Warning Score
MF	Median Frequency
%MinVol	Percentage of minute volume to be delivered
MRI	magnetic resonance imaging
MV	minute volume
$MVCO_2$	CO_2 minute production
MVe	expiratory minute volume
MVi	inspiratory minute volume
MVLEAK	leakage minute volume
MVO_2	O_2 minute consumption
MVspn	spontaneous breathed minute volume
N/A	not applied
N_2	nitrogen
N_2O	nitrous oxide
N_2O cyl.	N_2O cylinder pressure
N_2O Flow	N_2O flow
NE	Neutral Electrode
NEWS	National Early Warning Score
Neo	neonate
NIBP	noninvasive blood pressure
NIF	negative inspiratory force
NMT	neuromuscular transmission
O_2	oxygen
ΔO_2	Difference between inspiratory and expiratory O_2
O_2%	oxygen concentration
O_2CI	oxygen consumption index
O_2 cyl.	Oxygen cylinder pressure
O_2 cyl.2nd	Secondary oxygen cylinder pressure
O_2 Flow	O_2 flow
O_2R	oxygen extraction ratio
OR	operating room
oxyCRG	oxygen cardio-respirogram
PA	pulmonary artery
Pair	Air supply pressure
Papnea	apnea pressure
pArt-D	diastolic artery pressure
pArt-M	mean artery pressure
pArt-S	systolic artery pressure
Paux Mean	Mean auxiliary pressure

Paux Min	Minimum auxiliary pressure
Paux Peak	Peak auxiliary pressure
Paw	airway pressure
PAWP	pulmonary artery wedge pressure
PD	photodetector
Peak Flow	peak flow
Ped	pediatric
PEEP	positive end expiratory pressure
PEEP/CPAP	PEEP/CPAP
PEEPe	Extrinsic positive end-expiratory pressure
PEEPi	intrinsic positive end-expiratory pressure
PEEPi time	Intrinsic PEEP age (elapsed time since last maneuver)
PEEPtot	total PEEP
PEF	peak expiratory flow
PEP	pre-ejection period
PGND	Patient Ground
Phigh	upper pressure level
PIF	peak inspiratory flow
Pinsp	pressure control level of inspiration
PIP	peak inspiratory pressure
Pleth	plethysmogram
Plimit	pressure limit level
Plow	lower pressure level
Pmax	maximum airway rressure
Pmean	mean pressure
PN_2O	N_2O supply pressure
PO_2	Oxygen supply pressure
Ppeak	peak pressure
Pplat	plateau pressure
PPF	Peak Power Frequency
PPV	Pulse Pressure Variation
PR	pulse rate
Psupp	pressure support level
PTC	post tetanic count
PTP	Pressure time product
P-Trigger	inspiratory trigger level (pressure trigger)
PVC	premature ventricular contraction
PVR	pulmonary vascular resistance
PVRI	pulmonary vascular resistance index
PVPI	pulmonary vascular permeability index
pArt	artery pressure
pCVP	central venous pressure
P0.1	100 ms occlusion pressure
P0.1 time	P0.1 age (elapsed time since last maneuver)
R	right
RA	right arm

RAM	random access memory
Ramp	Ramp
RAP	right atrial pressure
RAW	airway resistance
RCexp	Expiratory time constant
RCinsp	Inspiratory time constant
Rdyn	dynamic lung resistance
Re	expiratory resistance
Rec	record, recording
Refer	reference response amplitude
Resp	respiration
RHb	reduced hemoglobin
Ri	inspiratory resistance
Rise Time%	rise time
RL	right leg
RM	respiratory mechanics
RQ	Respiratory quotient
RR	respiration rate
RSBI	rapid shallow breathing index
Rstat	static lung resistance
SaO_2	arterial oxygen saturation
SEF	spectral edge frequency
Sev	sevoflurane
SFM	self-maintenance
SI	stroke index
SMR	satellite module rack
SpO_2	arterial oxygen saturation from pulse oximetry
SQI	signal quality index
SR	suppression ratio
ST	single twitch stimulation
STR	systolic time ratio
Supra	supramaximal current
SV	stroke volume
SVI	Stroke Volume Index
SVR	systemic vascular resistance
SVRI	systemic vascular resistance index
SVV	stroke volume variation
SvO_2	mixed venous oxygen saturation
$ScvO_2$	central venous oxygen saturation
Sync	synchronization
Sys	systolic pressure
Tapnea	apnea interval
Taxil	axillary temperature
TB	Blood Temperature
TD	temperature difference
Temp	temperature

Texp	Expiratory time
TFC	thoracic fluid content
TFI	thoracic fluid index
TFT	thin-film technology
Thigh	time for the upper pressure level
Ti max	maximum inspiration time
Tinsp	time of inspiration
Tip	Inspiratory pause time
TIP:TI	percentage of inspiratory plateau time in inspiratory time
Tlow	time for the lower pressure level
TOF	train of four stimulation
Toral	oral temperature
TP	total power
Tplat	plateau time
TRC	Tube resistance compensation
Trect	rectal temperature
Trigger	trigger sensitivity
Trig Window	trigger window
Trise	rise time
Tslope	time for the pressure to rise to target pressure
Tube ID	tube ID
UAP	umbilical arterial pressure
UPS	uninterruptible power supply
USB	universal serial bus
UVP	umbilical venous pressure
VAC	volts alternating current
VCO_2	CO_2 production for one breath
VEPT	volume of electrically participating tissue
VI	velocity index
VO_2	oxygen consumption for one breath
VO_2e	estimated oxygen consumption
VO_2/kg	Oxygen consumption per body weight
VO_2/m^2	Oxygen consumption per body surface area
VO_2I	oxygen consumption index
VO_2Ie	estimated oxygen consumption index
VTe/TVe	expiratory tidal volume
VTi/TVi	inspiratory tidal volume
VT	tidal volume
VTapnea	apnea tidal volume
VTe spn	spontaneous expiratory tidal volume
VTsigh	sigh tidal volume
WLAN	wireless local area network
WOB	work of breathing
WOBimp	imposed work of breathing

FOR YOUR NOTE

G Declaration of Conformity

Declaration of Conformity V2.0

Declaration of Conformity

CE

Manufacturer:	Shenzhen Mindray Bio-Medical Electronics Co., Ltd. Mindray Building, Keji 12th Road South, Hi-tech Industrial Park, Nanshan, Shenzhen, 518057, P. R. China
EC-Representative:	Shanghai International Holding Corp. GmbH (Europe) Eiffestraße 80 20537 Hamburg, Germany
Product:	Patient Monitor (Including Accessories)
Model:	BeneView T5/BeneView T6/BeneView T8/BeneView T9 / BeneView T5 OR/BeneView T9 OR

We herewith declare under our sole responsibility that the above mentioned products meet the provisions of the Council Directive 2014/53/EU concerning radio equipment. All supporting documentation is retained under the premises of the manufacturer.

Standards Applied:

☒ EN 60601-1:2006/A1:2013	☒ EN 60601-1-2:2015
☒ EN 62311:2008	☒ EN 50385 :2002
☒ ETSI EN 301 489-1 V2.2.0	☒ ETSI EN 301 489-17 V3.1.1
☒ EN 300 328 V2.1.1	☒ ESTI EN 301 893 V2.1.1

Start of CE-Marking:	**2017-6-13**
Place, Date of Issue:	Shenzhen, 2018.12.19
Signature:	
Name of Authorized Signatory:	Mr. Wang Xinbing
Position Held in Company:	Manager, Technical Regulation

FOR YOUR NOTE

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