Instructions for Use

Infinity Delta Series

Infinity Patient Monitoring Series
Software VF9

WARNING

To properly use this medical device, read and comply with these instructions for use.

Infinity Delta Series Instructions for Use
Software VF9

Printed in the United States of America.

Before using any Dräger devices, carefully read all the manuals that are provided with your device. Patient monitoring equipment, however sophisticated, should never be used as a substitute for the human care, attention, and critical judgment that only trained health care professionals can provide.

The capnography component of this product is covered by one 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.

Overview

Intended Use

The Infinity Delta Series (Delta/Delta XL/Kappa) Monitors are intended for multi-parameter patient monitoring. The devices will produce visual and audible alarms if any of the physiological parameters monitored vary beyond preset limits and timed or alarm recordings will be produced. This device will connect to an R50 recorder, either directly or via the Infinity Network.

NOTE: All Dräger hardware and screen shots shown in these Instructions for Use are examples only. Actual product or screens may differ slightly.

NOTE: The Infinity CNAP SmartPod is available in selected markets. Contact your local sales representative for details and availability.

Indications for Use

The Infinity Delta series monitors are capable of monitoring:

- Heart rate
- Respiration rate
- Invasive pressure
- Non-invasive pressure
- Arrhythmia
- Temperature
- Cardiac output
- Arterial oxygen saturation
- Pulse rate
- Apnea
- ST segment analysis
- 12-lead ST segment analysis
- tcpO2/tcpCO2
- EEG signals
- FiO_2
- $etCO_2$
- Respiratory mechanics
- Anesthetic agents

- Neuromuscular transmission

The devices are intended to be used in the environment where patient care is provided by healthcare professionals, i.e. physicians, nurses, and technicians, who will determine when use of the device is indicated, based on their professional assessment of the patient's medical condition.

Intended Patient Categories

The Infinity Delta Series (Delta/Delta XL/Kappa) monitors are intended to be used on adult, pediatric, and neonatal populations, with the exception of the parameter Cardiac Output, ST Segment Analysis, and arrhythmia which are intended for use in the adult and pediatric populations only; and $tcpO_2$, which for the neonatal population, is to only be used when the patient is not under gas anesthesia.

Functional Safety

The essential performance of a patient monitor is to provide a clinician with meaningful parameter values and alarm annunciation when the established parameter limits have been exceeded or the ability to provide values is compromised. Risks associated with use of the monitor in light of these essential performance functions have been evaluated and mitigations implemented so that the residual risk is as low as reasonably practicable, provided routine maintenance and service recommendations are followed throughout the life of the product.

Documentation Features

Warnings, Cautions, Notes

WARNING: A WARNING statement provides important information about a potentially hazardous situation which, if not avoided, could result in death or serious injury.

CAUTION: *A CAUTION statement provides important information about a potentially hazardous situation which, if not avoided may result in minor or moderate injury to the user or patient, or in damage to the equipment or other property.*

NOTE: A note provides additional information intended to avoid inconvenience during operation.

Cross-references

Cross-references specify chapter and page (for example, page 16-3 refers to chapter 16, page 3). The chapter number is given when text refers to an entire chapter (for example, chapter 1).

Quick Reference Tables

Wherever possible, a quick reference table is provided for easy access to information about monitor functions.

Footer

The current software version appears at the bottom of each page, together with the chapter and page number and the device name.

Applicability

All references to "the monitor" in this manual refer to the Delta, Delta XL and Kappa patient monitors. Model-specific information is documented as required.

NOTE: Software funtionality is identical between the following products:

- Infinity Delta = Siemens SC 7000
- Infinity Delta XL = Siemens SC 9000XL
- Infinity Kappa = Siemens SC 8000

with the following exceptions as noted:

- Alarm bar (see pages 1-5, 2-18, and 3-21).
- Internal battery (see pages A-3, and B-10).
- Size and weight (see page B-9).

Definition of Target Groups

For this product, users, service personnel, and experts are defined as target groups.

These target groups must have received instruction in the use of the product and must have the necessary training and knowledge to use, install, reprocess, maintain, or repair the product.

The product must be used, installed, reprocessed, maintained, or repaired exclusively by defined target groups.

Users

Users are persons who use the product in accordance with its intended use.

Service Personnel

Service personnel are persons who are responsible for the maintenance of the product. Service personnel must be trained in the maintenance of medical devices and install, reprocess, and maintain the product.

Experts

Experts are persons who perform repair or complex maintenance work on the product. Experts must have the necessary knowledge and experience with complex maintenance work on the product.

Safety Considerations

These Instructions for Use assume a working knowledge of patient monitors. To support proper, safe and accurate operation of equipment, read all operating instructions carefully before you use the monitor. .

WARNING: To maintain patient safety, adhere to all WARNINGS and CAUTIONS listed in these Instructions for Use and on equipment labels.

WARNING: No modification of this equipment is allowed. Risk- modification of this equipment may cause interference with other devices, injury to patient and user including electric shock, burns or death.

WARNING: Risk of not hearing alarms. A rapid recognition of alarms and an appropriate response are only possible if the user is within the hearing range of the acoustic alarm signals. The user must stay within the hearing range of the acoustic alarm signals and adjust the volume according to the distance from the medical device.

Site of Operation

Only use these devices in areas that meet the environmental requirements outlined in the technical data section.

WARNING:

- **Do not operate the device in areas such as: magnetic resonance imaging (MRI) environments, aircraft, ambulance, home or hyperbaric chambers.**
- **Do not operate devices (monitor, pods, modules and accessories) in close proximity to equipment that emits microwave or other high-frequency emissions since they may interfere with the devices' operation.**
- **When placing the device make sure adequate ventilation exists and prevent overheating by positioning this device with at least 2 in (5 cm) of space around all sides. Do not cover the devices with blankets or bedsheets. To prevent burns to the patient avoid direct contact between these items' external surfaces and the patient.**
- **Only the items indicated on the list of accessories in the "Approved Options and Accessories" chapter have been tested and approved to be used with the device. Accordingly it is strongly recommended that only these accessories be used in conjunction with the specific device. Otherwise the correct functioning of the device may be compromised.**
- **Disposable accessories (such as disposable electrodes, transducers, etc.) are for single use only. Do not reuse disposable accessories.**
- **To minimize the risk of patient strangulation, carefully position and secure sensor cables. Also carefully position sensor cables to minimize inductive loops.**
- **This medical device is neither approved nor certified for use in areas where oxygen concentrations greater than 25 %, combustible or where explosive gas mixtures are likely to occur.**
- **Because of the danger of electric shock, never remove the cover of a device while it is in operation or connected to power.**
- **To avoid patient injury as the result of a falling monitor when using a rolling stand, universal bed hook or handle hook mount, do not apply excessive force to the monitor or mount to enter / exit elevators, or to pass over thresholds etc.**

CAUTION: *To avoid short-circuiting and otherwise damaging the device, do not allow fluids to come in contact with the device. If fluids are accidentally spilled on the equipment, remove the affected unit from service as soon as possible and contact the technical personnel to verify that patient safety is not compromised.*

CAUTION: *Before moving the patient, disconnect the patient from all sensors that will not be used (to avoid patient injury).*

CAUTION: *Read all cleaning instructions (for example, originating from the disinfectant manufacturer and the hospital) carefully before cleaning the device. Refer to the "Cleaning and Disinfecting" chapter for device-specific cleaning instructions. Moisture may damage the circuits, compromise critical performance and/or present a safety risk.*

Maintenance

Overview

This chapter describes the maintenance measures required to maintain the proper functioning of the medical device. Maintenance measures must be performed by the responsible personnel.

WARNING:

- **Risk of infection. Users and service personnel can become infected with pathogenic germs. Disinfect and clean the device or the device parts before any maintenance measures and also before returning the medical device for repair.**
- **Risk of electric shock. Current-carrying components are located under the cover. Do not remove the cover. Maintenance measures must be performed by the responsible personnel. Dräger recommends DrägerService to perform these measures.**
- **If the device is mechanically damaged, or if it is not working properly, do not use it. Contact your hospital's technical personnel. Never perform monitor service or maintenance activities while actively monitoring a patient.**
- **To avoid electric shock disconnect AC line cord from power supply prior to servicing the device.**

CAUTION:

- *This device must be inspected and serviced at regular intervals. A record must be kept on this preventive maintenance. We recommend obtaining a service contract with DrägerService through your vendor. For repairs we recommend that your contact DrägerService.*
- *When servicing devices from Dräger, always use replacement parts that are qualified to Dräger standards. Dräger does not warrant or ensure the safe performance of third-party replacement parts for use with the devices.*

Definition of Maintenance Concepts

Concept	Definition
Maintenance	All measures (inspection, preventive maintenance, repair) intended to maintain and restore the functional condition of a medical device.
Inspection	Measures intended to determine and assess the actual state of a medical device.
Preventative Maintenance	Recurrent specified measures intended to maintain the functional condition of a medical device.
Repair	Measures intended to restore the functional condition of a medical device after a device malfunction.

Inspection

Perform inspections at regular intervals and observe the following specifications.

Delta/DeltaXL/Kappa

Checks	Interval	Personnel Responsible
Inspection/safety checks	Every 2 years	Service personnel
Metrological checks	Every 2 years	Service personnel

Safety checks for Delta/DeltaXL/Kappa

Safety checks are no substitute for preventive maintenance measures (including preventive replacement of wear parts) as identified by the manufacturer. Perform safety checks at the indicated intervals.

WARNING: Risk of medical device failure. If safety checks are not performed on a regular basis, the proper operation of the medical device can be compromised.

Perform safety checks at the indicated intervals.

• Check accompanying documents:	The instructions for use are available, according to the user/owner
• Perform a functional test of the following features according to the instructions for use:	• Power On/Off LED's and tone • Battery charging indicator LED • Visual and acoustic alarm signals • Touch Keys on front panel • ECG lead off • Non-invasive blood pressure • Check/visual inspection of internal battery
• Check that the device combination is in good condition:	• Labels and inscriptions are complete and legible. • There is no visible damage
• Use the instructions for use to check that all components and accessories needed to use the product are available	
• Check the electrical safety requirements according to IEC62353	

Metrological Checks

If required by applicable regulations, the following measurement functions must be checked every two years by qualified DrägerService personnel:

- Body temperature
- Non-invasive blood pressure

Preventive Maintenance

WARNING:

- **Risk of faulty components Device failure is possible due to wear or material fatigue of the components. To maintain proper operation of all components, this device must undergo inspection and preventive maintenance at specified intervals.**
- **Risk of electric shock. Before performing any maintenance work, disconnect all electrical connectors from the power supply.**

The following table shows the preventive maintenance intervals:

Component	Interval	Personnel Responsible
NBP filter	Replace every 2 years	Service personnel

Repair

Dräger recommends that all repairs are carried out by Dräger Service and that only authentic parts are used. The monitor's Service Manual is available from your local Dräger Medical service representative.

WARNING:

- **Repair of the device may only be carried out by trained service personnel otherwise the correct functioning of the device may be compromised. Regular annual maintenance (functional and safety test) according to IEC 62353 is recommended, in addition to national regulations and laws (for example, accident prevention regulations). Connecting this medical device to other medical devices could result in additional maintenance requirements. Consult the documentation for these other devices to identify additional requirements.**
- **Dräger recommends contracting with DrägerService for any repairs. Use only authentic Dräger repair parts during maintenance. Using non-Dräger repair parts may adversely affect the operation of the device.**
- **Contact your hospital's technical personnel if the monitor's mounting mechanism appears mechanically damaged or its structural integrity is compromised. Do not mount the monitor under such circumstances. Always observe installation instructions with the mount.**

Before docking, undocking or moving a monitor, verify that the mounting mechanism is mechanically sound. Be careful not to apply too much force when docking the monitor.

Devices should be used in accordance with Dräger Instructions for Use.

General Electrical Safety

This device can be operated in combination with other Dräger devices or devices from other manufacturers.

WARNING: Observe the accompanying documentation of the specific devices. If a device combination is not approved by Dräger, the safety and functionality of the individual devices can be compromised.

The operating organization must ensure that the device combination complies with the applicable editions of the relevant standards for medical devices.

Device combinations approved by Dräger meet the requirements of the following standards:

- IEC 60601-1, 3rd edition (general safety requirements, device combinations, software controlled functions)
- IEC 60601-1-2 (electromagnetic compatibility)
- IEC 60601-1-8 (alarm systems)

Or:

- IEC 60601-1, 2nd edition (general safety requirements)
- IEC 60601-1-1 (device combinations)
- IEC 60601-1-2 (electromagnetic compatibility)
- IEC 60601-1-4 (software-controlled functions)
- IEC 60601-1-8 (alarm systems)

WARNING:

- **To protect the patient from possible injury due to electrical shock:**
- **When connecting the Dräger monitor to other equipment not described in these instructions for use ensure compliance of the configured medical electrical system with the requirements of IEC 60601-1/ IEC 60601-1-1.**
- **To avoid electric shock, inspect all cables before use. Never use cables that appear cracked, worn, or damaged in any way (doing so may compromise performance or put the patient at risk).**
- **To ensure that the device is properly grounded, connnect the AC adapter, communication power supply module, and IDS power supply to a hospital-grade outlet.**

WARNING: The use of multiple socket-outlets should be avoided as far as possible. The combined earth leakage currents could result in:

- **Excessive earth leakage current in normal condition**
- **Excessive touch current in the single fault condition of the broken protective earth conductor of the multiple socket-outlet supply cable**
- **Availability of the supply mains depends on the reliability of a single fixed mains socket outlet**
- **A complete interruption of electrical supply is possible and might require a long set-up time to reactivate the complete ME system**
- **Only one protective earth connection to the electrical installation is provided; this is less reliable than when each part of the ME system is directly earthed**
- **The protective earth resistance is increased.**

The operating organization must ensure that the device combination complies with the applicable editions of the relevant standards for medical devices.

CAUTION:

- *To avoid injuring the patient, do not touch any connector or mounting screw on the device when you are touching the patient. Do not allow the conductive parts of electrodes and cables to ever contact other conductive parts or ground, either.*

Potential Equalization Terminal

Even small electrical potential differences between housing surfaces of different devices in the vicinity of the patient can be reduced by potential equalization (consider IEC 60601-1 for Medical Electrical Systems).

1. Connect one end of the potential equalization cable to a potential equalization pin.
2. Connect the other end of the potential equalization cable to the potential equalization connector on the operating table or the wall.

NOTE: Do not use the connection as a PE (protective earth) connection.

Defibrillator Precautions

Defibrillator Precautions: The monitor is protected against defibrillator voltages, high-frequency interference from electrosurgical units and 50 / 60 Hz interference. Following defibrillation, the monitor begins displaying waveform data again within 5 seconds if the correct electrodes are used and those electrodes are applied in accordance with the manufacturer's instructions.

WARNING: To protect the patient during defibrillation and to ensure accurate ECG information use only ECG electrodes and cables specified by Dräger. Removal of applied parts that are not rated defibrillation proof such as disposable SpO2 sensors may be required to prevent sensor breakdown and energy shunting.

CAUTION:

- *Only defibrillate across the chest.*
- *To avoid potentially re-routing electrical current through electrodes, thus causing burns and electric shock, do not position the defibrillator pads near any electrodes or sensors.*

Pacemakers

NOTE: See the section "Pacemakers" on page 8-3 for safety precautions when monitoring paced patients.

Peripheral Devices

NOTE: See the section "Precautions" on page 29-5 for safety precautions when using a Medical Information Bus (MIB) protocol device or the Independent Surgical Display.

WARNING: Electrical connections to equipment not listed in these Instructions for Use should only be made following consultation with the respective manufacturer.

Electrosurgery

To support user and patient safety and to reduce electro-surgical unit (ESU) interference, observe the following precautions during electrosugery.

WARNING:

- **The NeoMed and MultiMed 12 pods are not intended for use during electrosurgery. To protect patients from burns, do not use these pods in an ESU environment.**
- **For better performance and to reduce the hazard of burns during surgery, always use accessories designed for ESU environments.**
- **To reduce the hazard of burns during surgery, keep the sensor or transducer (ECG, temperature, pressure, SpO_2, BISx) and their associated cables away from the surgical site, the electro-surgical unit return electrode, and earth ground.**
- **Always use a Dräger ESU block or MultiMed Plus OR cable with compatible lead wires. Doing so reduces ESU interference and protects the patient from burns caused by ESU-induced current flowing through the lead wires. For better performance, also set the ECG filter option to ESU.**
- **Dräger recommends using the ESU block during electrosurgery. If you do not have an ESU block or a MultiMed Plus OR, use only Dräger blue ECG lead sets. They help protect the patient from burns caused by ESU-induced current flowing through the leads.**
- **While the ESU block or the MultiMed Plus OR cable are in use, impedance respiration monitoring is inoperative and the detection of pacemaker spikes is degraded. If pacemaker detection is enabled, the ESU interference may be detected as pacemaker spike.**
- **Dräger recommends the use of the MultiMed Plus OR during electrosurgery only.**
- **Do not use the MultiMed Plus OR cable with Dräger blue ECG lead wires. Doing so, will degrade performance which can result in inaccurate values.**

NOTE:

- If ESU issues arise with HR values from ECG source, change the source to ART or SpO_2
- Use rectal temperature probe sheaths to cover internally placed temperature sensors.

Medical Device Disposal

WARNING: Risk of infection. The device and its components must be disinfected and cleaned before disposal.

When disposing of the medical device:

- Consult the relevant waste disposal company for appropriate disposal.
- Observe the applicable laws and regulations.

For countries subject to the EU Directive 2002/96/EC

This device is subject to EU Directive 2002/96/EC (WEEE). In order to comply with its registration according to the directive, this device may not be disposed of at municipal collection points for waste electrical and electronic equipment. Dräger has authorized a company to collect and dispose of this device. If access to Dräger's website is not possible, contact the local Dräger organization.

Disposal of Accessories

When disposing of accessory parts, observe the hospital hygiene regulations and the respective instructions for use.

Electromagnetic Compatibility

The monitor has been designed and tested for compliance with current regulatory standards (IEC 60601-1-2 and CISPR 11 Class B) regarding its capacity to reduce electromagnetic emissions (EMI) and to block EMI from external sources.

Dräger recommends these procedures to reduce electromagnetic interference:

- Use only Dräger provided accessories, otherwise the correct functioning of the device may be compromised (see appendix C).
- Ensure that other products in patient-monitoring and/or life-support areas comply to accepted emissions standards (CISPR 11, Class B).
- Maximize distance between electro medical devices. High-power devices relating to electrocautery, electrosurgery, and radiation (X-ray), as well as electrical stimulators and evoked potential devices, may produce interference on the monitor.

- Strictly limit access to portable radio-frequency sources (e.g., cellular phones and radio transmitters). Portable phones may periodically transmit even when in standby mode.
- Maintain good cable management. Avoid routing cables over electrical equipment. Do not intertwine cables and secure properly at both ends.
- Ensure electrical maintenance is done by qualified personnel.
- For more information on Electromagnetic Compatibility, see page B-3.

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1 Introduction

Overview

The patient monitor is intended for adult, pediatric, and neonatal monitoring. It can be used as a standalone device or can be connected to the Infinity network. Monitor use is restricted to one patient at a time.

The following optional software features are available:

- ACE full arrhythmia (Arrhythmia II)
- Hemodynamic & oxygenation/ventilation calculations (physiological calculations)
- 3-lead ST segment analysis
- Waveform channel upgrades (Kappa only: 4 channels to 5 channels. Delta/ Kappa only: 5 channels to 6 channels. Delta/Delta XL/Kappa: 6 channels to 8 channels)
- Aries (Advanced Review of Ischemia Event System)
- One PodCom connection is standard on the Delta monitor, a second PodCom connection is optional. Two PodCom connections are standard on the Kappa Delta XL. Three PodCom connections are available on Kappa.
- MIB (Kappa only: Advance Communication. Delta/Delta XL only: MIB II 1 to 4 Option for IDS)
- Wireless Networking
- OR mode (for the IDS and/or monitor)

NOTE: After connecting various sensors, make sure that each sensor's parameter data such as values and a waveform (if applicable) appear on the monitor screen.

Overview (Delta/Delta XL)

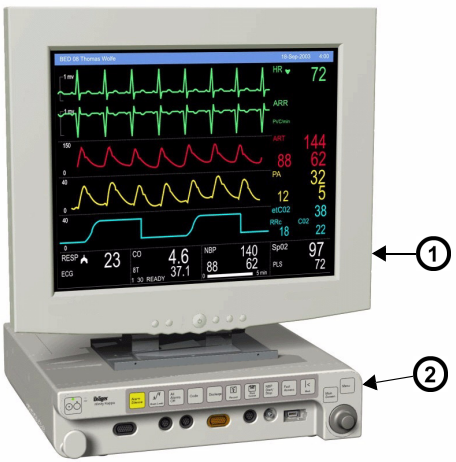
The Pick and Go feature allows you to disconnect the Delta or Delta XL monitor from the network and transport both monitor and patient to another location; you do not have to discharge the patient and admit him or her at another monitor. You can therefore not only save valuable time but maintain continuous monitoring during patient transport. At any time, you can reconnect (redock) the portable monitor to the network via the Docking Station or the Infinity Docking Station.

Overview (Kappa)

The basic Kappa monitoring system consists of two components: a processing CPU base unit and a display unit. These Instructions for Use use the word “Kappa” monitor to refer to the CPU base unit, unless otherwise specified. The Kappa is designed to operate with a separate large screen display.

The monitor displays trended data in graphical and tabular trends.

Kappa Monitoring System



1	Display unit
2	Kappa base unit

System Components

NOTE:

- For a complete list of accessories available with this product, see Appendix C.
- The monitor configuration may vary. Refer to your hospital's technical personnel for more information.
- The parts below include standard and optional components.

The Delta or Delta XL requires:

- Monitor
- Power supply
- Country specific power cord and monitor
- MultiMed or NeoMed cables
- Optional: Infinity Docking Station (IDS) for mounting, power, and networking capabilities

The Kappa requires:

- Monitor front end
- Country specific power cord
- A display unit
- MultiMed or NeoMed cables

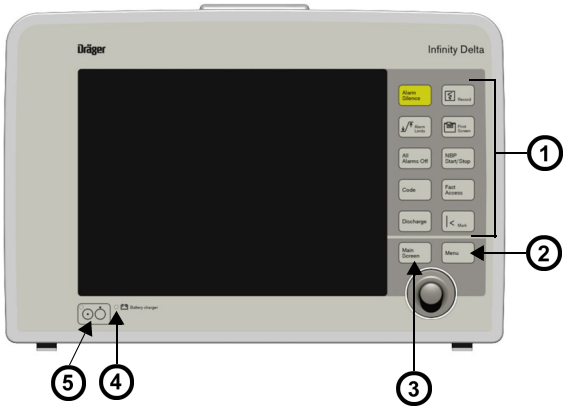
Applicable Software Options (on a memory option card) include:

- Options for Delta only:
- Delta second PodPort option
- Options for Kappa only:
- Kappa 4 to 5 channel option
- Kappa advanced communication option II
- Kappa 3rd pod communication option
- Delta and Kappa only:
- Delta and Kappa 5 to 6 channel option
- Delta and Delta XL only:
- OR Mode option (loaded in the IDS)

- Delta, Delta XL and Kappa:
- Delta/Delta XL MIB II 1 to 4 option for IDS/ Kappa - advance communication
- 6 to 8 channel option
- 3-Lead ST analysis option
- Wireless networking option
- ARIES option
- Physio calculations option
- ACE full arrhythmia option
- ARIES/Physio Calcs/ACE arrhythmia option package
- OR mode option (loaded in the monitor)

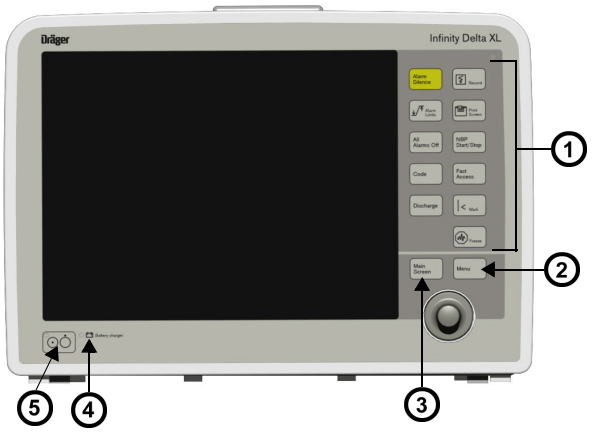
Base Unit

Monitor Front View – Delta



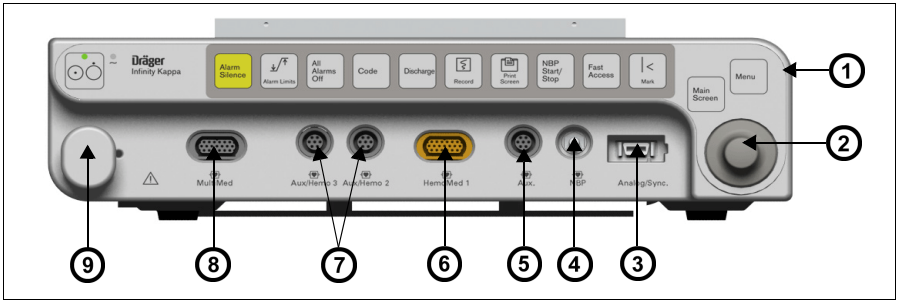
1	Fixed keys
2	Main menu fixed key
3	Main screen fixed key
4	Battery charge indicator
5	Power switch

Monitor Front View – Delta XL



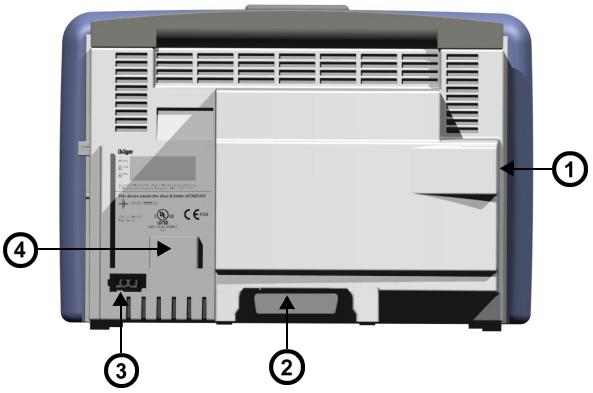
1	Fixed keys
2	Main menu fixed key
3	Main screen fixed key
4	Battery charge indicator
5	Power switch

Monitor Front View – Kappa



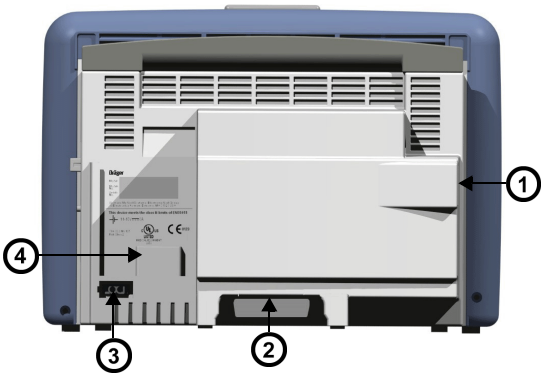
1	Fixed keys	**6**	HemoMed connector
2	Rotary knob	**7**	Connectors for Aux/Hemo or PodCom
3	Analog (balloon pump)/sync (QRS sync defib) connector	**8**	MultiMed connector
4	NBP hose connector	**9**	Cable strain relief
5	Auxiliary PodCom connector		

Monitor Rear View – Delta



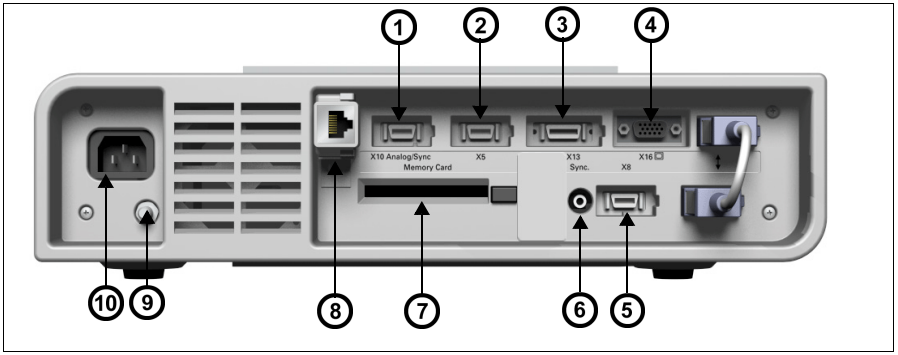
1	External (lead-acid) battery compartment (not supported with software VF9.0 or higher)
2	Connector for docking station interface plate
3	Connector for AC adaptor
4	Slot for $etCO_2$ module

Monitor Rear View – Delta XL



1	External (lead-acid) battery compartment (not supported with software VF9.0 or higher)
2	Connector for docking station interface plate
3	Connector for AC adaptor
4	Slot for $etCO_2$ module (not supported with software VF9.0 or higher)

Monitor Rear View – Kappa

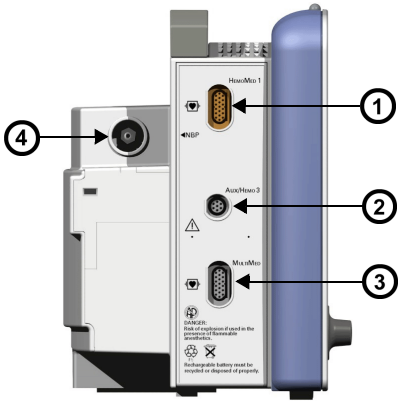


1	Analog (ECG & ART waveform for balloon pump)/sync (QRS sync defib)	**6**	QRS Sync (for example, for defibrillator connection)
2	Alarm output (nurse call)[1], export protocol (X5)	**7**	PCMCIA slot (“Memory card”)
3	Recorder output (X13)	**8**	Infinity network connector (X14)
4	Video out (VGA) (X16)	**9**	Potential equalization
5	RS232 connector, Scio module, Smart Pod, remote keypad, Vital Connect Cable (VCC), Alarm output (nurse call) [2] – (X8)	**10**	AC input

[1] **NOTE**: Alarm output (nurse call) requires the alarm output cable with partnumber 4314626.

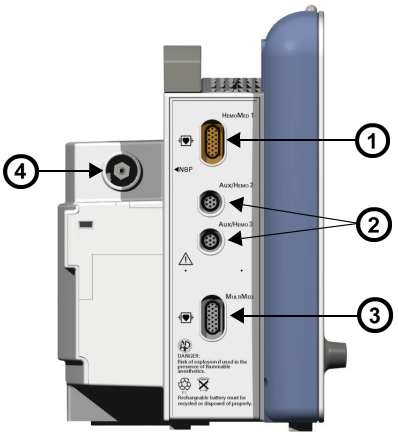
[2] **NOTE**: Alarm output (nurse call) requires the alarm output cable with partnumber 5194928.

Monitor Left Side – Delta



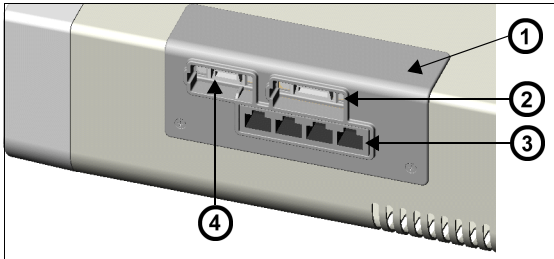
1	HemoMed connector
2	Connectors for Aux/Hemo or PodCom
3	MultiMed connector
4	NBP connector

Monitor Left Side – Delta XL



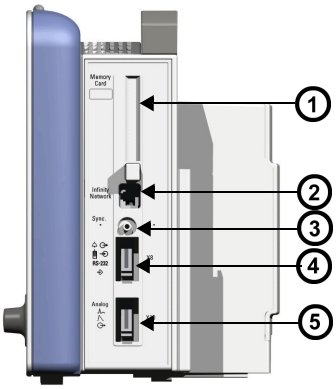
1	HemoMed connector
2	Connectors for Aux/Hemo or PodCom
3	MultiMed connector
4	NBP connector

Monitor Left Side – Kappa



1	Advanced Communications Options
2	CANBUS connector for old Scio module (PN 68 71 255)
3	MIB connectors
4	Scio/Independent Surgical Display (ISD) connector

Monitor Right Side – Delta/Delta XL



1	PCMCIA slot: memory card
2	Infinity network connector
3	QRS sync
4	RS232 connector, Scio module, Smart Pod, remote keypad, Vital Connect Cable (VCC), Alarm output (nurse call) [2] – (X8)
5	Analog (ECG & ART waveform for balloon pump)/sync (QRS sync defib) connector (X10)

[1] **NOTE**: Alarm output (nurse call) requires the alarm output cable with partnumber 4314626.

[2] **WARNING**: Alarm Output is not a confirmed delivery system

Monitor Right Side – Kappa is blank

CAUTION:

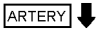
- *The Kappa video display is not battery-backed. When power is lost, nothing appears on screen unless the video display is connected to an Uninterruptable Power Supply (UPS). Dräger recommends the use of a UPS with the Kappa video display. The UPS must meet the electrical safety requirements of IEC 60601-1 or be connected to an isolation transformer that meets those requirements (see the "Electrical Safety" section).*
- *Connecting the Kappa monitor, Video display unit, and the optional UPS requires multiple line cords. To reduce the chance of electromagnetic interference from magnetic fields, the power cords should be run as close together as reasonably possible to reduce loop area.*
- *The video output connector on the back of the Kappa is not galvanically isolated.*
- *If you use a video monitor other than one specified by Dräger, it must comply with IEC 60601-1 (see "Safety Considerations" on page 8). Based on the intended use of the system, the video monitor must also have suitable classifications for water ingress protection as well as radiated and conducted emissions. Upon installation, the installer must make sure that all of these requirements are met.*
- *The Kappa video monitor settings (brightness, resolution, positioning, etc) on the display unit should not be altered. If video issues are encountered contact your hospital biomed or local service for assistance.*

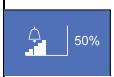
Kappa Video Display

The Kappa complies with the requirements of IEC 60601-1 when used with Dräger approved medical grade displays, available in multiple screen sizes (see page B-19.)

Device Markings

The following table describes symbols that appear on the monitor and its accessories that were not described on pages 1-5 through 1-11:

	Monitor on/off		Remote keypad in
	Battery-operated equipment		RS 232
	Attention! Consult the accompanying document		Analog out
	Artery symbol and arrow should be placed over brachial or femoral artery.		Analog out
	Direct current		Analog out
	Danger: Risk of explosion if used in presence of flammable anesthetics		This end up
	External lead-acid battery not supported		Defibrillator-proof equipment, Type CF
	Complies with the *European Medical Device Directive 93/42/EEC*		Defibrillator protected Type BF
	Isolated patient connection, Type CF		Not made with natural rubber latex.
	Isolated patient connection, Type BF	LOT	Manufacturer's lot number
	Gas in		Sterilization method used: Ethylene oxide
	Gas out	**REF**	Manufacturer's reorder code
	Observe WEEE (Waste Electrical and Electronic Equipment) disposal requirements		Does not provide isolation between connected devices
	Manufacturing date		Monitor is receiving AC power
	Alarm out		China RoHS marking

	Recycle properly		Potential equalization terminal
	General mandatory action		Video display output
	Alarm monitoring inactive		Warning! Strictly follow these instructions for use
	Audio off. Acoustic alarm deactivated		Audio paused. Acoustic alarm temporarily suppressed
	Do not reuse		Alarm monitoring temporarily inactive
	Legal manufacturer		Consult instructions for use
	QRS complex identified as paced heart beat		Use by
	Lung symbol for breath detected	Rx only	Caution: Federal law restricts this device to sale by or on the order of a physician
	Alarm volume		QRS complex identified as regular heart beat
			Wireless mode is active

Auxiliary Display and Other Components

The following devices enable remote viewing of patient data.

- Remote Display – Allows you to view but not control monitor functions away from the bedside. Dräger strongly recommends that you use only approved video monitors, otherwise the function of the monitor may be compromised. For a complete list of approved video monitors, contact your Dräger local representative to obtain a catalog. Any use of non-approved monitors may

compromise the correct functioning of the device. If you use an alternative video monitor, be advised of the following information.

CAUTION: *The remote display output on the IDS is not galvanically isolated. If you use a video monitor other than one specified by Dräger, it must comply with IEC 60601-1 (see "Site of Operation" on page 9). Based on the intended use of the system, the video monitor must also have suitable classifications for water ingress protection as well as radiated and conducted emissions. After installation, the installer must make sure that all of these requirements are met.*

- Surgical display controller – Allows you to display information acquired by the Surgical Display Interface on a remote video display. It provides a special interface adapted to the needs of surgeons and other operating-room personnel (see page 29-20 for more information).

NOTE: The Kappa monitor can only connect to the Surgical Display Interface (SDI) if the monitor is equipped with the advanced communication option.

- Remote keypad – The optional remote keypad allows you to operate the monitor from a distance. A rotary knob and fixed keys duplicate those of the monitor and pods, while a numeric keypad allows you to enter data. See page 1-22 for more information.
- Export protocol – Allows you to share data with other Dräger and third-party devices (for example, clinical information and anesthesia record systems and data loggers; see Dräger publication Infinity RS-232 Export Protocol Reference Booklet).

- MIB protocol converters – The monitor can display numeric, waveform, and trended data generated by external monitoring devices. Dräger provides protocol converters that translate the output from external devices into the Medical Information Bus (MIB) protocol, using the appropriate 1073 standards (IEEE 1073.3.2 or 1073.3.1 and 1073.4.1). For more information, see chapter 29.
- R50 series recorders – Produce alarm, timed, continuous, and trend recordings. See chapter 7, for more information about R50 and R50-N recorders.
- PCMCIA card – Allows you to transfer data, upgrade software, store setups, download setups, and store diagnostic logs.
- QRS Sync. output –Allows you to synchronize defibrillators to the patient's heart beat during cardioversion.
- Balloon pump interface – Permits interaction with a balloon pump by providing two analog output signals (ECG and ART).

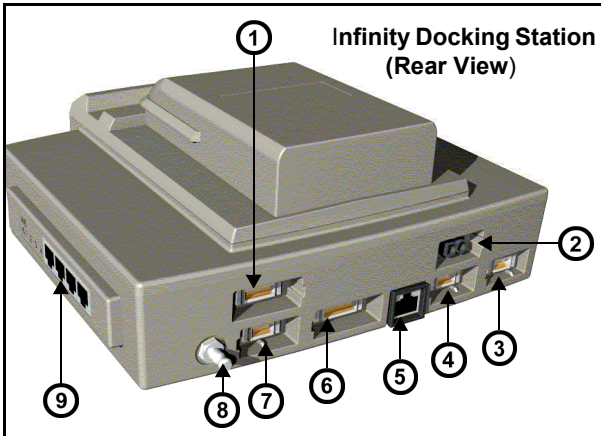
Power Sources (Delta/Delta XL)

The Delta/Delta XL monitor can be powered by the Infinity Docking Station (IDS), or an IDS Power Supply. The monitor automatically switches to battery power to provide continued patient monitoring without any loss of data, in case of line outage or disconnected cable or during transport.

CAUTION: *See the section "Safety Considerations" on page 8 in these Instructions for Use before connecting the monitor to a power source.*

Infinity Docking Station (IDS)

The Infinity Docking Station (IDS) helps facilitate patient transport, allowing you to remove the monitor from the bedside and dock it at another station while maintaining patient and monitor connections. This feature, called Pick and Go, is explained in further detail on page 3-9. With its companion DC power supply, the IDS provides power and data connection, stores setup defaults, and connects your monitor to a network.



Infinity Docking Station (Rear View)

1	MultiGas module
2	Power supply
3	Export protocol/alarm output (nurse call) [1], Scio module, (X3)
4	Independent Surgical Display (ISD) (X4)
5	Network
6	R50 series recorder (X13)
7	Video out / Remote display (X5)
8	Potential equalization
9	MIB connectors

[1] **NOTE**: Alarm output (nurse call) requires the alarm output cable with partnumber 5194928

Battery Power

The Delta/Delta XL monitor operates on an internal lithium ion battery, which can power the monitor for approximately 240 minutes when new.

NOTE: The external lead acid battery is not supported with VF9.0 software or higher

WARNING: Worn out or defective batteries can significantly reduce battery capacity or the operating time.

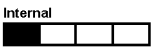
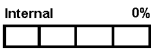
When the battery runs low, the monitor sounds an alarm, and a status message appears in the message area. When the battery is depleted, the monitor turns off automatically.

The table below illustrates the function of the battery charge bar graph at the top of the screen:

CAUTION: *The battery charger display is only accurate if the batteries are in normal working condition.*

NOTE:

- When AC power is disconnected, the battery charge display takes up to 15 seconds to reflect the internal battery's actual capacity.

Battery Charge Display		
Display	**Charge Left**	**Action**
	The battery is fully charged	Not applicable
	The battery has half of its charge capacity remaining	When possible, connect the monitor to an IDS or AC adapter.
	Internal battery is very low (approximately 20 mins remaining)	Prepare to connect monitor to AC adapter, or Infinity Docking Station.
	Internal battery is depleted; <5 minutes of power remaining.[1]	Immediately connect monitor to AC adapter, or Infinity Docking Station.
[1] The monitor sounds a medium or high alarm based on the Critical Battery Alarm configuration (see page 2-16).		

CAUTION:

- *It is strongly recommended that you use batteries that are provided by Dräger. The use of non-approved batteries may damage the device.*
- *Do not transport the patient using this monitor if the internal battery charge is low, and the "Monitor Internal Battery Low" alarm is active.*
- *High temperatures may adversely affect batteries. For optimal performance, charge batteries at temperatures below 35 °C (95 °F).*
- *Follow local regulations for disposal of batteries. To prevent fire or explosion, never dispose of batteries in fire.*

NOTE:

- To maximize the available charge for transport, leave the monitor connected until you are ready to move the patient. Reconnect the monitor immediately after transport.
- Dräger recommends replacing the lithium ion battery after 24 months of use.
- Battery life may vary depending upon usage. High Pick and Go utilization and duration of battery transport time will accelerate the battery wear and reduce the replacement interval.
- To prevent premature depletion, recharge the batteries after discharging them.

Charging the Batteries

When the monitor is connected to AC adapter, or Infinity Docking Station, the battery recharges automatically.

CAUTION: *The battery charger display is only accurate if the battery is in normal working condition.*

Before using the Delta/Delta XL monitor for the first time, fully charge the internal battery.

Power Sources (Kappa)

WARNING: Read the sections "Safety Considerations" on page i-8" and "Kappa Video Display" on page 1-11 of these Instructions for Use before connecting the monitor to a power source.

The Kappa monitor uses AC power (100-240 VAC). In case of a line outage or disconnected cable, the monitor automatically switches to battery power to provide continued patient monitoring without any loss of data. The base unit continues to operate and alarm on battery power for approximately 240 minutes.

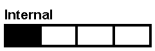
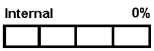
An internal battery can power the Kappa monitor (but not the Kappa video display) for up to approximately 240 minutes depending on the monitoring setup. It is intended for short-term use only, for example, as a backup during power interruptions.

WARNING: Worn out or defective batteries can significantly reduce battery capacity or the operating time.

When the monitor is operating solely on battery power, a message along the top of the screen tells you if the battery charge is low, and a bar graph indicates how much power is left (see the table below.) The battery is automatically recharged whenever you plug the monitor into an AC outlet.

CAUTION: *The battery charger display is only accurate if the batteries are in normal working condition.*

NOTE: When the monitor is disconnected from AC power, the battery charge display takes up to 15 seconds to reflect the battery's actual capacity.

Battery Charge Display		
Display	**Charge Left**	**Action**
	The battery is fully charged	Not applicable
	The battery has half of its charge capacity remaining.	When possible connect the monitor to power.
	The battery is very low (approximately 20 minutes remaining)	Immediately connect the monitor to power.
	Internal battery is depleted; <5 minutes of power remaining.[1]	
[1] The monitor sounds a medium or high alarm based on the Critical Battery Alarm configuration with the message “Recharge Battery” (see page 2-16)		

Getting Started

To turn the monitor on

- Press the power key (O), located on the bottom left of the Delta or Delta XL monitor's front panel and on the top left of the Kappa monitor's front panel. The monitor turns on the power indicator light, lights the alarm bar, emits a power-on tone, lights up the screen, performs a self-test, and displays the main screen.

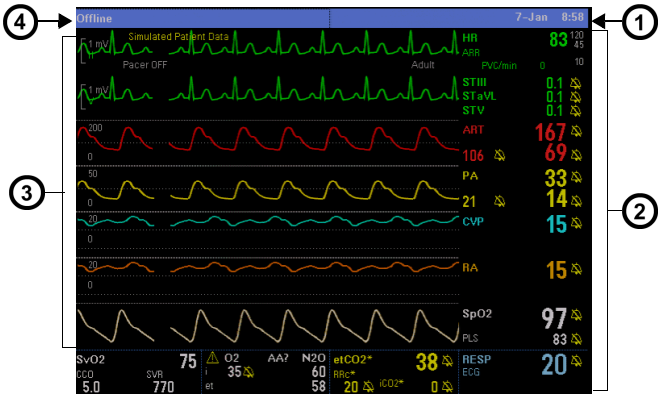
To turn the monitor off

- Press and hold the power key (O) for two seconds. The power indicator light turns dark, and the monitor emits a power-down tone.

Accessing the Main Screen

After you power up the monitor, the main screen appears. To return to the main screen from a menu or other display:

- Press the **Main Screen** fixed key, located just above the rotary knob on the front panel of the monitor. The main screen appears, as shown in the following illustration.



1	Network message
2	Parameter boxes
3	Waveforms
4	Local message

The standard Delta monitor provides five waveforms with adjacent parameter boxes. Kappa provides four waveforms with adjacent parameter boxes. Delta XL provides six waveforms with adjacent parameter boxes. Channels can be added to display up to eight waveforms. The bottom channel can be used to display additional parameter boxes (see "Bottom Channel" on page 2-6).

Parameter boxes show values, alarm limits, and special icons for selected parameters. Parameters and their associated waveforms are color-coded for easy recognition.

NOTE:

- You can access parameter setup menus by scrolling through the parameter boxes using the rotary knob and selecting the parameter you wish to configure.
- See "Quick Reference – Main Menu Setup" on page 2-3 to access parameter setup menus.
- You can change the default color coding for each parameter by accessing the Parameter Colors menu (see page 2-29). For a list of default parameter colors, see page 2-29.

Messages appear along the top of the screen. Local messages appear in the local message area (left) while network messages appear in the network message area (right). When no local messages are displayed, the monitor displays the patient's name and bed label. When no network message is displayed, the date and time appear instead.

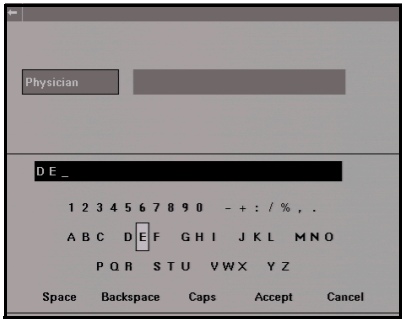
Using the Rotary Knob

The rotary knob allows you to browse menus, choose settings, and execute menu functions. Scroll through menu items by turning the rotary knob. Press the rotary knob (or click) to confirm.

To use the rotary knob

1. Select the required function by dialing the rotary knob.
2. Press the rotary knob and click to confirm your selection. A list of choices appears or the field switches to its alternate value, for example, **ON** to **OFF**.

You can also use the rotary knob to enter letters or numbers.



1. Click on a field (for example, **Physician**). The monitor displays a data-entry screen similar to the following:
2. Use the rotary knob to select each character or number, then click to confirm. Use the control buttons at the bottom of the screen for editing.
3. Click on **Accept** to confirm the entire entry or on **Cancel** to exit the data entry screen.

Remote Keypad

NOTE: The remote keypad's C.O. key is not available with the PiCCO pod.

The remote keypad has all of the fixed keys that are on the monitor and additional keys that perform the following:

Trends — Displays trend graphs
Freeze — Freezes waveform display
Calcs. — Activates Calculations menu
All ECG — Displays Show All Leads screen
Remote View — Displays Remote View menu
Recall Setup — Displays Restore Setups menu
View+ — Toggles from monitor to secondary (display) screen

To connect the remote keypad to the monitor

- (Delta/Delta XL) – Plug one end of the keypad cable into the keypad and the other into the connector marked RS232 on the right side of the monitor.
- (Kappa) – Plug one end of the keypad cable into the keypad and the other end into the keypad input connector on the monitor's rear panel.

Menu Access

There are two ways of accessing the menus. The Fast Access menu allows you to open commonly used menus quickly. The main menu lists the primary menus (Patient Setup, Monitor Setup, etc.), which allow you to access additional menus.

Fast Access Menu

The Fast Access menu accesses the following submenus and screens directly:

Fast Access Item	See page	Fast Access Item	See page
Remote View	3-17	**Calculations**	17-1
OxyCRG (Neonatal only)	12-9	**Show All Leads**	8-19
Alarm History	5-17	**Lab Data**	17-8
Trend Graphs	6-3	**Open Lung Tool** (via MIB only)	29-12
Trend Table	6-6	**OR**	2-14
Event Recall	1-27	**Split Screen**	2-7
Drug Dosage	17-12	**Reports**	7-11

To open the Fast Access menu

- Press the **Fast Access** fixed key located on the front of the monitor.

You can access many of these menus by selecting **Review** on the main screen. See page 2-5 for more information.

Main Menu

The Main menu allows you to execute certain functions and access others. Icons are used to identify menu items:

- Page icon (for example, **Restore Setups**) – Accesses a submenu
- Arrow icon (for example, **Review**) – Displays another column
- No icon (for example, **Standby**) – Executes a function

To display the Main menu

1. Press the **Menu** fixed key. The primary list of Main menu options appears.
2. Click on a page icon next to a heading ( ) to open a main menu submenu *or* on an arrow icon ( ) to display another column of main menu options (see page 2-2 for detailed information on configuring the main menu).

Fixed Keys

Fixed keys on the monitor front panel allow you to perform commonly executed functions.

Fixed Key	Description	Fixed Key	Description
Alarm Silence	Silences the active alarm tone for 2 minutes or cancels the Alarm Silence **NOTE**: Silences the active alarm tone for 1 minute when Backwards Compatibility is Enabled, subsequent key press resets the timer to 1 minute	**Record**	Starts/stops a timed recording.
Alarm Limits	Opens a table from which you can set upper and lower alarm limits	**Print Screen**	Prints the currently displayed screen to a network laser printer.
All Alarms Off	Suspends all alarms for a pre-selected time or cancels the suspension	**NBP Start Stop**	Starts or stops a non-invasive blood pressure (NBP) measurement.
Code	Activates a set of monitor functions for urgent care	**Fast Access**	Displays the Fast Access menu.
Discharge	Accesses the Discharge menu. **NOTE**: Press the **Discharge** key a second time to discharge the patient.	**Mark** |◂	Stores data with the current time stamp.
Main Screen	Activates the main screen.	**Freeze** (**Delta XL** only)	Freezes the waveforms.
		Menu	Activates the main menu.

CAUTION: *Discharge will remove all existing patient data and restore all setting to saved defaults.*

Control Buttons

Control buttons are located along the bottom of the various screens, trend tables, graphs, loop displays, etc. They permit additional screen-specific settings.

Data Archive Applications

The monitor stores events, alarms and trends automatically or at the user's request, depending on the type of information. Some events are automatically recorded and stored. Others can be stored manually by pressing the **Mark** fixed key. The monitor automatically stores alarm conditions and arrhythmia events that you have configured for storage in the Alarm Limits table (see page 5-8) and in the Arrhythmia setup table (see page 9-6).

NOTE: You cannot disable event storage for asystole and ventricular fibrillation events. The monitor stores these events automatically.

You can access archived information in one or more of the following databases:

- Trends
- Calculations
- Alarm history
- Event recall

Each database indicates the time of the data capture and parameter values and/or waveforms active at the time of capture. Trends, Calculations, and Alarm History are discussed in the following chapters (Event Recall and Storage is explained later in this section.):

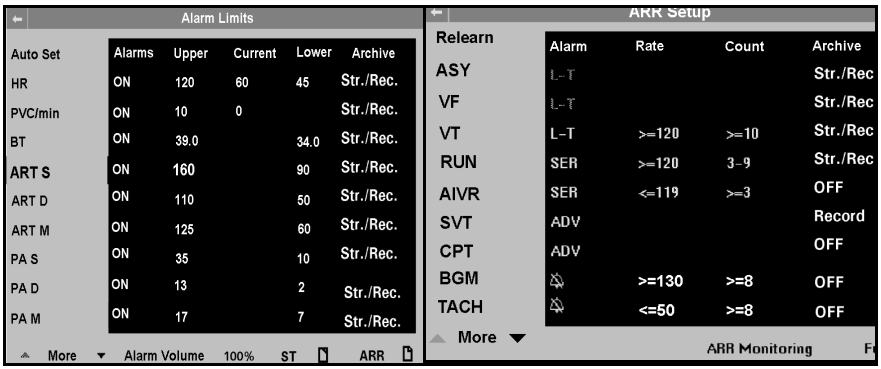
- Trends, see chapter 6. Stored events are marked with the time and date of capture as follows:
  - Trend table; an icon (|◂) over the time line marks manually stored events only. (Automatically stored alarms and arrhythmia calls are not marked in the trend table.)
  - Trend Graphs; a small yellow vertical line at the top of the screen marks manually and automatically stored events.
- Calculations; see chapter 17.
- Alarm history; see chapter 5.

Storing Events

Automatic Storage

The monitor stores events automatically, if you have first correctly configured the Alarm Limits and Arrhythmia Setup tables.

You can enable individual parameter alarms in the **Alarms** column of the Alarm Limits and/or the ARR Setup screens. Configure event storage in the **Archive** column by selecting **Store** or **Str./Rec.**



Storing Data Manually (Mark ◄ Key)

The **Mark** fixed key on the front of the monitor allows you to capture an event manually. All data displayed on the Main Screen at the time of capture is archived for later identification and comparison.

The number of events you can store depends on the **Max. Channels** setting on the Main Screen menu (see page 2-5). If the **Max. Channels** setting is **8**, the monitor stores four sets of waveforms; if set to **6**, the monitor stores three sets, etc. Waveforms are captured, stored, and displayed in pairs.

To store data manually

- Press the **Mark** ◄ fixed key on the front of the monitor to capture all waveforms and parameter values currently displayed on the main screen.

Event Recall

The monitor stores monitoring data (waveforms and parameter values), alarm conditions, and arrhythmia events on the Event Recall screen. You can view up to 50 stored events, each containing 20 seconds of data, with associated date and time stamps. Events are stored on a first-in, first-out basis. When event storage is full, the monitor deletes the oldest events to make room for new ones. All stored events are deleted whenever you discharge a patient, reset the monitor, or temporarily lose power.

To access the Event Recall screen

1. Press the **Fast Access** fixed key.
2. Click on **Event Recall** to display the Event Recall screen.

1	Time of capture	**6**	View[1]:
2	Parameter values at time of capture	**7**	Parameter display[2]:
3	Print report	**8**	Parameter labels
4	Requests recording	**9**	Waveform delay and speed
5	Saves/Deletes events		

[1] **View**: **All** - displays all stored events; **Manual** - displays manually stored events; **Alarm** - displays alarm events only; **BRDY** - displays bradycardia events only; **Desat** (Neonatal only) - displays desaturation events only

[2] **Parameter** display: **Prev** - displays previous set of (2) parameters; **Next** - displays next set of (2) parameters

Navigating the Event Recall Screen

To scroll forward and back through 20 seconds of waveform data, click on arrows at either side of scroll bar at the bottom of the screen.

To scroll through the list of parameter values at the time of data capture, click on the arrow keys above the list of parameters at the right of the screen:

To scroll through the waveforms displayed at the time of data capture, click on the **Prev** (Previous) and **Next** control buttons under waveform display.

Help Functions

You can display a short description of currently highlighted functions at the bottom of all active menus by enabling context-sensitive help.

1. Press the **Menu** fixed key to open the Main menu.
2. Click on **Monitor Setup.** Another column of options appears.
3. Open the **Display Options** menu by clicking on that heading.
4. Select **Help Line Display** and click to choose **ON**.

Additional information about the monitor is available in the Main Help menu.

1. Press the **Menu** fixed key.
2. Click on **Help**. The Main Help Menu appears.
3. Click on the appropriate selection in the table below.

Menu Item	Description
Locked Options	Displays active software options currently installed on the monitor.
Fixed Keys	Describes functions of fixed keys.

2 Monitor Setup

Overview

This chapter describes how to configure the monitor and offers tips on software upgrades. If the monitor is connected to a network, you can save defined setups and restore them for display.

Configuring the Monitor

Main Menu Setup

The Main menu allows you to access submenus, display screens, and execute certain monitor setup functions.

1. Press the **Menu** fixed key to display the Main menu.
2. Click on a page icon ( ) to open a submenu associated with the Main menu,

or

Click on arrow icon ( ) to display another column of submenu options.

3. Click on the desired setting to execute functions or access further submenus.
4. Click on **Exit** at the bottom of a submenu list or on the white arrow in upper left corner of the screen to return to prior menu or screen.

Quick Reference – Main Menu Setup

The Main Menu		
Menu Item	**Description**	**Available Settings**
Cursor Tool	Provides access to the Cursor Tool submenu (see below), which allows you to select three waveforms displayed with horizontal cursors and a vertical cursor.	• **Setup** • **Horizontal Cursor** • **Stop** • **Hemo/Calcs** • **Vertical Cursor**
The Cursor Tool Submenu		
Setup	Opens Cursor Tool setup menu.	• **Waveform** (up to 3) **NOTE**: In 4-channel mode, a maximum of 2 waveforms are available. **NOTE:** If any of the three ECG lead selections (Channel 1, Channel 2 and/or Channel 3) in the ECG menu are duplicate, then the cursor tool application will be unavailable/inaccessible. An error tone will indicate that the cursor tool is not accessible. • **Sweep Speed** • **6.25 mm/sec** • **12.5 mm/sec** • **25 mm/sec** (Default) • **50 mm/sec**
▲▼ **Horizontal Cursor** (One for each waveform on display)	Displays a horizontal cursor. User can scroll up and down each waveform. **NOTES:** • Cursor value is displayed [1]. • Cursor and value remain displayed until the window closes. • Buttons remain ghosted until you press the **Stop** key. **To exit the cursor tool:** • Press the **Menu**, **Main Screen, Alarm Limits, Fast Access,** or **Discharge** fixed key.	Not applicable
Stop	Stops scrolling of all waveforms in the cursor tool display and makes the **Horizontal** and **Vertical Cursor** buttons selectable.	Not applicable

The Main Menu		
Menu Item	**Description**	**Available Settings**
Hemo/Calcs	Opens the hemo/calcs screen. **NOTES:** • If a locked option is not available, the button is removed. • The advanced calcs menu is available if the option is installed.	Not applicable
[1] The cursor value is displayed only if a scale is associated with the waveform. Waveform scales are the same as parameter main display.		
◆▶ **Vertical Cursor**	Displays a vertical cursor. You can scroll forward and backward across all waveforms. **NOTES:** • The cursor has no value. • The cursor remains displayed until the window closes. • The buttons remain ghosted until you press the **Stop** key. **To exit the Cursor tool:** • Press the **Menu, Main Screen, Alarm Limits, Fast Access,** or **Discharge** fixed key.	Not applicable
Review	Provides access to submenus of the Main menu display (see page 2-2).	• Click on **Review** to open the following submenus and displays: Alarm History, Trend Graphs, Trend Table, Event Recall, Calc. Results, OxyCRG (neonatal mode only), Show All Leads, Lab Data, and Open Lung Tool. • Click on **Exit** to return to the first column of the Main menu.

The Main Menu		
Menu Item	**Description**	**Available Settings**
The Patient Setup submenu		
Patient Category	Determines the availability of monitoring features such as apnea detection (neonates only) and ventilation. Also alarm limit adjustment per saved setup for the patient category. **NOTES**: • Clicking on a setting displays a popup message that warns you that things will change if you confirm the action. Click on the category of your choice again to confirm the action. • If you change a patient's category, the weight selection is cleared and must be selected again.	• **Adult** • **Pediatric** • **Neonatal** **NOTE:** The monitor displays a banner indicating the selected patient category.
Pressure Labels	Assigns IBP pressure channel labels (see chapter 15, for detailed information).	**ART, PA, CVP, LA, LV, RV, RA, ICP, ICP2, ICP3, ICP4, GP1, GP2**
Parameters	Accesses the parameters' setup menus.	• Click on one of the listed parameters to access its setup menu: (for example, **ECG, ARR, ST, ART, PA CVP, RA, SPO2, NBP, RESP, etCO2, C.O.**) **NOTE:** The parameters that appear in this list depend upon the monitor's configuration and which devices are connected. • Click on **Exit** to return to the Main menu column.
Alarm Limits	Opens the alarm limits table	See page 5-8
The Monitor Setup submenu		
Main Screen This submenu allows you to layout the main screen. To access the second page of this menu, click on the down arrow at the bottom of the screen. Click on the up arrow to return to this page.		

The Main Menu		
Menu Item	**Description**	**Available Settings**
Parameter Priority	Allows you to modify the order of parameters displayed on the Main Screen without regard to whether or not that parameter is connected. **NOTES**: • Parameters must be assigned a priority; whether they appear on the main screen depends on their priority and on the number of channels configured to display waveforms (see **Max. Channels** on page 2-6). • In Automatic display mode, connected parameters are displayed according to their priority in the **Parameter Priority** list. If all available channels are filled, a higher priority parameter will NOT "bump" lower priority parameter boxes off the Main Screen when the associated device is connected. In order to display the parameter, the user must double-click on the parameter in the **Parameter Priority** list. • In OR Mode, if all available channels are filled, a higher priority parameter will "bump" lower priority parameter boxes off the Main Screen when the associated device is connected.	To change a parameter's display order: 1) Scroll to **Display Mode.** 2) Select **Manual (or Automatic)**. 3) Click on **Parameter Priority** to highlight the first listed parameter. **NOTE:** Parameters are numbered according to their priority. The display is color coded: A green parameter label indicates that the associated parameter device (for example, an NBP hose/cuff) is connected to the monitor. A white label indicates that the device is not connected. 4) Scroll the list to the parameter you wish to move and click. 5) Move the parameter to its new place using the rotary knob. 6) Click to confirm the parameter's new position on the list. 7) Click again to return to **Parameter Priority**. 8) Scroll to the arrow at the upper left corner of the menu to exit, or continue to set up other Main Screen submenu functions.
Max. Channels	Determines the number of waveform channels and parameters displayed.	• Click on **4, 5, 6, 7,** or **8** **NOTE:** The number of waveforms depends on the software option you have installed.
Bottom Channel	Configures the bottom waveform channel to display a waveform or 3 parameter boxes.	**Waveform**, **Parameters**
ECG Channels	Determines the number and format of ECG waveforms displayed.	Click on the following settings: • **ECG1** – Displays the primary ECG waveform • **ECG1 & 2** – Displays 2 waveforms • **ECG1 & 2 & 3** – Displays 3 waveforms • **Cascade** – Cascades ECG1 data into second channel

The Main Menu		
Menu Item	**Description**	**Available Settings**
ARR Monitoring	Selects the Arrhythmia mode (For detailed information, see page 9-5.)	• Select **OFF** to disable arrhythmia monitoring. • Select **FULL** to enable full arrhythmia monitoring. • Select **BASIC** to enable basic arrhythmia monitoring.
ST Monitoring	Enables and disables ST monitoring (for detailed information, refer to chapter 10).	• Select **ON** to enable ST monitoring. • Select **OFF** to disable ST monitoring.
RESP Monitoring	Enables and disables respiration monitoring (for detailed information, refer to chapter 12).	• Select **ON** to enable respiration monitoring. • Select **OFF** to disable respiration monitoring.
Display Mode	Reduces Main screen clutter by displaying only parameters associated with a connected device (see **Parameter Priority** on page 2-6).	• Select **Manual** to display all parameters and assign them a priority on the Parameter Priority screen. • Select **Automatic** to display active parameters only.
Agent Display	Displays an anesthetic agent parameter box.	• Select **ON** to display agent. • Select **OFF** to cancel display.
N2O Display	Displays N_2O/O_2 parameter box. Ghosted when MultiGas Parameter is set to ON. **NOTE**: This selection is ghosted unless MultiGas module is connected.	• Select **ON** to display N_2O/O_2. • Select **OFF** to cancel display.
MultiGas Parameter	Displays a combined O_2/Agent/N_2O parameter box. **NOTE**: You can also display or cancel the MultiGas Parameter box from the O_2 setup menu (see chapter 24, for more information).	To display the O_2/Agent/N_2O parameter box: • Click on **MultiGas Parameter**. • Click again to toggle **ON** or **OFF**.
Split Screen	Reserves a portion of the main screen for display of trend graphs and ventilation loops.	Click on one of the following: • **OFF** • **60 Min Trends** • **10 Min Trends** • **Ventilation**
EEG Channels	Sets number of EEG waveforms displayed.	• Click on 1, 2, 3, or 4.
Display Options This submenu allows you to access and modify waveforms and other display features by configuring the following functions.		

The Main Menu		
Menu Item	**Description**	**Available Settings**
Monitoring Sweep Speed	Determines the waveform speed. The higher the sweep speed the quicker the waveforms are move across the screen.	Click on **6.25, 12.5, 25,** or **50 mm/s**
Respiratory Sweep Speed	Allows you to set the sweep speed for the respiration waveform independently of other parameters.	Click on **6.25, 12.5, 25,** or **50 mm/s**
Pressure Overlap	Displays up to 4 overlapping IBP waveforms in a single oversized channel. Overlapped waveforms share a common zero point, but each waveform retains the original scale configuration (see page 15-15).	• Select **ON** to display IBP waveforms in overlapping format. • Select **OFF** to cancel display of waveforms in overlapping format.
Pressure Common Scale	Displays pressure waveforms with a common scale, making it easier to compare them.	Click on **5, 10, 15, 20, 25, 30, 40, 50, 75, 100, 150, 200, 250, 300 mmHg,** or **OFF.**
Monitor Brightness	Sets the brightness of the monitor screen.	Click on **Auto** (ambient light), **20, 40, 60, 80,** or **100%.**
Help Line Display	Shows a contextual help line at bottom of the menu.	• Select **ON** to display a help line. • Select **OFF** to cancel the display of a help line.
Parameter Units Display	Displays a unit of measure in the parameter boxes.	• Select **ON** to display units. • Select **OFF** to cancel the display of units.

The Main Menu		
Menu Item	**Description**	**Available Settings**
Monitor Options submenu		
Date & Time	Sets the date and time displayed in the lower right potion of the main screen **NOTES**: • An internal battery powers the monitor's clock even when the monitor is turned off. • This option is not available when the monitor is connected to network, since network date and time are set at the central station. • Changing the time does not affect other time-related functions such as timers and time stamps.	To set the monitor date and time: 1) Click on **Date & Time**. 2) Click on **Current Date**. A data entry screen appears. 3) Click on **Day**, scroll to the correct date, and click. 4) Repeat Step 3 for **Month** and **Year**. 5) Click on **Accept** to confirm or on **Cancel** to return to submenu. 6) Click on **Current Time** to set the time, using the same method described in steps 3 and 5.
Speaker Volumes	Allows you to set the volume for alarms, pulse tones, and attention tones. Note: The lowest alarm volume setting depends upon the Minimum Alarm Volume Setting configured under Unit Manager password protected screen.	• Click on **Alarm Volume** to set the volume of alarms (**OFF**, **10-100 %** in increments of 10). • Click on **Pulse Tone Volume** to set the volume of the pulse tone (**OFF, 5, 10**-**100 %** in increments of 10 after 5). • Click on **Attention Tone Volume** to set the volume of attention tones (**OFF, 5, 10**-**100 %** in increments of 10 after 5). **Note:** The alarm volume can be set to off only in OR mode or if the monitor is connected to the central station
Parameter Colors	Allows you to assign a color to an individual parameter/waveform	Submenu (see page 2-29).
Trend Setup	Allows you to configure trend display.	Submenu (see chapter 6, for detailed information).
Recordings	Allows you to configure and assign recorders.	Submenu (see chapter 7, for information).
Biomed	Provides access to technical and clinical logs and service menus.	Submenu (see page 2-26).
Unit Manager	Allows the unit manager, physician or head nurse to configure monitoring functions for the clinical staff.	Submenu (see page 2-10).
OR	Configures monitor to meet the special needs of the operating room environment.	Submenu (see page 2-14).

Setups Management

You can save and restore the current patient and monitoring settings. When you discharge a patient, the monitor automatically restores the saved patient category default settings upon new admission, while both default and user-defined settings are saved on the local IDS. The IDS allows storage of 5 setups per patient category (only 1 for the monitor). The setup labeled default is restored automatically with new admission. When connected to an IDS, the user can restore any setup from the menu.

Setups Management		
Menu function/item	**Description**	**Reference/Procedures**
Configuring Setups To name, save, or restore setups, configure them as shown in the referenced pages.		
Main screen display	Main Screen menu	Page 2-5
Parameters	Parameter setup menu(s) **NOTE**: For more information, see parameter chapters.	Page 2-5
Alarms	Alarm Limits Table	Page 5-8
Arrhythmia calls	Arrhythmia Setup Table	Page 9-6
Trends	Trend setup Trend graphs Trend table	Page 6-2 Page 6-3 Page 6-6
Naming and Renaming Setups Follow these procedures to name or rename the setups you have configured.		
Accessing the Unit Manager Menu	Allows you to label (name) or modify setups on the password-protected Unit Manager menu. **NOTE**: For information on other Unit Manager functions, see page 2-16.	To enter the password: 1) Press the **Menu** fixed key to display the Main menu. 2) Click on **Monitor Setup.** 3) Click on **Unit Manager.** A data entry box appears. 4) Click on each number of the appropriate password. If you make a mistake, click on **Backspace** and try again. 5) Click on **Accept** to open the Unit Manager menu.
Rename Setups	The selected setups on the Rename Setups menu are listed automatically on the Save/Restore Setups menu. **NOTE**: All setups on the Rename Setups menu except the default setup are ghosted if the monitor is not connected to a IDS.	1) Open **Unit Manager**. 2) Click on **Rename Setups.** 3) Select **Default** or a numbered setup. 4) Name a setup using the rotary knob and the edit keys at the bottom of the display. 5) Click on **Accept** to replace the numbered or default setup with the name of your choice.

Setups Management		
Menu function/item	**Description**	**Reference/Procedures**
Saving Setups Follow these procedures to save setups you have configured and named.		
Save Setup ***CAUTION:*** *Save setups with care; Saving a setup overwrites an existing setup.*	**NOTES**: • A **Save Setup** function is also available on the Independent Surgical Display (see page 29-20). Independent Surgical Display configuration does not affect monitor setups. • You can save a setup on a monitor that is not connected to the network only if you have defined the setup as **Default** on the Unit Manager menu under **Rename Setups**. All other setup options are ghosted. • If you upgrade your software to VF9 or higher, the following settings need to be reconfigured: - Parameter Priority list for the main screen - Trend graph scales - Pacer detection settings - Alarm Volume - All Alarms OFF Reminder - Audio OFF Reminder - Masimo Averaging/ Averaging Time settings (see page 18-9) - ECG Cable Type setting (see page 8-21) • You can save the software upgrade settings from one monitor to a memory card and use it to upgrade other monitors. • All monitors should use the latest software version.	1) Open the Unit Manager menu (see page 2-10). 2) Click on **Save/Restore**. 3) Click on **Save Setup**. 4) Click on the name of the setup you wish to save. The monitor saves the setup with its new configuration. A tone indicates the monitor has successfully saved the setup.
Restoring Setups Follow these procedures to restore setups you have configured, named, and saved.		

Setups Management		
Menu function/item	**Description**	**Reference/Procedures**
Restore Setup ***CAUTION**: Restore setups with care; Restoring a setup overwrites an existing setup.*	**NOTES:** • You can access **Restore Setups** quickly as follows: 1) Press the **Menu** fixed key. 2) Click on **Restore Setups**. 3) Follow Steps 4-6 at right. • **Save Setup** and **Restore Setup** menu selections are also available on the Independent Surgical Display (see page 29-20). The configuration of the Independent Surgical Display (ISD) Save or Restore menu does not affect monitor setups. • If a monitor is not connected to a network, you cannot restore user-defined setups. • You can also restore setups from the Main menu. • If the monitor is not connected to an IDS the four additional user defined setups cannot be restored, only the default saved setup.	1) Open the Unit Manager menu (see page 2-10) 2) Click on **Save/Restore**. 3) Click on **Restore Setup**. 4) Click on the name of the setup you wish to restore. 5) Select the type of setting you wish to restore: • **Monitor Settings Only** to restore settings configured on the Monitor Setup menu, *or* • **Patient and Monitor Settings** to restore monitor settings and settings configured on the Patient Setup menu. 6) The monitor restores the setup and returns to the Restore Setups menu*; or* Indicates which parameters will be removed to make room for restored setup. 7) Click on **New Setup** to remove the indicated parameter(s) and restore the selected setup, or **Cancel** to return to the main screen.
Restoring Factory Defaults Consult your hospital's technical personnel to restore settings shipped with the monitor to their original configuration. For detailed information on password-protected Biomed setup functions, please consult Service and installation documentation.		
Managing Setups during Pick And Go (Delta & Delta XL only) Follow these procedures to specify how the monitor downloads default configurations from the local Docking Station during PICK AND GO operations.		

Setups Management		
Menu function/item	**Description**	**Reference/Procedures**
Pick And Go	**NOTE:** Configure **Pick and Go** on the Save/Restore menu before you transport the patient (see page 2-13).	1) Open the Unit Manager menu (see page 2-10). 2) Click on **Save/Restore**. 3) Click on **Pick And Go**. 4) Click on one of the following settings to execute the indicated function: • **Automatic** — When the monitor docks, it automatically downloads the default configuration stored in the local Docking Station. If this will remove existing parameters from the display, a pop-up menu asks you to confirm this action. • **Manual** — When the monitor docks, a pop-up menu always asks you to confirm the downloading of the local default configuration, whether or not this will remove existing parameters from the display. • **OFF** — When the monitor docks, it does not download the local configuration but continues to operate with the existing settings.
Managing New Setup pop-up menu during Pick And Go (Delta & Delta XL only) Follow these procedures to specify if the monitor should download default configurations from the local Docking Station during PICK AND GO operations. The new setup pop-up menu appears when: • a new setup will remove a parameter from display, or • a new setup will cause loss of a locked option, or • in 'manual' Pick and Go mode (see page 2-14).		
New Setup pop-up menu	Allows you to restore monitor settings only, or patient and monitor settings, or cancel the procedure. Note: Monitor settings will alter only the display screen. Patient and monitor settings will alter alarm limit settings and the parameter display screen.	Select one of the following settings to execute the indicated function: • **Monitor settings** — Restores monitor settings only, patient settings remain as they are. • **Patient and Monitor settings** — Restores both patient and monitor settings. • **Cancel** — both patient and monitor settings remain as they are.

Specialty Menus

OR Mode

OR mode is designed specifically for the operating room environment, allowing you instant access to a particular set of parameters and functions. In addition, you can disable audible alarms without affecting visual alarms, even when the monitor is not connected to a network. The OR mode is a software locked option available for Delta, Delta XL and Kappa monitors, or with the Infinity Docking Station with the Delta or Delta XL monitors.

To access the OR menu

1. Press the **Fast Access** fixed key.
2. Click on **OR** to display the OR menu.

Quick Reference Table – OR Menu

OR Function	Description	Settings
The OR menu		
OR	Activates the OR menu functions. **NOTE**: This function is a locked option. It is installed at the time of purchase from perioperative care unit or it can be installed locally by DrägerService or your hospital's technical personnel.	• **ON** – OR functions are enabled. • **OFF** – The monitor reverts to normal functions; The settings **Cardiac Bypass** and **NBP Chime** are ghosted. **NOTE**: The monitor displays a banner indicating that OR mode is turned ON.
Cardiac Bypass	Configures the monitor for use during cardiac surgery.	• **ON** – Suspends all patient-monitoring alarms (except ventilator alarms), NBP interval measurements, and arrhythmia detection. **NOTE**: The monitor displays a banner indicating that OR mode is turned ON. • **OFF** – The monitor reverts to normal functions.
NBP Chime	Controls whether an attention tone sounds upon completion of an NBP measurement, see chapter 13 for more information).	• **ON** – Attention tone sounds when NBP measurement is complete. • **OFF** – No tone sounds when NBP measurement is complete.
Alarm Volume	Sets the alarm volume. **NOTE**: The alarm volume setting is displayed on the message area	• **10 - 100%** in increments of 10 • **OFF** **NOTE**: Range may be restricted by the minimum alarm volume password protected configuration setting.
Large IBP-Mean Display	Determines the relative size of the mean pressure value in invasive pressure parameter boxes.	• **ON** – The mean IBP value is larger than the systolic and diastolic IBP values. • **OFF** – The systolic, diastolic and mean IBP values are the same size.
Attention Tone Volume	Sets the attention tone volume	• **OFF, 5, 10 - 100%** in increments of 10
HR Source	Derives heart rate from various sources (see page 8-24). **NOTE**: This function is useful during electrosurgery when artifact makes the ECG channel unreliable.	Click on one of the following settings to determine the Heart Rate source: • **ECG** • **ART** • **SpO2** • **AUTO**
Filter	Determines sensitivity to noise, artifact, and other signal distortion (see page 8-22). **NOTE**: The **ESU** setting automatically disables pacer detection.	• **OFF** • **ESU** • **Monitor**

OR Function	Description	Settings
ARR Monitoring	Determines the number of arrhythmia events you can monitor (see page 9-5).	• **OFF** • **Basic** • **Full** **NOTE**: **Full** is not available if the arrhythmia II option is not installed.
Pulse Tone Volume	Sets the pulse tone volume (see page 2-9).	• **OFF** • **5%** • **10 % - 100 %**

Unit Manager

The Unit Manager menu lets supervisory personnel configure monitoring functions for the clinical staff. Access to this menu is restricted by a password. To open the Unit Manager menu:

1. Press the **Menu** fixed key to open the Main menu.
2. Click on **Monitor Setup**.
3. Click on **Unit Manager**. A data entry box appears.
4. Scroll through the numbers and click successively on the single digits of the clinical password. If you make a mistake, click on **Backspace** and try again.
5. Click on **Accept** to open the Unit Manager menu. Available functions are described in the table that follows.

The Unit Manager Menu		
Menu Item	**Description**	**Available Settings**
The Alarm Control 1 and Alarm Control 2 Submenus This menu allows the unit manager to configure alarm annunciation. Open the Unit Manager menu, click on **Alarm Control 1 or Alarm Control 2**, then follow the procedures outlined in this table to execute the indicated functions.		
All Alarms OFF Key (Alarm Control 1 submenu)	Determines whether clinical personnel can suspend alarms by using the **All Alarms Off** fixed key on the front of the monitor.	• **ON (default)** – Pressing **All Alarms Off** fixed key suspends alarms. • **OFF** – Pressing **All Alarms Off** fixed key triggers an error tone.
All Alarms OFF Time (Alarm Control 1 submenu)	Sets the alarm suspension time. **WARNING**: **If No Timeout is assigned to the 'alarm off period', no counter appears and alarms remain deactivated until you turn them on again.**	• **1, 2 (default), 3, 4,** or **5 min** – A timer at the top of the screen indicates the amount of time remaining in **All Alarms OFF Time.** • **No Timeout** – Alarms are suspended indefinitely; no timer appears.

The Unit Manager Menu		
Menu Item	**Description**	**Available Settings**
Extend All Alarms OFF (Alarm Control 1 submenu)	Determines whether clinical personnel can use the **All Alarms Off** fixed key to extend the **All Alarms Off** time. **NOTE**: This item only appears if your monitor is configured for this feature (contact your hospital's technical personnel for more information).	• **Enabled** • **Disabled** (default)
Alarm Validation (Alarm Control 1 submenu)	Validates the alarm conditions to limit nuisance alarms due to artifact or motion/ movement by delaying time to alarm. **NOTE:** When the **Alarm Validation** setting is set to **ON**, the time to alarm from the onset of a limit violation equals the time for detection plus the designated alarm validation signal delay. For HR, this time may exceed the maximum of 10 seconds as required by AAMI EC13 and IEC 60601-2-27. Alarm validation times are: Upper limit / Lower limit HR 6 sec / 6 sec RESP [2] 14 sec / 14 sec IBP 4 sec / 10 sec SpO_2 6 sec / 10 sec[1] PLS 6 sec. / 10 sec[1] SpO_2* 4 sec / 4 sec PLS* 4 sec. / immediately All other parameters immediately [1]See **SpO2 Alarm Delay** below. [2]also for Continuous Non-Invasive Arterial Pressure (Infinity CNAP Pod)	• **ON** – Enables the alarm validation. • **OFF** (default) – Disables the alarm validation.
SpO2 Alarm Delay (Alarm Control 1 submenu)	Validates an SpO_2 alarm condition by requiring that the violation persists for 10 seconds (lower limit) before sounding an alarm. **NOTE**: **Alarm validation** must be turned **ON**. If **Alarm Validation** is turned **OFF**, **SpO2 Alarm Delay** is automatically turned **OFF** and menu selection is ghosted.	• **ON** – SpO_2 or PLS lower limit alarm conditions are annunciated after it persists for a period of 10 seconds. • **OFF** – SpO_2 or PLS lower limit alarm condition is not validated before annunciation.

The Unit Manager Menu		
Menu Item	**Description**	**Available Settings**
ASY/VF Alarms (Alarm Control 1 submenu)	Allows user to prevent disabling of ASY and VFIB alarms. **WARNING: When the HR alarm is set to OFF and ARR monitoring is set to "OFF", the monitor cannot generate ASY/VF alarms.**	• **Always ON** – ASY and VFIB alarms are always active. • **Follow HR Alarms** (default) – ASY and VFIB alarms follow the HR alarm settings.
NBP/SpO2 Interlock (Alarm Control 1 submenu)	Allows user to render SpO_2 alarm inactive when NBP measurement is in progress. **WARNING: Visually check that the NBP cuff is on the same arm as the SpO_2 sensor. The monitor will not automatically detect that NBP cuff and SpO_2 sensor are on the same arm.**	• **ON** – The SpO_2 alarm function is inactive during an NBP measurement. • **OFF** (default) – The SpO_2 alarm is active during an NBP measurement.
Alarm Limits Display (Alarm Control 1 submenu)	Enables/disables the display of alarm limits in the parameter boxes.	• **ON** (default) – Alarm limits display next to the current parameter value in the parameter box. A crossed bell is displayed there if that alarm is disabled. • **OFF** – Alarm limits are not displayed. **NOTE:** Alarm limits for SpO2 parameter are always on display independent of the settings.
Alarm Light (Alarm Control 1 submenu)	Allows you to enable/disable the alarm bar which is located on top of the monitor's housing. **NOTE**: The alarm bar is not available on a SC 7000/8000/9000XL or Kappa monitor. **NOTE**: During multiple alarm conditions, the alarm bar flashes only for the alarm condition with the highest priority.	• **ON** (default) – Alarm bar reacts as follows: - Flashes red for all high-priority alarm conditions. - Flashes yellow for all medium-priority alarm conditions. • **OFF** – The alarm bar is disabled.
MIB Alarm Control (Alarm Control 2 submenu)	Allows you to activate/deactivate MIB disconnect alarms associated with ventilators and/or anesthesia machines. **NOTE**: This selection applies only with ventilators and/or anesthesia machines	• **ON** (default) – MIB disconnect alarms are active. • **OFF** – MIB disconnect alarms are inactive.

The Unit Manager Menu		
Menu Item	**Description**	**Available Settings**
Remote View Display (Alarm Control 2 submenu)	Allows user to set **Remote View** (see page 3-17) behavior when the **Remote View** is displaying telemetry ECG data.	• **Always ON** – the local bed alarm will not cause remote view feature to “pull down” the remote bed display. • **Pull Down on Alarm** (default) – the local bed alarm will cause remote the view feature to “pull down” remote bed display.
Audio OFF Reminder (Alarm Control 1 submenu)	Allows you to set a reminder when the **Alarm Volume** feature is set to **OFF**.	• **ON** (default) – When the **Alarm Volume** feature is set to **OFF**, a reminder tone sounds every 30 seconds at 50 % volume. **NOTE**: For monitors in OR mode: At the end of an alarm silence or an alarm off period, if the alarm condition is still active, the parameter box will flash and an appropriate reminder tone (high, medium, or low) sounds every 30 seconds at 50 % volume. • **OFF** – There is no reminder tone when **Alarm Volume** is set to **OFF**.
Minimum Alarm Volume (Alarm Control 2 submenu)	Allows you to set the minimum alarm volume for the monitor. **NOTE**: • This menu will not be available when backwards compatibility is enabled • While in CODE, if the user changes either the Alarm Volume or Minimum Alarm Volume, then the newly selected setting shall remain after CODE is exited. The new setting for Alarm Volume shall always be equal to or greater than the Minimum Alarm Volume setting at any point, regardless of CODE. • While in CODE, if the user changes the Minimum Alarm Volume to any setting other than OFF and then returns it to OFF prior to exiting CODE, then the Minimum Alarm Volume setting will be restored to the setting it contained prior to entering CODE.	• **Off** • **10, 20, 30, 40, 50, 60, 70, 80, 90, 100**
Critical Battery Alarm (Alarm Control 2 submenu)	Allows you to set the alarm grade for critical low battery capacity (< 5 minutes charge remaining). **NOTE:** When this alarm condition is triggered a "Recharge Battery" message is displayed.	• Medium (default) • High

The Unit Manager Menu		
Menu Item	**Description**	**Available Settings**
OR Audio Alarms (Alarm Control 2 submenu)	Allows you to configure the audio alarms for OR mode.	• **Standard** (default) – All alarms outside of alarm silence period sound full cycle according to the alarm grade. Any new alarms coming in when in Audio Paused (Alarm Silenced) state sound full cycle according to the alarm grade. • **Slow Repeat** – All alarms outside of Audio Paused (Alarm silenced) period sound single cycle according to the alarm grade and repeat every 30 seconds from end of current cycle to start of the next cycle. During Audio Paused (alarm silenced) period any new alarm sounds one attention tone (with no repetition) at 50% volume. During alarm silence period the Audio Paused banner with the countdown timer remains on display. After the Audio Paused (alarm silenced) timer expires the behavior reverts back to sounding single cycle with repeat every 30 seconds if the alarm condition still exits.
The Code Setup submenu This menu allows the unit manager to configure the monitor for quick emergency response. Open the Unit Manager menu (page 2-16), click on **Code Setup**, then select and execute functions as described in this table. For more information, see page 5-7.		
Continuous Record	**NOTE**: If no recorder is available, the recording request remains pending for later printing.	• **Yes** (default) – Provides a continuous recording when you press the **Code** fixed key. • **No** – No continuous recording is started when you press the **Code** fixed key.
Continuous NBP	**NOTE**: You must attach the NBP cuff and display the NBP parameter box before requesting NBP measurements.	• **Yes** – Starts continuous NBP measurements when you press the **Code** fixed key. • **No** (default) – No NBP measurements are started when you press the **Code** fixed key.

The Unit Manager Menu		
Menu Item	**Description**	**Available Settings**
Audio OFF	Allows you to lower the alarm volume to its minimum setting (see page 2-9 and page 2-15) when you press the **Code** fixed key.	• **Yes** – Allows you to lower the alarm volume. • **No** (default) – The alarm volume is not affected when you press the **Code** fixed key. **NOTE**: When the Audio OFF selection is set Yes and CODE is activated, the Alarm Volume and Minimum Alarm Volume is temporarily changed to OFF. When the Audio OFF selection is set to No and CODE is activated, the Alarm Volume and Minimum Alarm Volume will not change (i.e. retains the settings that existed prior to entering CODE).
Audio OFF	Allows you to turn the audio volume off on the monitor. **Note:** the central station continues to sound audio alarms.	• **Yes**- Allows you to turn the audio alarm off • **No** - (default) The alarm volume is not affected when you press the code fixed key
All Alarms OFF	When the **Code** fixed key is pressed, the following happens if the **All Alarms OFF** setting set to **Enabled**: • All alarms (audible and visual) are disabled immediately and an *All Alarms OFF* banner is displayed in the top center of the monitor. • A code timer is displayed in the bottom left of the monitor. • If the **Code** function is disabled by pressing the **Code** fixed key again, the **All Alarms OFF** feature is deactivated and the *All Alarms OFF* banner is removed from the display. When the **Code** fixed key is pressed, the following happens if the **All Alarms OFF** setting is set to **Disabled**: • The **Audio OFF** setting is disabled immediately and an Audio OFF banner is displayed in the top center of the monitor. • A code timer is displayed in the bottom left of the monitor. • If the **Code** function is disabled by pressing the **Code** fixed key again, the **Audio OFF** feature is deactivated and the *Audio OFF* banner is removed from the display.	• **Enabled** • **Disabled** (default)

The Unit Manager Menu		
Menu Item	**Description**	**Available Settings**
All Alarm Off Reminder Tone (Alarm Control 1 submenu)	A reminder tone to indicate All Alarms are OFF permanently.	• **Enable (default)** • **Disable**

The Unit Manager Menu		
Menu Item	**Description**	**Available Settings**
The Menu Setup submenu		
Menu Time Limit	Determines amount of time menus and screens remain displayed **NOTE**: This setting determines menu display time in **Remote View** also.	1) Click on **Menu Setup**. 2) Click on **Menu Time Limit**. 3) Click on one of the following: • **ON** – Active menus and screens are displayed for a limited time only (approximately 5 minutes). • **OFF** – Menus and screens remain displayed until you cancel them or select another display.
The Save/Restore and Rename Setups submenus These menus allow the unit manager to save and restore user-defined and default setups. Open the Unit Manager menu (page 2-16), click on **Save/Restore** or **Rename Setups**, then follow the procedures outlined on page 2-11 to execute the indicated functions.		
The TPO_2/CO_2 submenu This menu configures the monitor for transcutaneous blood gas monitoring. Open the Unit Manager menu (page 2-16), click on **TPO2/CO2**, select and execute functions as described in this table. For more about tpO_2/CO_2 functions, see page 19-10.		
Site Timer Control	Restricts or permits access to the site timer (see page 19-11).	• **Nurse** – Clinical personnel can set the site timer in the tpO_2/CO_2 menu. • **Manager** – Access to the site timer is restricted by the password-protected Unit Manager menu.
Site Timer	Limits the use of the tpO_2/CO_2 sensor to a specified period of time. When the time has expired, an alarm sounds and all network devices are advised with a message. Site Timer menu is disabled/ghosted when Site Timer Control is set to **Nurse**.	• **0.5** - **8.0 hr** in 0.5 hr increments. Default 2.0 hr • **OFF**

The Unit Manager Menu		
Menu Item	**Description**	**Available Settings**
Extend Site Timer	Clears the site timer alarm and extends the site timer by 30 minutes. This extension is only allowed once. **NOTES**: • Selection is ghosted and not selectable until the TP/TP* site timer alarm sounds. • Once activated, the selection is ghosted again and is not selectable until the site has been changed and the timer has expired for that TP or TP* site. • If the **Site Timer Control** setting has been set to **Manager** in Unit Manager menu, the **Extend Site Timer** setting on the tpO_2/CO_2 setup menu is ghosted. • If the **Auto Heater Shutdown** setting is set to **ON** in the Unit Manager menu, the **Extend Site Timer** setting on the tpO_2/CO_2 setup menu is ghosted on the Unit Manager menu. • If the **Site Timer Control** setting is set to **Nurse**, the **Extend Site Timer** setting is ghosted on the Unit Manager menu.	Not applicable
Timer OFF Control	Enables/disables the control of the site timer (see page 19-11).	• **ON** – Only the unit manager can disable the site timer. • **OFF** – The clinical personnel can disable the site timer in the tpO_2/CO_2 menu.
Auto Heater Shutdown	Refer to your hospital's policy for this feature. **NOTE**: The sensor heater is disabled in standby mode to conserve power and prolong the life of the sensor.	• **ON** – Disables the sensor heater when site timer expires. • **OFF** – Continues tpO_2/CO_2 monitoring when the site timer expires.

The Unit Manager Menu		
Menu Item	**Description**	**Available Settings**
Correction Factors	Adjusts the $tpCO_2$ values to more closely align them with arterial CO_2 values by compensating for certain metabolic factors. **NOTES**: • The monitor does not apply correction factors while the electrode is in the calibration chamber. • When you change the correction factor setting, the monitor displays a line in the trend graph and an event marker (+CF or -CF) into the trend table. • Changing settings in the Unit Manager menu while monitoring invalidates tpO_2/CO_2 sensor calibration. A message prompts you to recalibrate the sensor.	• **Severing (default)** – The monitor applies the Severinghaus/metabolic correction factors to $tpCO_2$ parameter and trend values according to the following equation: $tpCO_{2Severinghaus} = [tpCO_{2uncorrected} * e^{-0.0484(t-37)}]-k$ where: t = sensor temperature; k=metabolic correction factor = 4 (fixed) • **None** – No correction factors are applied.

The Unit Manager Menu		
Menu Item	**Description**	**Available Settings**
The Drug List Setup submenu This menu allows the unit manager to store up to 44 types of drugs and their dosages for use during drug calculations. Open the Unit Manager menu (page 2-16), click on **Drug Setup**, then follow the procedures outlined on page 17-16.		
The Change Password submenu This feature allows you to change the password of the Unit Manager menu. Open the Unit Manager menu (page 2-16), click on **Change Password**, then follow the procedures outlined in this table.		
1) Scroll through the numbers and click successively on the single digits of the clinical password. If you make a mistake, click on **Backspace** and try again. 2) Click on **Accept** to confirm the new password.		
The Pacer Detection Mode submenu This feature allows you to set pacer detection function. Open the Unit Manager menu (page 2-16), click on **Pacer Detection Mode**, then follow the procedures outlined in this table.		
Basic (default)	Sets the **Pacer Detection** selections in the **ECG options** submenu to **ON/OFF** (see page 8-22) only.	Not applicable
Advanced	Sets **Pacer Detection** selections in the **ECG options** submenu to **ON/OFF/ Fusion** (see page 8-22).	Not applicable

Biomed

The Biomed menu addresses technical aspects of the monitor.

To open the Biomed menu:

1. Press the **Menu** fixed key to open the Main menu.
2. Click on **Monitor Setup**.
3. Click on **Biomed**.

Biomed functions are described in the following table:

Quick Reference – Biomed Menu

Menu Item	Description	Settings/Procedures
The Logs Submenu This menu displays clinical and technical diagnostic records. Open the Biomed menu (page 2-26) and click on **Logs**, then follow the procedures described in this table.		
Component Log	The monitor maintains read-only logs for principal components or devices. These logs include a part number, revision numbers, serial numbers, software version, and compatibility information.	1) Scroll to the component you wish to inspect and click on it. The log appears with the exit arrow already selected. 2) Return to the **Logs** submenu by clicking again.
Status Log	Displays information about your current software and hardware versions.	The display is read-only.
Diagnostic Log	Captures data about hardware and software performance relating to the monitor's operation.	Display is read-only. • Click on the down arrow at the bottom of screen to scroll through the display.
CPS/IDS Diag. Log	Captures data about CPS and IDS performance relating to the monitor's operation.	Display is read-only. • Click on the down arrow at the bottom of screen to scroll through the display.
FE Diag. Log	Captures and displays data about front-end performance related to the monitor's operation.	Display is read-only. • Click on the down arrow at the bottom of screen to scroll through the display.
Copy All Logs	Downloads status logs and diagnostic logs to a memory card.	Click on **Copy All Logs**. A confirmation message appears in the message area to indicate the download is complete.
Print Log	Prints an expanded version of the Diagnostic Log to an Infinity network laser printer	Click on **Print Log**.
The Service submenu The Service menu is password-protected and intended for the hospital's technical personnel or DrägerService personnel only. ***Caution:****The Biomed Service sub-menu contains one time configuration items such as line frequency that can affect ECG waveform artifact, if there are monitoring performance concerns contact your biomedical or Dräger service personnel.* **NOTE:** The backward compatibility settings are under the Service submenu. To Enable or Disable backwards compatibility contact hospitals technical personnel or Drager Service personnel only.		

Menu Item	Description	Settings/Procedures
Test Pulse		
Test Pulse	Tests the ECG and EEG signal clarity and display.	Clicking on **Test Pulse** causes the following to happen: • Injects a 300 ms pulse into the ECG waveform (1 mV on leads I and III, 2 mV on lead II). • Superimposes a 100 µV pulse on all EEG channels for 200 ms.

Parameter Colors

The Parameter Colors menu allows the user to assign a color to an individual parameter/waveform.

To open the Parameter Colors menu:

1. Press the **Menu** fixed key to open the Main menu.
2. Click on **Monitor Setup**.
3. Click on **Monitor Options**.
4. Click on **Parameter Colors**.
5. Enter clinical password.

NOTE: The clinical password menu will time-out after approximately 5 minutes. It will stay active that long unless the user clicks **Accept.**

6. Click on **Accept**.
7. Click on parameter and select color desired.
8. Click on desired color.

Parameter Colors functions are described in the following table:

Quick Reference – Parameter Colors Menu

Parameter	Default Color
NOTES: • Any color change set in this menu changes the color of the parameter wherever it is used (for example, the parameter-box, waveform, trends). • The parameter list is not limited to only connected parameters. • Agent parameters (HAL, ISO, ENF, SEV, DES) and O_2/N_2O cannot change color and always appear with default colors. • Possible selections for the parameter colors are: red, white, yellow, green, lt. blue, blue, purple, orange.	
ECG (inc. ST, ARR) **NOTES:** • ECG lead label on the main screen is the same color as the waveform. • ST complexes follow the color selected for ECG (with the exception of reference waveforms which remain purple)	Green
ART	Red
PA	Yellow
CVP	Lt. Blue
RA	Orange
LA	Purple

Parameter	Default Color
LV	Yellow
ICP and/or ICP2 and/or ICP3 and/or ICP4	Lt.Blue
RV	Orange
GP1 and/or GP2	Red
P1a and/or P1b and/or P1c and/or P1d	Red
P2a and/or P2b and/or P2c and/or P2d	Red
P3a and/or P3b and/or P3c and/or P3d	Red
CO (inc. BT, Inj. T)	White
TEMP and/or TEMP2 and/or TEMP3	White
$etCO_2$ (inc. iCO2, RRc) and/or $etCO_2$* (inc. iCO_2*, RRc*)	Yellow
SPO_2 (inc. PLS) and/or SPO_2* (no waveform, but inc. PLS*, SPO_2%)	White
NMT	White
NBP **NOTE:** During NBP measurement, NBP parameter box becomes white background with black letters/numerics regardless of color selected in this menu.	White
RESP	Blue
O_2/N_2O	White
SvO_2 parameters	White
Paw and/or Vent parameters	Blue
BIS **NOTE:** In BIS parameter box, SQI remains purple and EMG remains white regardless of color selected in this menu.	White
TP and/or TP*	White
FiO_2	White
EEG1 and/or EEG2 and/or EEG3 and/or EEG4	White
PiCCO TD (p-CO, p-CI, GEDV, GEDVI, EVLW, EVLWI, GEF, PVPI, CFI, ITBV, ITBVI)	White
PiCCO PC (PCCO, PCCI, p-SV, p-SVI, p-SVR, p-SVRI, dPmax, SVV, PPV)	White
INCUB1/2	White
WARMER1/2	White
HAL	Red
ENF	Orange
ISO	Purple
SEV	Yellow

Parameter	Default Color
DES	Blue
LrSO2 and/or RrSO2 and/or S1rSO2 and/or S2rSO2and/or BL NOTE: In the Show All Parameters menu only, the BL parameter is always purple.	White

Software Upgrades

When upgrading the monitor from VF8.x to VF9.0 the following settings must be reconfigured:

- Parameter Priority list for the main screen
- Trend graph scales
- Pacer detection settings
- Alarm Volume
- All Alarms OFF Reminder
- Audio OFF Reminder
- Masimo **Averaging/ Averaging Time** settings (see page 18-9)
- ECG **Cable Type** setting (see page 8-21)

NOTE: For VF9.0 software or higher, IBP Transducer Failure detection is only available with the following hardware combination:

- Monitors with only A106 main processor board and HemoMed pod (see page 15-24)
- Monitors with A103 (and higher) main processor board and QuadHemo pod hardware revision 10 or higher (see page 15-24)
- Any hardware revision Monitors with PiCCO Pod Part number MS23133 (see page 27-29)

CAUTION: *After upgrading one monitor, save the settings on a memory card and copy the settings to the rest of the installed monitors. Dräger recommends that all monitors be upgraded to the same software version in all locations After upgrading one monitor, save the settings on a memory card and copy the settings to the rest of the installed monitors. Contact your DrägerService representative to make sure that you are using the latest available software version.*

Backward Compatibility functionality

For VF9.0 software or higher, if backward compatibility is Enabled, the following settings/ features are not available:

- ECG Leads Invalid Alarm (see page 8-20)
- Resp Lead Invalid Alarm (see page 12-6)
- SpO2 Sensor Off Alarm (see page 18-8)
- Art Cath Disconn Alarm (see page 15-15)
- Minimum Alarm Volume setting (see page 2-19)

For VF9.0 software or higher, if backward compatibility is Enabled, the following settings/ features will change behavior:

- Audio pause/alarm silence functionality (see page 5-6)
- Low Priority Alarm (see page 5-4)

For VF9.0 software or higher, IBP Transducer Failure detection is only available with the following hardware combination:

- Monitors with only A106 main processor board and HemoMed pod (see page 15-24)
- Monitors with A103 (and higher) main processor board and QuadHemo pod hardware revision 10 or higher (see page 15-24)
- Any hardware revision Monitors with PiCCO Pod Part number MS23133 (see page 27-29)

CAUTION: *Changing the units of measure will cause all patient data to be deleted.*

3 Network Applications

Overview

By connecting your bedside monitor to a network, you can access a patient's information from any other monitor that is connected to the network or from a central station. Each of these devices can present Main Screen information for remote viewing.

The Infinity network™ links monitors and other devices to a central station and to each other, providing a wide range of monitoring functions. On the Infinity CentralStation™ you can display information from network monitors. (For more information on the central station, see the Infinity CentralStation Instructions for Use.)

Your monitor's RemoteView™ function allows you to display other networked monitor screens, print remote recordings, and silence remote alarms (see page 3-17). Via the Remote Control function on the Infinity CentralStation, you can perform the following tasks at the central station for any bedside monitor that is configured for remote control:

- Initiate recordings
- Modify alarm limits
- Silence alarms
- Initiate an arrhythmia or respiration relearn
- Print the current monitor screen on a network laser printer (via the optional remote keypad)
- Enter, edit, and view patient data

Connecting to the Network

In an IT network, data can be exchanged by means of wired or wireless technologies. An IT network can be any data interface (e.g., RS232, LAN, USB, printer interface) that is described in standards and conventions.

During operation, this device can exchange information with other devices by means of IT networks and supports the following functions:

- Display of waveforms and parameter data
- Signaling of alarms
- Recording, storing, and printing
- Remote control (e.g., alarm management)
- Bed view by remote access
- Access to saved patient data
- Transfer of device settings and patient data
- Service mode, access to logbooks

Connecting this device to a network that incorporates other devices or making subsequent changes to that network can lead to new risks for patients, users, and third parties. Before the device is connected to the network or the network is changed, these risks must be identified, analyzed, and evaluated, and appropriate measures taken.

Examples of subsequent changes to the network:

- Changing the network configuration
- Removing devices from the network
- Adding new devices to the network
- Performing upgrades or updates on devices that are connected to the network

Information about connecting to the IT network

Prerequisites

This device must only be connected to the network by service personnel. The IT representative of the hospital must be consulted in advance.

The following documents must be followed:

- – Accompanying documents of this device
- – Description of the network interface
- – Description of the network-based alarm systems

Dräger recommends complying with IEC 80001-1 (risk management for IT networks with medical devices

LAN networks

- LAN networks are usually configured in a star topology. Individual devices can be combined into groups by means of layer-n-switches. Other data traffic is decoupled by means of separate VLAN networks. Configure the network settings of the device in accordance with these instructions for use and the network specifications.
- Specifications for LAN connections are described in the following standards:
  - — Wired networks: IEEE 802.3
  - — Wireless networks: IEEE 802.11 (b, g, n)
- If the device is used with a layer-2-switch or a layer-3-switch, the port settings must be configured on the network switch. Before the device is shipped, Dräger can configure the network settings of the device so that they are compatible with the specifications of the operating organization.
- This device exchanges data with other medical devices over the LAN network. The network must support the following transmissions and protocols:
  - — TCP/IP
  - — Unicast (static or dynamic addressing with the ARP or RARP network protocols)
  - — Multicast
  - — Broadcast
  - — IGMP (Version 2)

This device can join or leave an IP multicast group by using the IGMP network protocol.

VLAN networks

If the data is being exchanged within a single network, an independent VLAN network for the clinical information system must be set up. Additionally, at least one of the following independent VLAN networks must be set up:

- Network for medical devices for intrahospita use
- Network for portable patient monitors

WLAN networks

- On Dräger devices, the Advanced Encryption Standard (AES) WPA2 with pre-shared key administration is used during installation.
- With some Dräger clinical devices, the installation is carried out using SSL and additional functions that are defined in the form "Manufacturer Disclosure Statement for Medical Device Security" (MDS^2).

Serial interfaces

The following interfaces are supported:

- RS232 interfaces conforming to EIA RS-232 (CCITT V.24/V.28) for the following applications:
  - MEDIBUS, MEDIBUS.X
  - Connections to medical devices from other manufacturers
- Interfaces conforming to IEEE 1073 (Medical Information Bus) for connection to medical devices from other manufacturers. The requirements of IEEE 1073.3.2 or the combined requirements of IEEE 1073.3.1 and IEEE 1073.4.1 must be complied with.

Consequences of using an unsuitable network

If the network does not meet the requirements, hazardous situations can result. The following situations can occur with this device:

- Due to unsafe distributed alarm system:
  - Alarms are not transmitted.
  - Alarms or data are delayed.
  - False alarms are indicated.
- During an interruption of the network connection:
  - Alarms are not transmitted.
  - Suppressed alarms or alarm tones are not reactivated, but remain suppressed.
- Without firewall and antivirus software:
  - Data are not protected.
  - Device settings are changed.
  - The device generates false alarms or no alarms.
- Data are sent incomplete, sent to the wrong device, or not sent at all.
- Patient data are intercepted, falsified, or damaged.
- Data have incorrect timestamps.

- An overload of the device due to very high network loading (e.g., caused by denial-of-service attacks) can lead to deactivation of the interface. The interface will only be available again after the device has been restarted. In rare cases, a warm boot may take place and may occur repeatedly.

Requirements for the electrical characteristics of connected devices and networks

The LAN interfaces and the serial interfaces are only suitable for the connection of devices or networks that have a rated voltage of at most 24 V DC on the network side and that meet the requirements of one of the following standards:

- IEC 60950-1: Ungrounded SELV circuits
- IEC 60601-1 (as of 2nd edition): Touchable

Connecting the monitor to the network via the Infinity Docking Station (IDS) gives you access to the following:

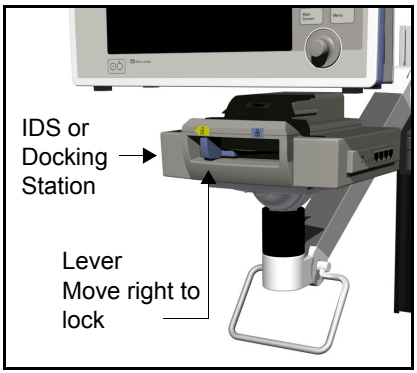
- Power
- Infinity network
- Bedside recorder
- Nurse call alarm
- Remote keypad
- Memory for storing monitor setup defaults
- Scio Four modules for anesthetic and respiratory monitoring
- MIB device interfaces

The DirectNet feature allows you to connect your monitor directly to the Infinity network, bypassing the need for a Docking Station or Infinity Docking Station. DirectNet does not support the MultiGas module or MIB protocol.

Connecting the Delta/Delta XL to the Network

For the Delta/Delta XL, you can also use a Docking Station™, to access the network (refer to the Infinity Docking Station and Docking Station Power Supply Hardware Installation Instructions).

Connecting the monitor to the network:



1. Place the monitor on the IDS or Docking Station using both hands — one holding the handle, the other steadying the monitor. Make sure the monitor clicks firmly into place.
2. Slide the lever to the right to lock the monitor in place.

Be sure the monitor is securely positioned, as the lever does not move unless the monitor is seated properly. A battery charge indicator LED lights up when the monitor is properly docked.

Disconnecting the Delta/Delta XL from the Network

Disconnecting the monitor from the network

1. Hold the monitor firmly by its handle. Slide the lever to the left to disengage the power supply. The monitor automatically switches to battery power.
2. Continue to move the lever to the left until it clicks. Use both hands to tilt the monitor forward and lift it off the IDS or Docking Station.

Connecting/disconnecting the Kappa to/from the Network

- Plug the network cable into the Infinity network connector (X14) on the rear panel of the monitor (see page 1-3).
- Unplug the network cable to disconnect the Kappa monitor from the network.

Network Message (Delta/Delta XL/Kappa)

Once the monitor is connected to the network, the following message may appear.:

Message	Condition	Display Area
Offline	• Monitor not communicating with Infinity network	Network
Not monitored by central	The monitor is connected to the network, but is not assigned to an Infinity CentralStation	Network
Duplicate address	More than one monitor configured for the same IP address	Network

PICK AND GO Transport (Delta/Delta XL only)

The Pick and Go patient transport system allows the monitor to travel with the patient to different care stations within the hospital. By uploading setups from the IDS at the new care station, the monitor adapts to its new clinical "home" (OR, ICU, CCU, etc.) while retaining patient data.

The Pick and Go scenario below describes how monitored information follows the patient from an ICU to the operating room.

1. Undock the monitor in the ICU — the monitor retains the ICU and patient setup.
2. Transport the monitor with the patient— the monitor continues to use the setups configured at the ICU bedside.
3. Dock the monitor in the OR — the monitor uploads the OR default monitor settings.
4. Undock the monitor in the OR — the monitor retains the OR and patient setups. **NOTE**: Alarm volume if disabled, automatically changes to 50% when undocked in OR mode only.
5. Return transport — the monitor continues to monitor the patient using the OR monitoring configuration.
6. Redock the monitor at the ICU bedside — the monitor uploads the ICU monitoring defaults at the bedside and resumes bedside monitoring. Patient settings are not affected.

For more information on managing setups during Pick and Go operations, see page 2-12. For information about setups management (including restoring patient or patient and monitor settings), see page 2-10.

NOTE: A monitor may automatically change to wireless mode during Pick and Go, if certain criteria are met (see page 3-14).

Infinity Explorer Support

When the Delta/Delta XL/Kappa is connected over the network to Infinity Explorer, all parameters and their alarm status pass to Infinity Explorer. Menu items for these parameters can be controlled from either the monitor or the Infinity Explorer. Contact your local sales representative for details on hardware configuration available for Infinity Explorer.

Wireless Network

NOTE: Wireless networking is a locked option. Contact your hospital's technical personnel for more information.

The Delta/Delta XL/Kappa can operate in a wireless network which allows the monitor to establish and maintain contact with the Infinity network and the central station without being connected by cable or docked at a Docking Station.

A wireless monitor transmits and receives data with the help of a wireless LAN PC card installed in the memory card slot on the monitor. The wireless card communicates with access points which are strategically placed within a monitoring unit in order to cover the desired transmission area.

If monitoring difficulties are encountered contact hospital IT personnel or Dräger Service regarding antenna coverage and VLAN technical configuration information.

A wireless network offers the following:

- Seamless patient transport — A wireless monitor continues to communicate with the Infinity network during Pick and Go transport situations and its data remains on the central display after leaving the bedside Docking Station.
- Seamless patient relocation — Patient and monitor can be moved to a different room or care unit, within the same monitoring unit, without ever losing contact with the Infinity network.
- Simplified network setup — Wireless monitors can be networks without the need of docking stations or hard-wired hub connectors, which reduces the need for network cables within the hospital.

NOTE: Central station, access points, and recorders/printers are connected to the network by cable.

Wireless Network Safety Considerations

When operating the monitor in a wireless network, observe the following:

- While the monitor is transmitting or receiving signals, do not hold the transmitting/receiving unit close to exposed body parts, especially the face or eyes. The antenna/wireless card should be at least 5 cm (2 inch) away from the body.
- Operation of the wireless network relies on uninterrupted signal transmission between the transmitting and receiving components of the network. When using the wireless network, be aware that
  - — certain structural limitations within the hospital building may interfere with signal transmission,
  - — other devices emitting radio frequencies, such as leaky microwave ovens or warmers, may interfere with signal transmission,
  - — the frequencies emitted by the device may interfere with the operation of other medical equipment.
- Wireless mode does not support Infinity Explorer.

NOTE: More than 6 monitors associated with one wireless access point, may result in compromised performance.

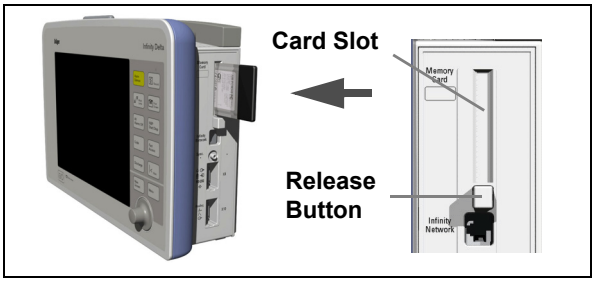
Wireless Network Setup

NOTE: Wireless mode is available only if the monitor is in DirectNet mode (see page 3-16) or during Pick and Go (see page 3-9).

Installing the Wireless Card (Delta/Delta XL)

NOTE: The wireless card and adapter are slotted and can only be inserted in one orientation. Do not force the card into the adapter, there are pins in the adapter that can bend or break.

1. (Optional) Place the wireless card into the wireless card adapter. For more information about the wireless card adapter, contact your local DrägerService representative.
2. Facing the monitor, turn the card so that the flat side (back label) faces you.
3. Press the card firmly into the memory card slot until the slot's release button protrudes.



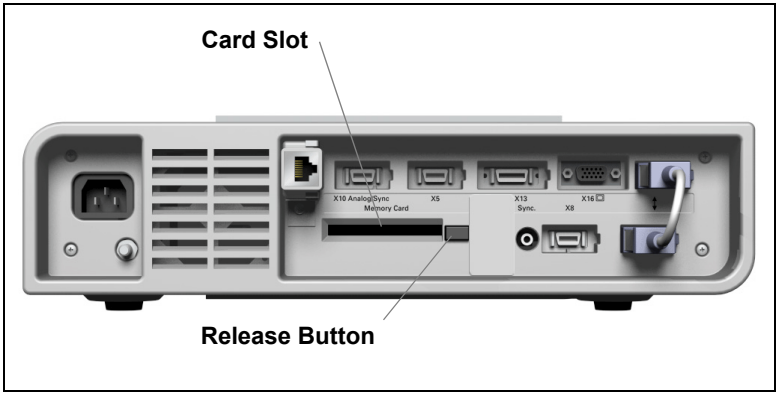
Delta/Delta XL Memory Card Slot

Installing the Wireless Card (Kappa)

1. Turn the monitor off.

NOTE: The wireless card and adapter are slotted and can only be inserted in one orientation. Do not force the card into the adapter, there are pins in the adapter that can bend or break.

2. (Optional) Place the wireless card into the wireless card adapter. For more information about the wireless card adapter, contact your local DrägerService representative.
3. Facing the rear of the monitor, turn the card so that the flat side (back label) faces down.
4. Press the card firmly into the Memory Card slot until the slot's release button protrudes.
5. Turn the monitor back on.



Kappa Memory Card Slot

Wireless Card Removal

- Press the release button and remove card from slot.

Wireless Mode

NOTE: Wireless networking is a locked option. Contact your hospital's technical personnel for more information.

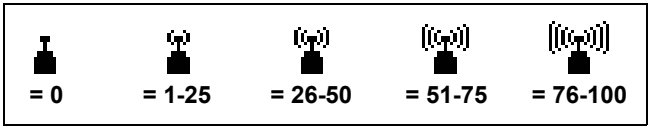
Accessing wireless settings

1. Press the **Menu** fixed key.
2. Click on **Admit/Discharge**.
3. Click on **Wireless**.
4. Click on **Care Unit** to select from a list of available care units.
5. Click on **Exit** to return to the Wireless menu.
6. Click on **Bed Label** to select from a list of available beds.

NOTE: **Bed Label** selection is ghosted until a valid care unit is selected.

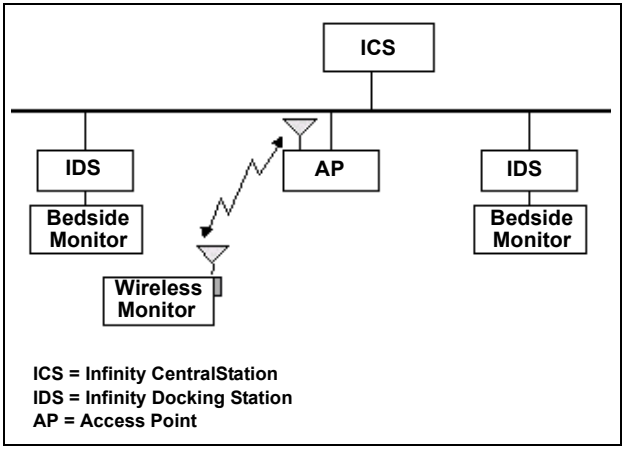
When the wireless mode is active, an icon  appears with the date/time icon to reflect signal strength. The icon and the date/time icon alternate with other secondary messages in the network messaging area.

There are five different signal strength icons:



In wireless mode, the monitor uploads setups from the docking station and communicates with all supported devices connected to the IDS.

NOTE: *Wireless monitors cannot send recordings to a local recorder that is connected to a IDS.*



If a wireless monitor loses contact with all access points and wireless transmission is interrupted (for example, you remove the wireless card or the monitor is out of range), the network generates an offline message with a tone notification and the monitor operates as a standalone device.

If a wireless monitor regains contact with any access point (for example, you insert the wireless card or the monitor is brought back into range) the normal monitoring state will be restored and the offline message cleared within 40 seconds.

CAUTION: *When the monitor is in wireless mode, patient data is not displayed at the Infinity CentralStation while software upgrades, saved setups and card data transfers are occurring.*

Wireless During Pick and Go

A monitor in IDS mode will automatically switch to wireless mode when it is undocked from the Docking Station, if:

- a wireless card is inserted (see page 3-12).

and

- all wireless settings are correct (contact your hospital's technical personnel).

When the monitor is re-docked to the Docking Station, it will automatically return to IDS mode.

NOTE: If the setting **Keep bed label** is set to **yes**, the IDS bed label is maintained when the monitor is undocked.

Wireless During DirectNet™ mode

To change the monitor to wireless mode, consult your hospital's technical personnel or the Service and installation documentation.

Wireless Messages

In wireless mode, the messages in the following table may appear:

Message	Condition	Display Area
Offline	• The monitor travels out of range of AP or • The wireless card is removed	Network
Invalid memory card	• The wireless card is defective	Local
Wireless option not enabled	• The wireless card was inserted without the wireless option enabled **NOTE**: To clear the message, either install the wireless option or power-cycle the monitor. Although the message may not clear, the functionality of the monitor and the display of other messages is not affected.	Local
Not monitored by central	The monitor is connected to the network, but is not assigned to an Infinity CentralStation	Network
Duplicate address	• More than one monitor acting wirelessly (undocked) from the same IDS configured for Keep Bedlabel • More than one monitor configured for the same IP address	Network

Network Transfer

Patient Data

NOTE: Card data transfer from VF8 level software to VF9 will work with some exceptions within alarm or event history. Card data transfer from VF9 level software to a lower level software is not supported.

You can transfer patient data (demographic data, trends, events, and hemo/oxy/vent calculations) from one monitor to another. Procedures differ according to whether or not the source and destination monitors are connected to the Infinity network. To transfer information involving a non-networked monitor, you must use a PCMCIA

memory card. To transfer information over the network, you can use menu options. See page 4-3 for more information.

Software Licenses

Optional software functions must be “unlocked” (activated) with the proper license before you can use them. Your hospital’s technical personnel can transfer licenses and optional software from the monitor to the network and vice-versa. Refer to your Service and installation manual for more information on transferring Dräger product licenses.

License Transfer via PICK AND GO (Delta/Delta XL only)

The Pick and Go function allows you to upload the monitor setups of the care unit where it redocks. If the monitor does not have licenses that support the care unit setups, the care unit’s IDS (if a Docking Station is being used) temporarily “loans” its licenses to the monitor. The following guidelines apply to the transfer of locked options involving Pick and Go.

- When the IDS of the care unit transfers its setups to a monitor, it temporarily adds its licenses as well. These “loaned” licenses temporarily unlock options on the monitor.
- Temporary licenses remain valid on the monitor even after it undocks from the care unit for transport.

Remote View

If the monitor is connected to the Infinity network, you can view other networked monitors, print their recordings, and silence their alarms from your monitor. Procedures to display the Remote View screen follow. To set menu display time, see Main Menu Setup on page 2-2.

NOTE: You can print a Remote View screen as it appears on the local monitor by using the **Print Screen** fixed key on the monitor’s front panel.

Quick Reference – Remote View Setup

Menu Item	Description	Settings
Select Remote Bed	Displays up to two waveforms and parameter boxes of a remote bed. If the remote bed is not in alarm, the top two waveforms are displayed on the local bed, otherwise the alarming waveform occupies the bottom channel. **NOTES**: • The monitor continuously updates the remote bed label, patient name, and alarm or status messages. • The remote display appears on the bottom half of the screen so that you can continue to display the local monitor's top waveform(s), parameter box(es), and message area.	1) Press the **Fast Access** fixed key. 2) Click on **Remote View**. 3) Select **Remote Bed** to display a list of all beds in the monitoring unit. 4) Click on the label of the bed you wish to view. 5) Press the **Main Screen** fixed key to return to Main Screen, *or* click on **Select Remote Bed** to return to the Remote View menu. **NOTE**: To access Remote View functions, see the section "Remote View Screen" on page 3-19.
Alarm Group	Assigns the monitor an alarm group number (0 - 255), allowing you to restrict the number of messages received over the network from the central station or other bedsides	1) Press the **Fast Access** fixed key. 2) Click on **Remote View**. 3) Click on **Alarm Group**. 4) Click on the number of the desired alarm group.
Auto Dual View	Configures the monitor to display any remote bed in alarm that is part of the local bed's alarm group	1) Press the **Fast Access** fixed key. 2) Click on **Remote View**. 3) Click on **Auto Dual View**. 4) Click to toggle **ON** or **OFF**. **NOTE**: Beds in the same alarm group continue to post messages in the alarm group's network message area when **Auto Dual View** is disabled. If you do not want to display messages at a particular bed, place the bed in its own alarm group by selecting an unassigned Alarm Group number.

Remote View Screen

The Remote View menu bar divides the screen horizontally, separating the remote display from the main screen. Follow the procedures outlined on page 3-17 (**Select Remote Bed**) to display the Remote View screen.

1	Accesses the Remote View menu	**8**	Screen label (display only)
2	Local bed display	**9**	Local bed message
3	Remote View menu bar	**10**	Remote bed label
4	Remote bed display (Remote View)	**11**	Exit arrow (restores local bed display)
5	Remote bed alarm message area	**12**	Local bed label
6	Silences remote bed alarm for 60 seconds	**13**	Initiate Remote bed recording (see the note below)
7	Patient name		

NOTE:

- Recordings print on the recorder assigned to the local monitor and use that monitor's settings for recording delay, duration, and speed. The remote patient's name and bed label are printed on the recording strip. (For more on timed and continuous recordings, see Chapter 7, Recordings).
- You cannot select waveforms for remote recordings. Waveforms are printed according to the remote bed's recording setup. If the remote bed is configured for manual waveform selection (see page 7-9), the recording's waveforms may differ from those displayed on the Remote View menu.
- If the local bed alarms while Remote View is displayed, the monitor behavior depends upon the Remote View Display selection in the Unit Manager menu (see page 2-10).
- If the remote bed alarms, the top waveform and the alarming waveform channel are displayed. In the presence of multiple alarms, the one with the highest alarm priority is displayed.
- For information about the Alarm Silence feature, see page 5-7.

Privacy

When operating in Privacy mode, the monitor blanks the screen and silences audible alarms at the bedside. This feature is helpful when such displays and alarms are distracting to patients and visitors. All audible alarms are suppressed, and the screen is blank except for the following message: *Privacy: Press Main Screen to resume monitoring.*

All other monitoring functions remain active, and you can continue to monitor the patient at the central station.

NOTE:

- Privacy mode is only available on bedsides connected to a central station. The monitor exits privacy mode any time it is disconnected from the network or the Infinity CentralStation.
- The nurse call option is still supported in privacy mode.

Steps: Activating Privacy mode

1. Press the **Menu** fixed key.
2. Click on **Privacy**.
3. Press the **Main Screen** fixed key to return to the main screen.

WARNING: When a bedside monitor is in privacy mode, audible alarms only sound at the Infinity CentralStation (the bedside monitor does not provide audible alarms or activate its alarm bar).

NOTE: Alarm bar not applicable to SC 7000/8000/9000XL or Kappa.

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4 Admission, Transfer, and Discharge

Overview

The Patient Admit screen allows you to enter and edit a patient's demographic data (name, ID, birth date, height, weight, admit date, and physician). You can admit patients at the bedside monitor or at the central station, provided your monitor is connected to the network. You can also transfer a patient's data, trends, and calculations from one monitor to another. Transfer procedures differ according to whether or not the source and destination monitors are connected to the Infinity network. Discharging a patient deletes all related data, both on the monitor and at the central station. Monitor and patient settings return to their local default settings and all recordings are cancelled.

Admitting a Patient

Admitting a patient at the bedside monitor

1. Press the **Menu** fixed key.
2. Click on **Admit/Discharge**.
3. Click on **Admit** to display the **Patient Admit** menu.
4. Click on a field. A data-entry screen appears.
5. Click successively on the letters of the word you would like to enter. If you make a mistake, click on **Backspace** and try again.
6. Click on **Accept** to confirm your entry.
7. Click on the next field, and repeat steps 5 and 6.

NOTE:

- To change the patient's category (adult, pediatric, or neonatal), you must access the Patient Setup menu (see page 2-1).
- If you change a patient's category, the weight selection is cleared and must be entered again.
- In neonatal mode additional settings (gestational age and birth weight) are available. Day of Life and corrected GA values also appear in a read only field.
- Entries and changes regarding a patient's height and weight affect all other monitor menus and displays that use this information.
- When you admit a patient from the CentralStation to a monitor that is connected to the Infinity network, you can enter additional patient data such as sex, religion, blood type, and telephone number. You cannot, however, view this additional data at the monitor. For information on admission at the central station, see the Instructions For Use for the Infinity CentralStation.

Transferring Patient Data

You can transfer patient data, including trends, calculations, and event recall data, to or from another monitor. To transfer information involving a non-networked monitor, you must use a PCMCIA memory card. To transfer information over the network, you can use either the **Copy Patient Data** (PCMCIA card required) or **Transfer** options of the menu system (see pages 4-4 and 4-6). Certain conditions restrict the transfer of patient data:

- Both source and destination monitors must have the same software level (consult your hospital's technical personnel for more information).

Calculations only transfer if the destination bed supports that option (see chapter 17, Calculations).

CAUTION: *When you begin a transfer, the destination monitor automatically discharges its current patient. All current patient data stored in the destination monitor is overwritten with the new patient's data.*

Data Transfer Using the Memory Card

Transferring data from one monitor to another with the PCMCIA memory card is a two-step process:

1. Copy data from the source monitor to the card.
2. Copy the data from the card to the destination monitor.

After the data has been copied to the destination monitor, it is no longer available on the card. The monitor displays the current patient's name and ID number at the beginning of a data transfer. Because the data on the card overwrites data on the destination monitor, you can overwrite one patient's data with another's, effectively discharging the former and admitting the latter. Make sure you copy information to the destination monitor before you perform significant monitoring functions.

Memory Card Transfer

WARNING:

- **Use electrostatic discharge (ESD) prevention practices when inserting the PCMCIA card into the monitor. In some environmental conditions, insertion of the memory card could cause the monitor to reset as the result of an ESD event.**
- **The patient's stored event and trend information will be lost after the monitor resets.**
- **Monitoring does not occur during data transfer.**

CAUTION: *Do not remove the memory card while a copy is in process. If the transfer fails, repeat the procedure using a new card.*

NOTE: A memory card transfer from a monitor with VF8 level software to a monitor with a lower level software functions appropriately. However, a memory card transfer from a monitor with a lower level software to one with a VF8 level software is no supported.

Copying data onto the memory card

1. Press the **Menu** fixed key on the source monitor.
2. Click on **Admit/Discharge**.
3. Click on **Copy Patient Data**.
4. Highlight **Copy To Card** and click**.** On the right side of the screen, a large arrow shows the direction of the data flow.
5. Go to step 7 if the patient's name and ID appear in both the upper and lower windows.

or

Click on **Patient Admit** and follow standard data entry procedures (page 4-2) if the upper window instructs you to enter a patient's name or ID.

A banner informs you that the copy is in process. A message appears when the copy is successfully completed.

6. Remove the memory card from the source monitor.

Copying patient data from the card to the destination monitor

1. Insert the memory card in the destination monitor.
2. Press the **Menu** fixed key on the destination monitor.
3. Click on **Admit/Discharge**.
4. Click on **Copy Patient Data**. The large arrow now indicates that the direction of the data flow is from monitor to card.
5. Click on **Move To Monitor**. If the date and time are correct on both monitors, the following message appears: *Current data will be replaced. Copy data to Monitor?*

   If the date and time are not correct, the following messages may appear to indicate synchronization of monitors is needed:

   Some data on the card is ahead of the monitor's time. That data cannot be copied to the monitor.

   Some data on the card is older than the monitor can accept. That data cannot be copied to the monitor.
6. Click **Yes** to initiate the transfer, or **No** to cancel the transfer and return to the Copy Patient Data menu.

Synchronizing the Monitors

To provide a complete and successful transfer of information, you must check that the date and time of the source and destination monitors are identical. Trend data that is copied from the source monitor 24 hours before or five minutes after the destination monitor time is transferred without interruption. If you attempt to transfer data that falls outside this time window, a banner appears requesting you to confirm the transfer.

Network Data Transfer

To transfer data over the network, you must interrupt patient monitoring temporarily by putting the source monitor in standby mode. The monitor saves both patient and monitor settings until you exit standby and resume monitoring the same patient. To transfer data over the network:

Transferring data over the network

1. Press the fixed key **Menu**. The main menu appears.
2. Scroll to **Standby** and click. The screen goes blank except for the following message: *Standby: Press Main Screen to resume monitoring.*
3. Press the **Menu** fixed key at the destination monitor.
4. Click on **Admit/Discharge**.
5. Click on **Transfer** to display the Transfer Patient Data menu. If you are transferring data from outside the destination care unit, proceed with step 6. Otherwise proceed with step 8.
6. Click on **Select Care Unit to transfer from**. A list of care units appears (if you are monitoring only one care unit, this item is ghosted).
7. Click on the care unit from which you are transferring data. The selected unit appears next to **Care Unit**.
8. Click on **Select Bed to transfer from** to display beds currently in standby.
9. Click on the source bed to display it on the menu.
10. Click on **Start Transfer to this bed**.
11. Click on **Transfer to this bed** to transfer patient data and display the message, *Transfer In Progress*, *or* on **Cancel** to return to the previous menu.
12. Press the **Main Screen** fixed key on the source monitor to exit standby mode.

Discharging a Patient

You must discharge one patient before admitting another. The monitor otherwise appends existing data to the subsequently admitted patient. You can discharge a patient only at the bedside monitor. You cannot discharge a patient at the central station.

Discharging a patient at the bedside monitor

1. Press the **Discharge** fixed key.
2. The screen warns you that the discharge operation deletes all patient data.
3. Press the **Discharge** fixed key a second time. The discharge takes place.

NOTE: You can also click on **Cancel** to return to the main menu without discharging the patient

The monitor displays the message, *Discharge In Progress...* When the patient has been successfully discharged, the following discharge banner appears: *Press main screen to resume monitoring*.

Discharging a patient from the Main menu

1. Press the **Menu** fixed key.
2. Click on **Admit/Discharge**.
3. Click on **Discharge**. The monitor displays the following message *Discharge will delete patient data*.

NOTE: You can also click on **Cancel** to return to the main menu without discharging the patient

4. Click on **Discharge** again.

The monitor displays the message, *Discharge In Progress...* When the patient has been successfully discharged, the following discharge banner appears: *Press main screen to resume monitoring*.

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5 Alarms

Overview

You can configure the monitor to display alarm limits (parameter thresholds) which, if violated, trigger an alarm. Limits are displayed both on the alarm limits table and in parameter boxes, where visual or audible alarms alert you to limit violations.

While your bedside monitor is the primary alarming device, other secondary alarming devices may also exist depending upon how your device/network is configured. Depending on the alarm condition, the monitor announces alarms using one or more of the following indicators:

- Audible tones that reflect the severity of the alarm
- Color changes in the parameter box of the alarm parameter
- Alarm messages in the local message area
- Alarm banner to indicate alarm status
- External alarm devices such as a nurse call system
- Activation of an alarm recording

The monitor issues alarms for parameters that are set to **ON** in the Alarm Limits table (see page 5-8). It is not a prerequisite for the parameter to be on display or connected for a parameter to alarm.

WARNING: Risk – failure to hear alarms
The user must remain within hearing range to detect an alarm signal and to respond accordingly. The distance to the patient monitor must be appropriate for the alarm volume setting.

The monitor does not alarm for the following parameters: Cardiac Output (C.O.), Pulmonary Wedge Pressure (PWP), Injectate Temperature (IT), Paced beats (% Paced) or Cerebral Perfusion Pressure (CPP/CPP2/CPP3/CPP4), EEG, or N2O.

WARNING: The bedside monitor does not annunciate alarms for external devices connected via the MIB interface.

Testing Visual and Auditory Alarm Signals

WARNING: The operator should check that the current alarm preset is appropriate prior to use on each patient.

WARNING: The operator must remain within the hearing range of the acoustic alarm signal. This operator position makes it possible to quickly detect an alarm and to respond accordingly. The distance to the medical device must be appropriate for the volume of the alarm signal.

WARNING: When operating in a noisy environment, the volume of the alarm signals must be adjusted to suit.Always set the volume of the alarm signal sufficiently high.

The monitor's alarm bar and speakers are tested during startup. You can test the visual and auditory alarm signals by creating an alarm condition (for example, lower the patient's HR upper limit to cause an alarm condition). Restore the proper alarm limits to end the test (see "Alarm Setup" on page 5-8).

WARNING: Alarm signals are not generated for ventricular fibrillation and asystole events when the following conditions are met:
- The ASY/VF alarms setting is set to Always on or Follow HR
- The ARR mode is set to Off
- The HR source is set to ART or SpO2 with ECG available as a heart rate source

WARNING: To make sure that asystole and ventricular fibrillation alarms are always reported do one of the following:
- Turn arrhythmia monitoring on
or
- Set the HR source to ECG when the ARR mode setting is set to Off

Networked Alarms

The monitor can broadcast networked alarm messages to any compatible monitor or central station within the network (typically in less than two seconds). However, a central station will not annunciate or display any alarms for a connected bedside monitor whose parameter alarms are turned off. In the Infinity network, you can also group monitors into separate alarm groups to limit the number of messages posted at a given device (see page 3-18).

Monitors connected to the network automatically relay alarms to the central station. If the central station cannot acknowledge an alarm within 10 seconds (because of a network interruption, for instance), the monitor displays the message, *Network Alarm Error*, and sounds a tone at maximum volume (100 %). The alarm volume remains set

at 100% until you change it on the Alarm Limits menu or communication with the central is established (see page 5-8).

NOTE: The network distinguishes between unwanted network interruptions (offline errors) and the deliberate undocking of a Delta/Delta XL bedside device during Pick and Go transport operations. Removing a monitor from its IDS or Docking Station does not trigger a network error alarm.

Alarm Priorities

The monitor has three alarm priorities: High, Medium and Low. Previously, Dräger has referred to these as life-threatening (L-T), serious (SER), and advisory (ADV) alarm conditions. You can define alarm priorities for arrhythmia, ST parameters, critical battery capacity, sensor inoperable conditions, using the arrhythmia setup table (see page 9-6) or the ST alarms table (see page 10-10). Each alarm priority has its own distinctive auditory alarm signal (alarm tone) and color.

[1]Alarm Priority	Examples	Alarm Color
High	Asystole, ventricular fibrillation	Red
Medium	Parameter limit violation.	Yellow
Low	Technical conditions[2] or arrhythmia alarm selections are Low.	Cyan **NOTE**: White flashing when Backwards Compatibility is Enabled.

[1]Alarm priority is fixed with the exception for Low Battery, SpO2 Sensor OFF, Respiration Leads Invalid, ECG Leads Invalid, and Arrhythmia events where the user may adjust alarm priority to better fit their environment of care. Asystole, Ventricular Fibrillation, inspired O2 concentration, SpO2 Desaturation and Apnea (for Pediatric and Neonate patient category) are HIGH priority. All limit violations, including parameter Out of Range are MEDIUM priority alarms. All Technical alarms (cause non-physiologic) are LOW priority alarms.

[2]Technical alarms (low level repeating tone until acknowledged or condition cleared) are annunciated as a result of equipment failure or other non-physiologic conditions requiring clinician corrective action (for example detached lead wires, monitor overheating, 12 lead pod incompatible, misapplied transducer, etc.).

Whenever an alarm occurs, the monitor provides an auditory alarm signal and several visual alarm signals. The visual alarm signals are:

- The alarming parameter's box flashes in red for High and yellow for Medium alarms. For Low alarms the parameter box does not flash and stays solid with cyan background.

NOTE: If Backward compatibility is enabled, the monitor displays Low alarms in White and the parameter box flashes.

- The alarm's cause appears in the message area at the top left of the screen (the background color is that message's alarm priority).
- For high and medium-priority alarm conditions, the monitor's alarm bar flashes in the color for that alarm priority.

The monitor provides alarm notification within 2 seconds of event detection, the alarm condition time is parameter dependent. Example -The SpO2 alarm signal generation delay is dependent upon the SpO2 sensor type (Dräger, Masimo or Nellcor) and the averaging selection, additional alarm condition delay for particular parameters (see page 2-17) is user selectable.

Your monitor is configured to provide one of three possible auditory alarm tones, Infinity, IEC1 and IEC2 (see the Auditory Alarm Tones table). The IEC1 and IEC2 tone sequences are the same, but the IEC2 sequence has longer pauses between repetitions. The high and medium priority tone sequences are:

- High (10 beeps): Four beeps, higher pitched beep, short pause, four beeps, higher pitched beep, long pause
- Medium (3 beeps): Two beeps, lower pitched beep, long pause.

Auditory Alarm Tones			
Alarm Priority	**Infinity**	**IEC1**	**IEC2**
High-priority	Continuous two-tone sequence	Five beeps, short pause, five beeps, pause of 3 seconds	Five beeps, short pause, five beeps, pause of 8 seconds
Medium-priority	Two tones, then pause	Three beeps (two beeps, followed by a lower pitched beep), pause of 5 seconds	Three beeps (two beeps, followed by a lower pitched beep), pause of 15 seconds
Low-priority	Low tone, once every ten seconds	Two beeps, pause of 16 seconds	Two beeps, pause of 30 seconds

NOTE: Attention tones (information signals) will be annunciated with a single tone, e.g. Offline or Not Monitored by Central.

If more than one alarm occurs simultaneously, the monitor sounds only the highest priority auditory alarm tone and flashes the alarm bar in that alarm's color. The monitor also flashes several parameter boxes and displays the associated alarm messages in sequence.

However, if more than one ECG arrhythmia condition occurs simultaneously, arrhythmia determination follows priorities within the ECG algorithm. More information and the list of arrhythmia event priorities can be found in Chapter 9, Beat and Rhythm Classification.

Alarm recordings are initiated if the alarm and recording functions are enabled. The alarm limits table, arrhythmia and ST tables control the recording functions for alarm conditions. The recording functions for sensor parameter alarms are controlled by the related parameter alarm archive settings. In addition, high and medium alarm priorities activate any external alarm system which is connected to the monitor.

Alarm Latching

Some alarms are latched: they continue to annunciate visually and audibly until you acknowledge them manually, even if the condition that caused the alarm no longer exists. Other alarms may be latched only partially, as indicated in the following table.

NOTE: High-priority and medium-priority alarms do not latch in OR mode; see page 2-14 for more information.

Alarm Latching Behavior
High-priority alarms are latched (visual and auditory alarm signals continue).
Medium-priority alarms only latch the alarm message; it continues to display when the alarm condition ceases, while the parameter box stops flashing and the alarm tone ceases.
Low-priority alarms cease as soon as the cause of the alarm disappears or you acknowledge the alarm.

- To acknowledge (or silence) a latched alarm, press the **Alarm Silence** fixed key

Alarm Management

Suspending Alarms

You can suspend alarms using the fixed keys on the front of the monitor.

- **All Alarms OFF** – Press to suspend visual and audible alarms for a user-determined period of time. A banner appears at the top of the screen with the message *All Alarms Paused banner with countdown timer*.

Alarms remain suspended until you press the **All Alarms Off** fixed key again or the time-out period expires.

WARNING: Never leave a patient unattended when alarms have been permanently turned off. Always enable alarms again as soon as possible.

NOTE: If the monitor is configured for German regulation mode, it can support a feature that allows the **All Alarms Off** fixed key to be used to extend the **All Alarms Off** time (via incremental presses of the **All Alarms Off** fixed key).

- Alarm Silence when backwards compatibility is disabled: Press once to pause an alarm for 2 minutes. Visual alarm indications remain on the screen. Press a second time to exit the Alarm Paused/Silence state. The alarm tone resumes if a new alarm occurs during an alarm silence period, or if any alarm condition persists past the 2-minute silence period.
- Alarm Silence when backwards compatibility is enabled: Press once to silence an alarm for 1 minute. Visual alarm indications remain on the screen. Pressing the Alarm Silence key a second time during this state will reset the timer to 1 minute. The alarm tone resumes if a new alarm occurs during an alarm silence period, or if any alarm condition persists past the 1 minute silence period.
- Code: Press once to silence alarm tone (in network mode) or reduce volume to 10 % (in standalone mode) and activate and display an event timer. Press again to deactivate all active Code functions. Press a third time to deactivate the event timer (see page 2-20 for more information).

NOTE: For Alarm Silence behavior when OR mode is set to ON (see page 2-16).

Alarm Control

Many alarm functions, including alarm suspension, validation, and the display of alarm limits, can be configured only on the Alarm Control menu, which in turn is accessible only via the password-protected Unit Manager menu. For a description of available functions on the Alarm Control menu, see page 2-15.

CAUTION: *Alarms are disabled for a period of 1 or 2 minutes (backward compatibility configuration setting) when the monitor is powered on, exiting standby and upon new patient admit.*

Alarm Setup (Alarm Limits Table)

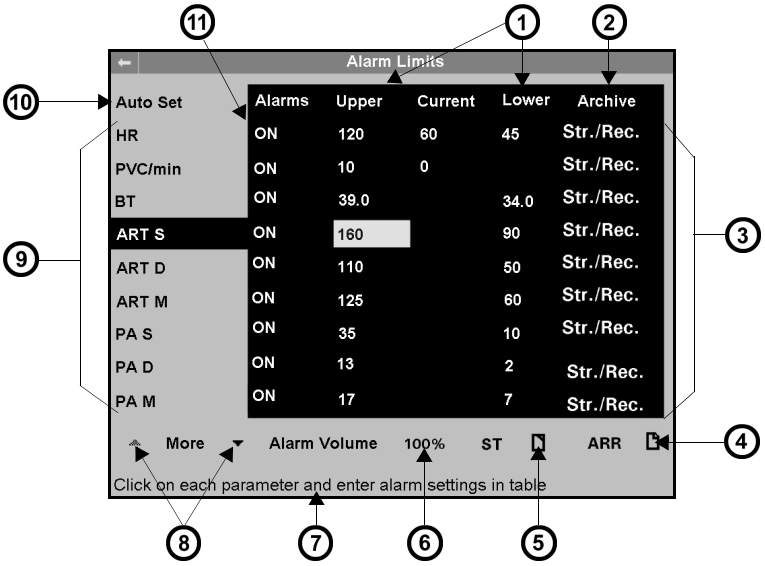
The alarm limits table allows you to modify the alarm limits of multiple parameters in a single location.

WARNING: For monitors within the same care area, different standard alarm limits can be configured provided the user observes the following precautions:

- Make sure that the values set for new patients are appropriate.
- Make sure that the alarm system is neither rendered useless by setting extreme values for the alarm limits nor deactivated by switching off the alarms.
- Check the start settings for alarms and alarm settings each time the monitoring parameters are changed.

The Alarm Limits table displays values only if the associated parameter has been prioritized (see page 2-6) or the associated monitoring device (for example, the NBP cuff or the etCO_2/respiratory mechanics pod) is connected.

- Press the **Alarm Limits** fixed key. The Alarm Limits table appears.



1	Set alarm limits	**7**	On-line help message
2	Store and/or record alarms	**8**	Click on arrows to scroll up or down
3	Storage/recording options	**9**	List of parameters
4	Access Arrhythmia setup	**10**	Auto set
5	Access ST alarm limits	**11**	Enable alarms
6	Alarm volume		

Upper and Lower Alarm Limits

Alarm limits should be set according to your patient's prevailing condition within the predefined ranges of the monitor listed in the following table.

Parameter	Predefined Alarm Range/ Resolution	Default State	Default Alarm Setting / Alarm Priority
ARR	See "Arrhythmia Setup Table" on page 9-6.		
ART S/M/D	-5 to 300 mmHg (-0.7 to 40.0 kPa) Increments of 1 mmHg or 0.1 kPa	On	S: (Adult) Low 90 mmHg (12.0 kPa) High 160 mmHg (21.3 kPa) M: (Adult) Low 60 mmHg (8.0 kPa) High 125 mmHg (16.7 kPa) D: (Adult) Low 50 mmHg (6.7 kPa) High 110 mmHg (14.7 kPa)
			S: (Pediatric) Low 50 mmHg (6.7 kPa) High 120 mmHg (16.0 kPa) M: (Pediatric) Low 50 mmHg (6.7 kPa) High 80 mmHg (10.7 kPa) D: (Pediatric) Low 30 mmHg (4.0 kPa) High 80 mmHg (10.7 kPa)
			S: (Neonatal) Low 50 mmHg (6.7 kPa) High 120 mmHg (16.0 kPa) M: (Neonatal) Low 40 mmHg (5.3 kPa) High 85 mmHg (11.3 kPa) D: (Neonatal) Low 35 mmHg (4.7 kPa) High 80 mmHg (10.7 kPa)
BIS (From BISx pod only. You cannot control alarms from Aspect A2000)	10 to 100 Increments of 5	Off	Low 10 High 100
BT/BT*	25.0 to 43.0 ^{o}C (77.0 to 109.4 ^{o}F) Increments of 0.1^{o}C (1 ^{o}F)	Off	Low 34.0 ^{o}C (93.2 ^{o}F) High 39.0 ^{o}C (102.2 ^{o}F)

Parameter	Predefined Alarm Range/ Resolution	Default State	Default Alarm Setting / Alarm Priority
CNAP	30 to 250 mmHg (4.0 to 33.3 kPa) Increments of 1 mmHg or 0.1 kPa	Off	S: (Adult) Low 90 mmHg (12.0 kPa) High 160 mmHg (21.3 kPa) M: (Adult) Low 60 mmHg (8.0 kPa) High 125 mmHg (16.7 kPa) D: (Adult) Low 50 mmHg (6.7 kPa) High 110 mmHg (14.7 kPa)
CPP/CPP2/ CPP3/CPP4	-25 to 300 mmHg (-3.3 to 40.0 kPa) Increments of 1 mmHg or 0.1 kPa	Off	Low 70 mmHg (9.3 kPa) High 100 mmHg (13.3 kPa)
CVP	-5 to 300 mmHg (-0.7 to 40.0 kPa) Increments of 1 mmHg or 0.1 kPa	On	Low 0 mmHg (0.0 kPa) High 20 mmHg (2.7 kPa)
et DES/i DES	0 to 20 % Increments of 0.5%	Off	Low 0% High 20%
et ENF/i ENF	0 to 7.5 % Increments of 0.1%	Off	Low 0% High 6%
et HAL/i HAL	0 to 7.5 % Increments of 0.1%	Off	Low 0% High 6%
et ISO/i ISO	0 to 7.5 % Increments of 0.1%	Off	Low 0% High 6%
et O_2	10 to 100 % Increments of 0.1%	Off	Low 10% High 100%
et SEV/i SEV	0 to 9.0 % Increments of 0.1%	Off	Low 0% High 9%
$etCO_2$/$etCO_2$*	5 to 95 mmHg (0.7 to 12.6 kPa) Increments of 1 mmHg or 0.1 kPa	On	Low 30 mmHg (4.0 kPa) High 50 mmHg (6.7 kPa)
FiO_2	18 to 100 % Increments of 1%	On	Low 18% High 100%

Parameter	Predefined Alarm Range/ Resolution	Default State	Default Alarm Setting / Alarm Priority
GP1/GP2 S/M/D	-5 to 300 mmHg (-0.7 to 40.0 kPa) Increments of 1 mmHg or 0.1 kPa	On	S: (Adult/Pediatric) Low 90 mmHg (12.0 kPa) High 160 mmHg (21.3 kPa) M: (Adult/Pediatric) Low 60 mmHg (8.0 kPa) High 125 mmHg (16.7 kPa) D: (Adult/Pediatric) Low 50 mmHg (6.7 kPa) High 110 mmHg (14.7 kPa)
			S: (Neonatal) Low 50 mmHg (6.7 kPa) High 120 mmHg (16.0 kPa) M: (Neonatal) Low 40 mmHg (5.3 kPa) High 85 mmHg (11.3 kPa) D: (Neonatal) Low 35 mmHg (4.7 kPa) High 80 mmHg (10.7 kPa)
HR	20 to 300 beats per minute Increments of 5 b/min	On	Adult: Low 45 bpm High 120 bpm Pediatric: Low 50 bpm High 150 bpm Neonatal: Low 80 bpm High 170 bpm
iCO_2/iCO_2*	2 to 10 mmHg (0.3 to 1.3 kPa) (upper high limit only) Increments of 1 mmHg or 0.1 kPa	Off	High: 4 mmHg (0.5 kPa)
ICP/ICP2/ ICP3/ICP4	-25 to 300 mmHg (-3.3 to 40.0 kPa) Increments of 1 mmHg or 0.1 kPa	Off	Low 2 mmHg (0.3 kPa) High 20 mmHg (2.7 kPa)
iO_2	18 to 100 % Increments of 1%	Off	Low 18% High 100%
LA	-5 to 300 mmHg (-0.7 to 40.0 kPa) Increments of 1 mmHg or 0.1 kPa	On	Low 0 mmHg (0.0 kPa) High 20 mmHg (2.7 kPa)
LV S/M/D	-5 to 300 mmHg (-0.7 to 40.0 kPa) Increments of 1 mmHg or 0.1 kPa	On	S: Low 75 mmHg (10.0 kPa) High 160 mmHg (21.3 kPa) M: Low 40 mmHg (5.3 kPa) High 80 mmHg (10.7 kPa) D: Low 2 mmHg (0.3 kPa) High 25 mmHg (3.3 kPa)

Parameter	Predefined Alarm Range/ Resolution	Default State	Default Alarm Setting / Alarm Priority
NBP S/M/D	Adult: 10 to 250 mmHg (1.3 to 33.3 kPa) Pediatric: 10 to 170 mmHg (1.3 to 22.7 kPa) Neonatal: 10 to 130 mmHg (1.3 to 17.3 kPa) Increments of 1 mmHg or 0.1 kPa	On	S: (Adult) Low 90 mmHg (12.0 kPa) High 160 mmHg (21.3 kPa) M: (Adult) Low 60 mmHg (8.0 kPa) High 125 mmHg (16.7 kPa) D: (Adult) Low 50 mmHg (6.7 kPa) High 110 mmHg (14.7 kPa)
			S: (Pediatric) Low 50 mmHg (6.7 kPa) High 120 mmHg (16.0 kPa) M: (Pediatric) Low 40 mmHg (5.3 kPa) High 85 mmHg (11.3 kPa) D: (Pediatric) Low 35 mmHg (4.7 kPa) High 80 mmHg (10.7 kPa)
			S: (Neonatal) Low 50 mmHg (6.7 kPa) High 80 mmHg (10.7 kPa) M: (Neonatal) Low 40 mmHg (5.3 kPa) High 70 mmHg (9.3 kPa) D: (Neonatal) Low 25 mmHg (3.3 kPa) High 60 mmHg (8.0 kPa)
PA S/M/D	-5 to 300 mmHg (-0.7 to 40.0 kPa) Increments of 1 mmHg or 0.1 kPa	On	S: Low 10 mmHg (1.3 kPa) High 35 mmHg (4.7 kPa) M: Low 7 mmHg (0.9 kPa) High 17 mmHg (2.3 kPa) D: Low 2 mmHg (0.3 kPa) High 13 mmHg (1.7 kPa)
PCCO	0.50 to 25.00 L/min Increments of 0.5 L/min	Off	Low 5.50 L/min High 9.50 L/min
PCCI	0.75 to 15.00 L/min Increments of 0.25 L/min	Off	Low 3.00 L/min High 8.00 L/min
PLS/PLS*	30 to 300 beats per minute Increments of 1 b/min	On	Adult: Low 45 bpm High 120 bpm Pediatric: Low 50 bpm High 150 bpm Neonatal: Low 80 bpm High 180 bpm

Parameter	Predefined Alarm Range/ Resolution	Default State	Default Alarm Setting / Alarm Priority
PVC/min	Adult and pediatric: 1 to 50 PVC per minute (upper high limit only) Increments of 1 PVC/min	On	High: 10 PVC per minute
RA	-5 to 300 mmHg (-0.7 to 40.0 kPa) Increments of 1 mmHg or 0.1 kPa	On	Low 2 mmHg (0.3 kPa) High 12 mmHg (1.6 kPa)
RESP	Adult: 5 to 100 breaths per minute Pediatric and Neonatal: 5 to 145 breaths per minute Increments of 1 b/min	On	Adult: Low 5 bpm High 30 bpm Pediatric/Neonatal: Low 20 bpm High 80 bpm
RRc	5 to 145 breaths per minute Increments of 1 b/min	On	Adult: Low 5 bpm High 30 bpm Pediatric/Neonatal: Low 20 bpm High 60 bpm
RRc*	5 to 90 breaths per minute Increments of 1 b/min	On	Low 5 bpm High 30 bpm
RV S/M/D	-5 to 300 mmHg (-0.7 to 40.0 kPa) Increments of 1 mmHg or 0.1 kPa	On	S: Low 10 mmHg (1.3 kPa) High 35 mmHg (4.7 kPa) M: Low 7 mmHg (0.9 kPa) High 17 mmHg (2.3 kPa) D: Low 2 mmHg (0.3 kPa) High 13 mmHg (1.7 kPa)
SpO_2/SpO_2*	20 to 100% Increments of 1% **NOTE**: High and low SpO_2 (saturation) alarm conditions are graded “Medium”.	On	Adult/Pediatric: Low 90% High 100% Neonatal: Low 85% High 95%
ΔSpO_2%	1 to 100% (high limit only) Increments of 1%	Off	Adult/Pediatric: High 20% Neonatal: High 10%
ST Alarms	See “ST Alarms Table” on page 10-10.		
STVM/STVCM	0 to 45 mm (0 to 4.5 mV) Increments of 1 mm or 0.1 mv	See “ST Alarms Table” on page 10-10.	
TOF-Cnt	0 to 4 Increments of 1	Off	Low 0 High 4

Parameter	Predefined Alarm Range/ Resolution	Default State	Default Alarm Setting / Alarm Priority
TruST Parameters (see: ST TruST Leads)			
Temperature (Ta/b, T2a/b, T3a/b)	-5.0 to 50.0 °C (23.0 to 122.0°F) Increments of 0.1°C (1 °F)	Off	Low 34.0 °C (93.2 °F) High 39.0 °C (102.2 °F)
ΔT/ΔT2/ΔT3	-32.0 to 35.0 °C (-25.6 to 95.0°F) Increments of 0.1°C (1 °F)	Off	Low 0.0 °C (32.0 °F) High 2.0 °C (35.6 °F)
$ttpCO_2$/$tpCO_2$*	10 to 150 mmHg (1.3 to 20.0 kPa) Increments of 1 mmHg or 0.1 kPa	On	Low 30 mmHg (4.0 kPa) High 50 mmHg (6.7 kPa)
tpO_2/tpO_2*	10 to 300 mmHg (1.3 to 40.0 kPa) Increments of 1 mmHg or 0.1 kPa	On	Low 50 mmHg (6.7 kPa) High 80 mmHg (10.7 kPa)

Modifying Alarm Functions

1. Access the **Alarm Limits** table (see page 5-8).
2. Scroll to the parameter whose alarm functions you wish to configure and click.
3. Scroll to the alarm function you wish to modify (the first column, *Alarms*, is highlighted when you first click on the parameter).

NOTE:

- Turning a parameter's alarm function on allows alarms to be triggered for that parameter. It is not a prerequisite for a parameter to be on display or to be connected for it to produce an alarm.
- Turning a parameter's alarm function off prevents the parameter from triggering an alarm.

4. Choose the new setting, and click to confirm your selection.
5. Repeat steps 2 - 4 for each change.

Quick Reference – Alarm Limits Table Setup

<table>
<tr><th colspan="3">Alarm Limits Table</th></tr>
<tr><th>Function</th><th>Description</th><th>Available Settings</th></tr>
<tr><td>Auto Set</td><td>Sets alarm limits based on current values
<table>
<tr><th>Parameters</th><th>Upper Limit</th><th>Lower Limit</th></tr>
<tr><td>Ta, T1a-b, T2a-b, T3a-b</td><td>≤ 107% of current value</td><td>≤ 93% of current value</td></tr>
<tr><td>ΔT1, ΔT2, ΔT3, PVC/min, iCO_2, iCO_2*</td><td>No change</td><td>No change</td></tr>
<tr><td>SpO_2/SpO_2*</td><td>Adults 100
Neonates 98</td><td>Current value - (value x 5%)</td></tr>
<tr><td>ΔSpO_2%</td><td>Current value + 20%</td><td>None</td></tr>
<tr><td>ST</td><td>Current value + 2.0 mm</td><td>Current value -2.0 mm</td></tr>
<tr><td>MultiGas Agent</td><td>≤ 105% of current value</td><td>≤ 95% of current value</td></tr>
<tr><td>BIS</td><td>No change</td><td>No change</td></tr>
<tr><td>TOF-Cnt</td><td>No change</td><td>No change</td></tr>
<tr><td>PCCO</td><td>Current value + 30%</td><td>Current value - 30%</td></tr>
<tr><td>PCCI</td><td>Current value + 30%</td><td>Current value - 30%</td></tr>
<tr><td>MultiGas O_2</td><td>100%</td><td>21%</td></tr>
<tr><td>tp</td><td>≤ 125% of current value</td><td>≤ 80% of current value</td></tr>
</table></td><td>Not applicable

NOTES:
• The monitor recalculates the upper and lower alarm limits based on the parameter values in the Current column.
• Auto Set applies to all displayed parameters and ST parameters only.
• If a calculated limit value falls outside the range for that parameter, the parameter's alarm limits will remain unchanged.</td></tr>
<tr><td>Alarms</td><td>Enables or disables the alarm function for the selected parameter</td><td>• ON
•  (Alarm off icon)</td></tr>
<tr><td>Upper</td><td>Determines current upper alarm limit</td><td>Settings are parameter-specific</td></tr>
<tr><td>Current</td><td>Read-only; cannot be modified</td><td>Not applicable</td></tr>
<tr><td>Lower</td><td>Determines current lower alarm limit</td><td>Settings are parameter-specific</td></tr>
</table>

Alarm Limits Table		
Function	**Description**	**Available Settings**
Archive	Allows you to store and/or record automatically an alarm event for the selected parameter. You can later review stored alarms on the Event Recall screen. **NOTE**: You cannot turn the Archive option off for asystole and ventricular fibrillation.	• **Store** • **Record** • **Str./Rec.** • **OFF**

Alarm Limits Shortcut

Each parameter setup menu has an alarm menu selection which accesses the Alarm Limits table, targeting associated parameters on the Alarm Limits table. Exiting the Alarm Limits table returns you to the parameter setup screen.

ST and Arrhythmia Alarms

ST and arrhythmia parameters have their own alarm limits configuration screens, which you can access by selecting the **ST** or **ARR** control button at the bottom of the alarm limits table (see page 5-8). Refer to chapters 10, and 9, for more information about ST and arrhythmia tables.

Alarm History Table

The monitor stores up to 50 physiological alarm events for each patient (the oldest log entry is overwritten). Events are deleted when the patient is discharged. Data is stored in the monitor and remains with the patient during Pick and Go transports. Data also survives power shutdowns. The Alarm History table records all high-priority and medium-priority alarms, every activation and deactivation of cardiac bypass mode, every change of patient category, and records whenever you perform an **All Alarms Off/Paused** or **Audio Paused/Alarm Silence**. Switching the device on and off is not recorded.

To access the Alarm History table

1. Press the **Fast Access** fixed key.
2. Click on **Alarm History** to display the Alarm History table.

Alarm Banner Messages

The monitor displays the following alarm state messages, in order of priority, on a banner at the top of the display:

Alarm Banner		Description
	All Alarms OFF	All alarms (audible and visual) are suspended indefinitely
	All Alarms OFF Bypass	The monitor is in cardiac bypass mode. All alarms (audible and visual) are suspended indefinitely
	All Alarms Paused m:ss	All alarms (audible and visual) are suspended for the predetermined time
	Audio OFF	All audible alarms are suspended indefinitely. All visual alarm indications remain active
	Audio Paused m:ss	All audible alarms are suspended for 2.00 minutes. All visual alarm indications remain active
	HR, ASY, VF OFF	Audio and visual alarms for HR, ASY and VF are suspended indefinitely. This banner displays when: • the “ASY/VF Alarms” selection under password control is set to “Follows HR Alarms” • HR alarm limits are set to OFF • HR Source is ECG • Arrhythmia is set to OFF • OR mode is OFF This banner is also displayed under the following conditions: • the “ASY/VF Alarms” selection under password control is set to "Always ON" or “Follows HR Alarms” • HR alarm limits are set to OFF • Arrhythmia is set to OFF • HR Source is set to anything but ECG • OR mode is OFF **NOTE**: ART and SpO2 must be connected and should have a numeric value, if not connected it will default to ECG)

Alarm Banner		Description
	ASY, VF OFF	Audio and visual alarms for ASY and VF are suspended indefinitely. This banner displays when: • “ASY/VF Alarms” selection under password control is set to “Always ON” or "Follow HR Alarms", and • HR alarms limits are set to ON, and • Arrhythmia is set to OFF, and • HR source is other than ECG (note: ART and SpO2 must be connected and should have a numeric value, if not connected it will default to ECG • OR mode is OFF
	HR Alarms OFF	Audio and visual alarms for HR are suspended indefinitely.

OR Alarms

Monitoring may be interrupted or discontinued more frequently during anesthesia than in the course of critical care. For this reason, some alarms behave differently when the monitor operates in OR mode. As shown in the following table, certain alarms stop annunciating when the condition ceases (one-shot alarms), while others emit a single attention tone. For more information on OR mode, see page 2-14.

NOTE: For anesthesia alarms you cannot set the menu selection **Attention Tone Volume** to **OFF**.

Message	Condition	Priority	Annunciation
SpO_2 Sensor Off	Nothing detected between the sensor's light source and the detector	Low	Low Persistent Low Non Persistent MED HIGH or One Shot/ Persistent
SpO2 Light Blocked	Insufficient light for valid measurement	Low	One-shot
ECG Leads Invalid	• QRS processing leads invalid for > 10 seconds • Faulty electrode contact or lead set • Unplugged lead set • Wrong Cable Type selected on ECG Lead Setup menu (see page 8-19)	Low	LOW MED HIGH or One Shot/ Persistent
Apnea	Breath has not been detected for Apnea Time (**A_T**) **seconds**	No alarm	Single attention tone
	Breath has not been detected for A_T x 2 seconds	No alarm	Single attention tone
	Breath has not been detected for **A_T x 3 seconds**	Medium	One-shot
	Breath has not been detected for **A_T x 6 seconds**	High	One-shot

NOTES:

- The information in this table applies to apnea detected by $etCO_2$ monitoring from any source ($etCO_2$ pod or module, MultiGas module, etc.). You can set RRc Apnea Time (A_T) to OFF, 10, 15, 20, 25 or 30 seconds on setup menus for $etCO_2$ or $etCO_2$*.
- If you press the **Alarm Silence** key any time after the monitor's first indication of an apnea condition (A_T), subsequent alarms for that apnea condition do not annunciate.

6 Trends

Overview

The monitor stores trend data for all connected signals except for pressures labeled P1a-d, P2a-d, P3a-d, which are automatically assigned as temporary labels when pressure transducers are initially connected. You can request a trend recording or report and execute a print screen of displayed trends. The monitor deletes all trend data once the patient is discharged.

You can store a currently displayed trend screen in the Event Recall Database by pressing the **Mark** |◂ fixed key on the front of the monitor. Manually and automatically stored events are identified on an event summary bar at the top of the trend display as outlined below:

- Trend Table – An icon (|◂) over time line marks manually stored events only; alarms and arrhythmia calls are not marked (see illustration on page 6-6)
- Trend Graphs – A small yellow vertical line marks manually and automatically stored events (see illustration on page 6-4).

For information on marking or storing events (including use of the **Mark** |◂ fixed key and the Event Recall screen), see page 1-26.

Trend Setup

The Trend Setup menu allows you to customize trend functions.

To access the Trend Setup menu

1. Click on the **Menu** fixed key on the front of the monitor.
2. Click on **Monitor Setup**.
3. Click on **Trend Setup** to display the Trend Setup menu.

Display Mode

There are two modes for determining the order of parameters in trend graphs: automatic mode, which displays parameters in the order in which they appear on the Main Screen, and manual mode, which allows you to determine the order of parameters in the trend display.

To select the trend display mode:

1. Access the Trend Setup menu (see page 6-2).
2. Select **Display Mode** and click the rotary knob to switch between automatic and manual modes.

Channel Assignment

You display a parameter trend by assigning parameters to one of twelve display channels.

To display parameter trends

1. Access the Trend Setup menu (see page 6-2).
2. Select **Display Mode** and select **Manual** mode.
3. Scroll to the channel you want to format and click on it. A list of available parameters appears.
4. Click on the parameter whose trended values you wish to view in trend graphs.

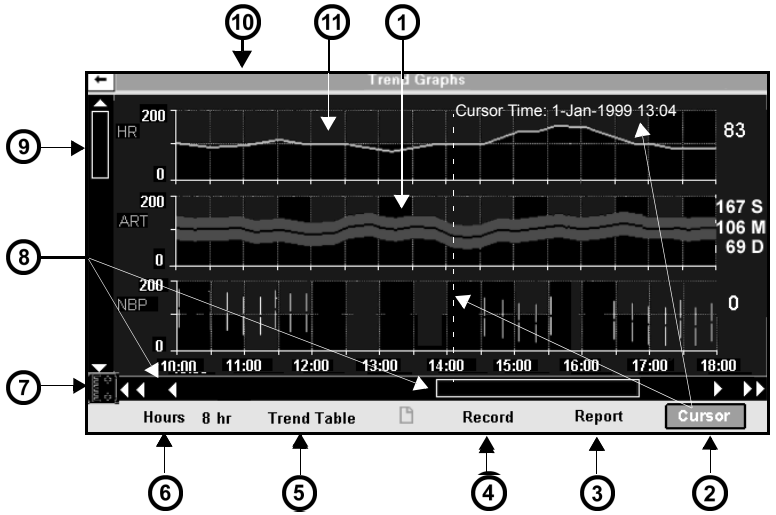
Trend Graphs

Trend graphs display stored trend data in the form of individual graphs for each parameter. These graphs show the behavior of the displayed parameters over a significant time period, three channels at a time. The parameter label in its identifying color and a scale bar appear to the left of the associated trend channel. Vertical lines in each graph mark time divisions. Trends are updated automatically, with the most recent data entering continuously on the right side.

To display trend graphs

1. Click on the **Fast Access** fixed key to display the Fast Access menu.
2. Click on **Trend Graphs** to display the Trend Graphs screen.

Several features are available to help you navigate the Trend Graphs screen. Using the rotary knob, scroll to the desired function and click.



1	Multiple-value parameter display – set of variable values (for example, ART, plotted as a multi-layered band below) (here, top layer = systolic pressure; bottom layer = diastolic pressure; blank "layer" in the middle = mean pressure	**7**	Trend scales
2	Activate/cancel cursor	**8**	Selected scrolling intervals
3	Print a report	**9**	Scroll trends
4	Request a trend recording	**10**	Vertical marker showing time of alarm, arrhythmia, or manually marked event
5	Access the trend table	**11**	Single-value parameter display; Single variable value (for example, HR) is plotted as a single continuous line
6	Set intervals		

Changing the Size of Trend Graphs

You can change the scale of an individual trend graph for easier or more detailed viewing.

1. Highlight the scale icon (). Scale values are simultaneously highlighted.
2. Using the rotary knob to scroll through the trend scales, click on the value you wish to change.
3. Dial to the desired value.
4. Click to confirm your choice.

Reviewing Graphs in Time

To review a specific point on the trend graphs.

- Select the vertical bar at the left of the screen and click the rotary knob. Scroll through the trended parameters and click to select the graphs to be viewed.
- Click repeatedly on either pair of arrows below the trend graphs *or* click on the horizontal bar at the bottom of the screen and dial to the desired time.
- Click on **Hours**, dial to the desired trend duration (**1**, **2**, **4**, **8**, **12**, or **24 hr**), and click again to confirm your choice. This function also affects scrolling intervals when you use the horizontal bar or arrows as described above.

NOTE: The monitor's clock controls the time scale. When you adjust the clock, a vertical yellow marker appears at the base of the trend graph. If you adjust the clock more than once in a 24-hour period, only the most recent change is marked.

- Click on **Cursor** to display a vertical white line, a corresponding date and time stamp and cursor-time parameter values at the right of the screen. Use the rotary knob to move the cursor to the time you wish to delineate. If no data is stored for that point in time, no value is displayed.

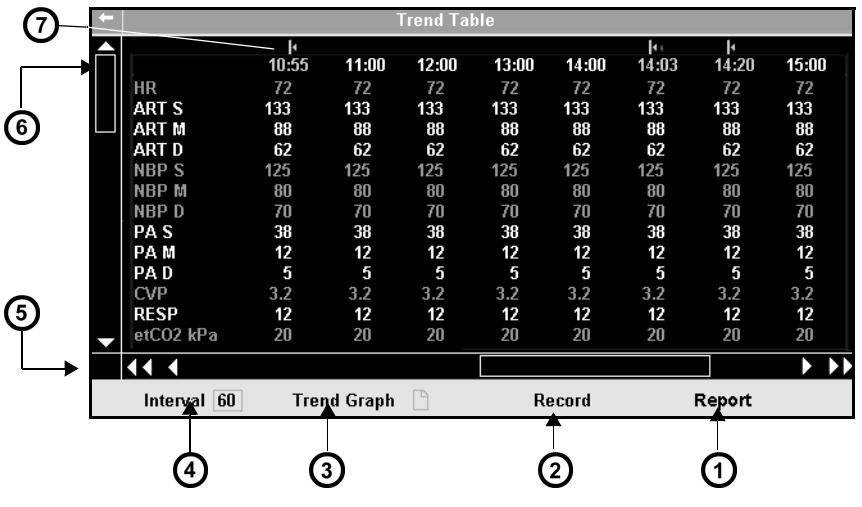
Trend Table

The trend table displays stored trend data in an easy-to-read tabular format. Up to eight columns are displayed and updated every 60 seconds. A time stamp above each column marks the interval during which that column of data was trended. The value displayed is the last acquired during that interval, with the rightmost column reserved for most recent data.

To view the Trend Table

1. Click on the **Fast Access** fixed key on the front of the monitor.
2. Click on **Trend Table**.

NOTE: The time stamp indicates the *end* of the interval. If the **Interval** setting is 15 minutes, then the time stamp 11:15 marks a column of data trended between 11:00:00 and 11:14:59.



1	Request trend report
2	Request trend recording
3	Access trend graphs
4	Set intervals
5	Scroll intervals
6	Scroll trends
7	Manual event

The **Interval** key at the bottom left of the trend table display functions similarly to the **Hours** feature in trend graphs (see page 6-4). Settings are **1**, **5**, **15**, **30**, or **60 min**.

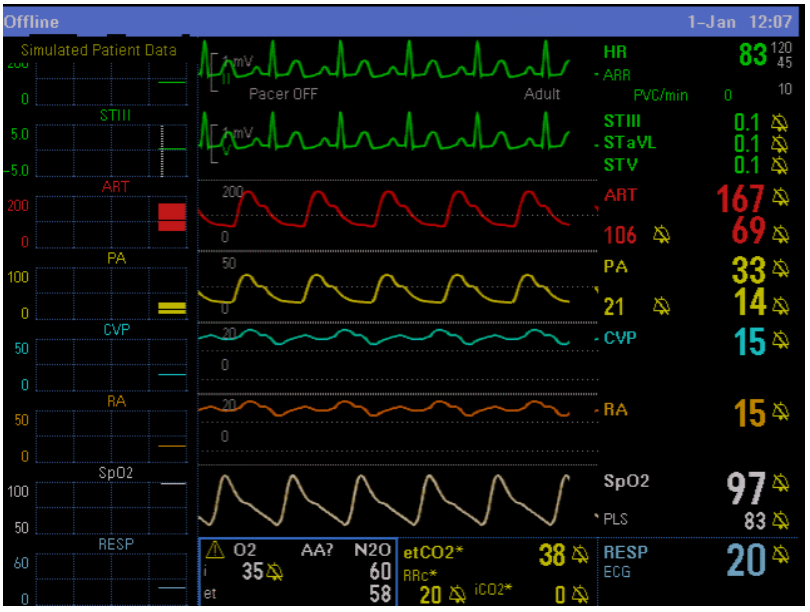
NOTE: The monitor always marks an NBP measurement and a C.O. average with a time-stamp in the trend table.

Mini-Trends

You can display up to one hour of trend data (every 60 seconds when set to 60 min and every 10 seconds when set to 10 min) for as many as eight parameters while continuing to monitor main screen waveforms and parameter boxes. Mini-trend graphs follow the color coding and display order of the parameters they represent and are updated with new trend data every 60 seconds.

To display Mini-Trends

1. Press the **Fast Access** fixed key.
2. Click on **Split Screen**.
3. Click on **10 Min Trends**, **60 Min Trends**, **Ventilation,** or **Off**.
4. Press the main screen fixed key to exit the menu.



Mini-trend display **Main Screen**

NOTE: You can only select one parameter for the mini trend display from a parameter box that contains multiple parameters.

7 Recordings

Overview

The monitor can print out a real-time record of its monitoring results on a bedside recorder or on a centrally located recorder within the monitoring network. You can request a recording at the local monitor, a remote monitor in the network (using the Remote View screen), or the network's central station.

Recordings are printed on an R50 series recorder, which can be connected to the bedside monitor as well as the Infinity network. The R50 and R50-N are two-channel recorders. The Infinity network also supports print screen recordings (reports) on a laser printer.

WARNING: Use ECG strip recordings for documentation only (they are not of diagnostic quality). Use a resting 12-lead ECG for diagnostic purposes instead. Diagnostic interpretation of a 12-lead ECG should only be performed by a physician or by trained personnel under the supervision of a physician.

Recordings are either continuous or timed and can be triggered manually or automatically, depending on their origin. The monitor can also print recordings of trends, events, and OCRG waveforms. Alarm recordings may be automatically triggered, depending on how they are configured or on the associated condition (see chapter 5, Alarms, for more information).

All recordings are identified by the patient name and ID, the bed number, and the date and time of the recording.

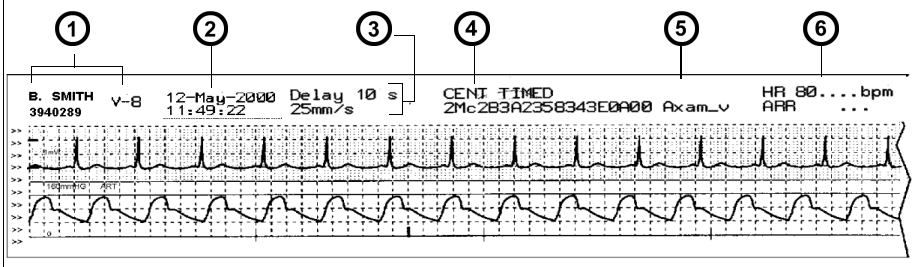
Recordings

Layout

Recordings contain one, two, or three waveforms on 50 mm strips. To print a waveform, you must first display it on the screen. Pressure waveforms are recorded in either standard or overlapped mode, depending on your prior configuration of Pressure Overlap display on the Monitor Setup menu (see page 2-5). A header displays information about the patient, monitor and recorder settings, and currently monitored parameters.

Header Information

The header shows parameter values, patient name, ID #, date and time, and other pertinent information. The following illustration shows a typical timed recording strip. Continuous recording headers do not show a delay time but are otherwise identical to timed recording headers.



1	Patient name, ID, and bed label	**4**	Origin and type of request
2	Date and time of recording request	**5**	Diagnostic code
3	Recording delay and recording speed	**6**	Events and alarm conditions

NOTE: Values and alarm off indicators active at the time of the recording request are printed after the recording header for each parameter (if appropriate).

Diagnostic Code

The following table explains the characters which make up the diagnostic code in the header of a strip recording. The first column shows each character's position in the string (left to right).

Position	Description	Values	Definition
1	Lead Processed for VF and Pacer Pulse Detection	X 1 2 3 S T U V + a b c d e f g h i A B C D E F G H I j k l m n o p q r J K L M N O P Q R	None I II III aVR aVL aVF V V+ V1 V2 V3 V4 V5 V6 V7 V8 V9 dV1 dV2 dV3 dV4 dV5 dV6 dV7 dV8 dV9 V1R V2R V3R V4R V5R V6R V7R V8R V9R dV1R dV2R dV3R dV4R dV5R dV6R dV7R dV8R dV9R

Position	Description	Values	Definition
2	ECG Filter	M D E	Monitor Off ESU
3	Pacemaker Detection	C c H	On - Artifact Rejection<Medium> Off - Artifact Rejection<Medium> Fusion
4	QRS/ARR processing	2 1	ECG1 + ECG2 ECG1
5	Patient Category/QRS Classification	<Space> 1 2 B n	Adult, Neither lead completed learn Adult, ECG1 lead completed learn Adult, ECG2 lead completed learn Adult, ECG1 & ECG2 leads completed learn Neonate
6	Leads available for processing	0 1 2 3	No valid lead to process ECG1 lead valid to process ECG2 lead valid to process ECG1 & ECG2 lead valid to process
7	VT Count	5-F	Value = VT Count (where A-F corresponds to 10-15)
8	VT Rate	0-A	Value = (VT Rate - 100)/10 (where A corresponds to 10)
9	SVT Count	3-A	Value = SVT Count (where A corresponds to 10)
10	SVT Rate	2-A	Value = (SVT Rate - 100)/10 (where A corresponds to 10)
11	TACH Count	5-F	Value = TACH Count (where A-F corresponds to 10-15)
12	TACH Rate	0-A	Value = (TACH Rate - 100)/10 (where A corresponds to 10)
13	BRDY Rate	0-F	Value = (BRDY Rate - 30)/5 (where A-F corresponds to 10-15)
14	PAUS Rate	0-5	Value = (PAUS Rate - 1.0)/0.5 (where A-F corresponds to 10-15)
15	HR Source	E P S	ECG is HR Source IBP(AP) is HR Source SPO_2 is HR Source
16	RESP Mode	O M A	Resp Monitoring Off Manual Automatic

Position	Description	Values	Definition
17	RESP Size	1-K	Value = (RESP Size)/5 (where A-K corresponds to 10-20)
18-19	minutes since breath detector initialization	00-99	Number of minutes that have elapsed since the breath detector was initialized (where 99 corresponds to >= 99 minutes)
20	Not Used	<Space>	Not applicable
21	Monitor Model	A B I J T	SC9000 Delta/Delta XL/Kappa SC6000 Gamma Infinity Telemetry
22-26	Software Version	XXXXX (ASCII)	First 5 characters of base software (i.e. “VA1.1”)

Timed Recordings

Timed recordings are strip recordings of a specified duration (from 6 to 20 seconds). They contain delay data that originated before the recording was initiated and real-time data that was acquired after the recording started.

Alarm limit violations and arrhythmia events trigger a timed recording automatically, if the recording and/or alarm function has been enabled on the Alarm Limits table, the ST Alarms menu, or the Arrhythmia Setup menu (see chapter 5, Alarms).

To request a timed recording

- Press the **Record** fixed key on the front of the monitor.

To cancel a timed recording

- Press the **Record** fixed key again or the recorder’s **Stop** fixed key.

Continuous Recordings

Unlike timed recordings, which run only for a specified time, continuous recordings run until you stop them manually.

To request a continuous recording

1. Press the **Menu** fixed key to open the Main menu.
2. Click on **Cont. Record**.

To stop the recording:

- Click on **Cont. Record** again or press the recorder's **Stop** fixed key.

Events and Trends

The monitor can store waveforms and parameter values for up to 50 events (parameter alarms, arrhythmia events, marked events). These are displayed on the Event Recall screen (see page 1-27).

To request Event and Trend Recordings

1. Press the **Fast Access** fixed key.
2. Click on **Trend Graphs**, **Trend Table,** or **Event Recall**.
3. Click on **Record** at the bottom of the displayed screen.

Pending Recordings

Recorders connected to the monitor may be temporarily unavailable to print (for example, during a paper change). If another recorder is available, the recording is rerouted to that recorder and printed there in its entirety. If no recorder is available, the data becomes a pending recording and is printed as soon as a recorder is available. The monitor can store up to six timed recordings and one request for a continuous recording. The print order is determined by the type of recording. Continuous recordings have the highest priority, followed by timed recordings.

NOTE: When the monitor stores a timed recording, it saves the actual monitoring data at the time of the recording request. For continuous recordings, however, the monitor saves only the recording request, and not the actual data.

Recorder Setup

The monitor prints recordings on a bedside R50 recorder or on a networked R50-N recorder. The R50-N recorder (see illustration), used for printing recordings over the network, looks similar but is slightly larger. The **mm/s** fixed key on the recorder's front panel (**Alternate Speed** on older recorders) allows you to change the recording speed while a recording is in progress. The recorder stops briefly and then restarts automatically at the new recording speed. The **Stop** fixed key, also on the recorder's front panel, stops a recording in progress.

NOTE: The **mm/s** or **Alternate Speed** key only functions while a recording is in progress.

On the R50 Setup menu, you can customize a variety of recorder functions.

To access the R50 series Setup menu

1. Press the **Menu** fixed key to display the Main menu.
2. Click on **Monitor Setup.**
3. Click on **Recordings.**
4. Click on **R50 Setup** to display the Setup menu.

Quick Reference: R50 Series Setup Menu

The functions listed on the R50 Setup menu are described below.

Menu Selection	Description	Available Settings
Delay	Determines the amount of pre-event data included in the timed recording	• **6**, **10**, **15** s This selected value cannot exceed the selected **Duration** setting.
Duration	Determines the length of a timed recording	• **6**, **10**, **15, 20** s This selected value cannot exceed the selected **Duration** setting.
Speed	Determines the recording speed	• **1, 6.25, 12.5, 25, 50 mm/s**

Menu Selection	Description	Available Settings
Alternate Speed	Determines the recording speed when you press the **mm/s** (**Alternate Speed)** key on R50 series recorder.	• **1, 6.25, 12.5, 25, 50 mm/s**
Waveform Selection	Determines whether waveforms to be printed are selected automatically or manually.	• **Auto** - The topmost displayed waveforms are automatically selected for recordings. • **Manual** - The waveforms that you have selected are printed (see **Waveform 1** and **Waveform 2** settings).
Waveform 1	Assigns the top waveform for R50 recordings, provided **Waveform Selection** is set to **Manual**	• **ECG1, ECG2, RESP, ART, PA, RV, LV, RA, LA, CVP, ICP, ICP2, ICP3, ICP4, GP1, GP2, SpO2, etCO2, etCO2*, O2, Agent, Paw, Flow, Vol, EEG1, EEG2, EEG3, EEG4, BIS, CNAP**
Waveform 2	Assigns the waveform for channel 2 on R50 recordings, provided **Waveform Selection** is set to **Manual**	
Recording mode	Displays current recorder This setting is read-only and cannot be modified.	Not applicable
Alarm Waveform	Gives priority to an alarmed parameter, which (if **Alarm Waveform** is enabled) appears in the second recording channel regardless of previous waveform assignments **NOTE**: If the alarmed parameter does not have a waveform (for example, NBP, TEMP), the recorder prints the assigned waveform to the second recording channel.	• **ON** – Places the waveform associated with the alarming condition in a lower recording channel Waveforms are printed according to how you have configured the **Waveform Selection** setting (**Auto** or **Manual**). • **OFF**

Primary and Secondary Recorders

You can designate a primary and a secondary recorder or a backup recorder on the Infinity network. The monitor prints to the designated recorder on the network or to the local or bedside recorder according to the following criteria:

- The primary recorder prints the recording if no local R50 recorder is connected to the monitor. The secondary recorder prints the recording if the primary recorder is not available.
- The local recorder, if connected, prints the requested recording. If a local recorder is connected but is not available, the secondary recorder executes the print request.

To assign recorders

1. Press the **Menu** fixed key to display the Main menu.
2. Click on **Monitor Setup.**
3. Click on **Recordings**.
4. Click on **R50 Assign**. A data entry window appears.
5. Scroll through the numbers and click successively on the single digits of the clinical password. If you make a mistake, click on **Backspace** and try again.
6. Click on **Accept** to open the R50 Assign menu.
7. Click on **Primary Recorder** to display available recorders.
8. Click on the desired recorder.
9. Click on **Secondary Recorder**.
10. Click on the desired recorder.

NOTE:

- Recorder names are assigned by DrägerService when the Infinity network is configured.
- If your monitor and recorders are not networked, contact DrägerService to configure the recorder.

Replacing Recorder Paper

When the recorder is about to run out of paper, a red line appears on the recording strip. Replace the paper as soon as possible to provide continued operation.

To replace the recorder paper:

1. Open the paper door.
2. Pull out the paper roll from the spool holder.
3. Remove any paper remaining in the printing mechanism.
4. Place the new paper roll into the spool holder. Unroll a few inches of paper from the bottom. The printed side should be facing up.
5. Align the paper roll with paper guides. If not aligned, paper could jam.
6. Close the paper door.
7. To verify positive results, generate a timed recording (see page 7-6).

Print Screen

If the monitor is connected to the Infinity network and a laser printer is available on the network, you can request and print the monitor screen. To request a printed copy of the monitor screen, press the **Print Screen** fixed key.

Reports

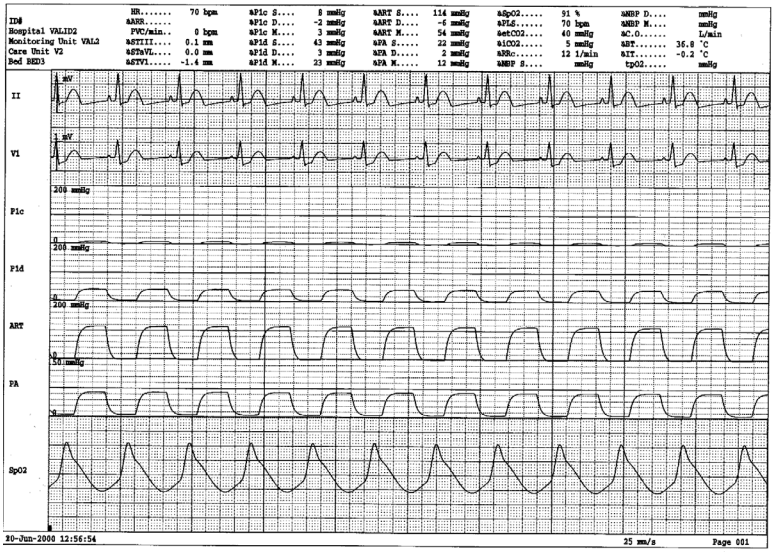
If the monitor is connected to an Infinity network, you can generate reports on a laser printer. In addition to trends, ECG, and standard waveforms, you can also print reports of events and conditions stored in the Event Recall database. For more information, see page 1-27.

To open the Reports setup menu:

1. Press the **Fast Access** fixed key to display the Fast Access menu.
2. Click on **Reports** to display the Reports menu:

Available functions on the Reports setup menu are described in the table “Quick Reference: Reports Setup” on page 7-12.

The following illustration shows a typical ECG report:



Quick Reference: Reports Setup

Menu Item	Description	Available settings
ECG Report	Prints Rest-ECG report **NOTES**: • A diagnostic ECG Report is available with a 12 lead pod provided the Aries SW option is installed and the monitor is connected to an Infinity CentralStation with REST ECG report option. • If you are not connected to the Infinity CentralStation, you can print an ECG waveform report. See 8, ECG and Heart Rate, for more information.	Click on the printer icon to request a report.
Timed Waveforms	Prints a timed recording report (see page 7-6).	
Continuous Waveforms	Prints a continuous recording report (see page 7-6).	• Click on the printer icon to request report. • Click on the printer icon again to stop printing the report.
Waveform Delay	Determines the amount of pre-event data included in the timed recording.	**6**, **10**, **15 s**
Waveform Duration	Determines the length of timed report.	**10**, **20 s**
Trend Graph	Prints a graphical trend report See chapter 6, Trends, for more information.	Click on printer icon to request report.
Trend Table	Prints tabular trend report See chapter 6, Trends, for more information.	
Trend Duration	Determines length of graphical trend report This item corresponds to the **Hours** setting at bottom of Trend Graphs display. See chapter 6, Trends, for more information.	**1, 2, 4, 8, 12, 24 hr**
Table Interval	Determines time interval for tabular trend report This item corresponds to the **Interval** setting at the bottom of the trend table. See chapter 6, Trends, for more information.	**1, 5, 15, 30, 60 min**

Status Messages

Message	Possible Cause	Suggested Action
Check Printer	The printer is not connected.	Check the printer connection.
[Primary/Secondary] Recorder not connected	The recorder is disconnected or the connection is poor.	• Connect a recorder and verify that it is appropriately assigned. • Inspect the cable, replace it, if necessary.
[Primary/Secondary] Recorder not assigned	You have not specified a recorder.	Specify a recorder from the R50 Assign menu.
[Primary/Secondary] Recorder door open	The paper door is open.	Close the door to the recorder paper compartment.
Timed recording started	The recorder is currently printing.	Let the recorder finish printing.
Recording not accepted	The recorder does not understand the print request.	Try again; call the hospital's technical personnel.

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8 ECG and Heart Rate

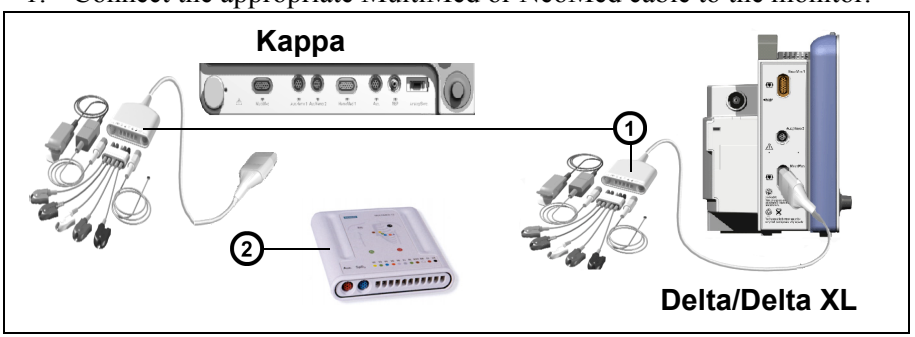
Overview

The monitor can calculate heart rate, detect arrhythmia conditions (adult and pediatric patients only), and display ECG data. Lead wires are connected to the monitor via special pods designed to facilitate cable management. The MultiMedCables accommodate standard (3-lead, 5-lead, or 6-lead) cable sets with the (MultiMed 12 Pod) or a 12-lead cable set with the (optional MultiMed 12 Pod). The NeoMed Pod is designed for 3-lead monitoring for neonatal patients, allowing one ECG waveform to be displayed. The MultiMed and NeoMed cables also have connectors for an SpO_2 sensor and up to two temperature probes. A connector for an FiO_2 sensor is available only on the NeoMed cable.

NOTE: If you have a Masimo SET or Nellcor OxiMax logo on the front of your monitor, the SpO_2 port is not enabled.

Before you begin ECG and heart rate monitoring, proceed as follows:

1. Connect the appropriate MultiMed or NeoMed cable to the monitor.



1	MultiMed 5 cable with accessories (NeoMed, MultiMed6, MultiMed Plus, and MultiMed Plus OR cables look similar)
2	MultiMed 12 pod (Connects to the PodCom connector (Not in scale to MultiMed 5 pod)

2. Plug leads and accessories into designated connectors.
3. Attach the lead wires to the electrodes on the patient.

ECG Precautions

Refer to the "Safety Considerations" section starting on page 8, at the beginning of these Instructions for Use, for general precautions regarding safe device operation.

WARNING:

- **Use ECG strip recordings for documentation only (they are not of diagnostic quality). Use a resting 12-lead ECG for diagnostic purposes instead. Diagnostic interpretation of a 12-lead ECG should only be performed by a physician or by trained personnel under the supervision of a physician.**
- **To prevent patient injury, always verify the timing of the SYNC pulse before attempting cardioversion.**
- **Use caution when using evoked potential devices because they may interfere with ECG monitoring.**
- **Do not rely solely on ECG with seizure-prone patients. Electrical artifacts of non-cardiac origin, such as seizure, may prevent detection of certain arrhythmias.**

WARNING: To protect the patient during defibrillation and to ensure accurate ECG information use only ECG electrodes and cables specified by Dräger. Removal of applied parts that are not rated defibrillation proof such as disposable SpO2 sensors may be required to prevent sensor breakdown and energy shunting

NOTE: Use of a 12 Lead ECG module is required for ECG signal quality compliant with the IEC 60601-2-25 diagnostic high frequency response specification of 500 Hz. The standard multimed ECG input has a maximum high frequency response limit of 40 Hz causing minor distortion of the waveform.

Pacemakers

Difficulties inherent in ECG monitoring require special attention for patients with pacemakers. The monitor errs on the side of caution in cases of uncertain pacemaker performance and may not count QRS complexes in paced patients. False "low rate" alarms may therefore result under the following circumstances:

- Fused beats and asynchronous pacers when coupling intervals are +10 to -90ms

- 700mV pacer pulses followed by QRS complexes smaller than 0.5 mV
- Asynchronous pacer pulses with overshoot

The monitor has been tested for pacer pulse rejection. It is not possible, however, to anticipate every clinically possible waveform characteristic. Consequently, for some paced patients, the monitor may not count heart rates accurately and may misinterpret rate-dependent arrhythmias.

WARNING:

- **Always keep pacemaker patients under close surveillance and monitor their vital signs carefully.**
- **Do not assess the patient's condition exclusively from the heart and respiration rate values the monitor displays and the rate alarms that are generated. Heart rate meters may continue to count the pacemaker rate during cardiac arrest or some arrhythmias.**
- **Some pacemakers (especially external pacemakers with body surface electrodes) emit pulses with amplitudes far exceeding the 700mV maximum amplitude specified for the monitor. The monitor may incorrectly detect these large pacemaker pulses as valid QRS complexes and may fail to detect cardiac arrest.**
- **Interference from a monitor may cause some rate-adaptive implantable pacemakers to pace at unnecessarily high rates. Be extra vigilant with patients when using these types of pacemakers.**
- **Make sure pacer detection is turned OFF for patients without pacemakers and turned ON for patients with pacemakers. Disabling pacemaker detection for paced patients may result in pacemaker pulses being counted as regular QRS complexes, which could prevent an asystole alarm from being detected. Always verify that the pacer detection status is correct for the patient. Be aware that setting the ECG filter option to ESU disables pacemaker detection automatically.**

Pacer Detection

NOTE: Configuring the monitor for neonatal monitoring or for protection from electrosurgery automatically disables Pacemaker Detection.

When pacer detection is enabled, the monitor identifies as a pacer pulse any pulse that meets the following specifications:

Amplitude – ±2 to ±700 mV
Width (d_p) – 0.2 to 2.0 ms
Rise/Fall times (min.) – 0.1 d_p, 100 ms
Overshoot (min.) – 0.025 a_p, 2 mV
Recharge time constant – 4 to 100 ms

The monitor identifies detected pacer pulse by a blue mark on the patient's ECG in channel ECG1. If a QRS complex occurs within 250 ms of a pacemaker pulse, that QRS complex is identified as a paced beat. In the HR parameter box, paced beats are identified by the icon **P♥**. Regular beats continue to be identified by the flashing heart symbol (♥).

When pacer detection is disabled, the message *Pacer Off* appears in the ECG1 channel.

To activate pacer detection

1. Click on the **HR** parameter box.
2. Click on **ECG Options**.
3. Click on **Filter** and check if **OFF** or **Monitor.**
4. Scroll to **Pacer Detection** and click to toggle it **ON**.

NOTE: When Pacer Detection setup under Unit Manager is set to **Advanced**, the selection **Fusion** is available (see page 8-22).

Using a five-lead or six-lead cable set to maximize your range of signal choices, you can further optimize ECG signal acquisition and processing for paced patients as follows:

1. Activate pacer detection as described above.
2. Select the lead with the least interference and highest R-wave for display in channel ECG1.
3. Scroll again to **Filter** on the ECG menu.
4. Toggle between **Monitor** and **OFF** until you determine which setting gives you the clearest signal.

Impedance-Derived Rate Response Pacemakers

Pacemakers with impedance-derived rate response emit pulses which can adjust the pacer rate to the respiration rate. The monitor may interpret the emitted pulses as pacer pulses, superimposing a blue pacemaker spike on the ECG waveform. For impedance-derived rate response pacemakers, modify electrode placement until blue spikes on the waveform disappear.

Electrosurgery

Observe the “Safety Considerations” section on page 8 and the “Electrosurgery” section on page 17 of these Instructions for Use for general safety precautions during electrosurgical procedures to reduce ESU interference and enhance user and patient safety.

NOTE:

- Place the electrodes as far from the surgical incision as possible while maintaining a clinically useful configuration.
- Place the cable and lead wires as far from the ESU as possible and perpendicular to the ESU cables.
- Use ESU-return electrode with largest possible contact area. Whenever possible, place the ESU-return electrode directly under the surgical site, avoiding bony protrusions.
- Replace ECG electrodes regularly.
- Read the operating instructions that came with the ESU block for additional information.

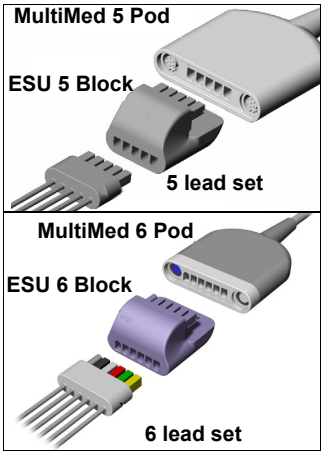
The monitor’s ECG function is protected against high-frequency interference from defibrillators and electrosurgical units.

ESU Block

The MultiMed Plus OR cable and the 5/6-lead ESU block have an integrated electro-surgical unit (ESU) filter which helps to reduce HF surgery artifacts for improved reliability. The ESU filter helps to protect the patient from burns caused by ESU-induced currents flowing through unprotected leads. See chapter 30, for information on cleaning the device.

NOTE: Only use the ESU block during electrosurgery. Only for use with the MultiMed 3/5, or MultiMed 6.

To enable the ESU Filter for ESU Block or MultiMed Plus OR Cable



1. Click on the **HR** parameter box on the main screen.
2. Click on **ECG Options**.
3. Click on **Filter**.
4. Scroll to **ESU** and click.
5. Plug the ESU 5/6 block into the MultiMed 5/6 pod.

NOTE: The MultiMed Plus OR cable has an integrated ESU filter. Therefore, no ESU block has to be connected.

6. Plug in the applicable ECG lead set (see appendix C, “Approved Options and Accessories”).

WARNING: During electrosurgery, Dräger recommends using an ESU block or an MultiMed Plus OR cable with Dräger ECG lead sets. They help protect the patient from burns caused by ESU-induced current flowing through the leads.

Infusion or Roller Bypass Pumps

Infusion or roller bypass pumps may cause artifact in the monitor's ECG signals. Such interference may cause the monitor to display pacemaker spikes even though the ECG waveform appears normal. To determine if the pump is the source of the electrical disturbance, turn it off, if possible. If the artifact disappears, the pump is the probable cause. To reduce such artifact, choose the lead with the best signal for monitoring or replace the electrodes. Rerouting invasive pressure tubing away from the infusion pump tubing may also improve the signals.

Line Isolation Devices

To reduce the effect of line isolation devices, which may cause temporary disturbances (transients) in the ECG signal, take the following precautions:

- Choose the lead with the best signal for monitoring.
- Check the electrodes and replace them, if necessary.

Transcutaneous Electrical Nerve Stimulators

Signals from transcutaneous electrical nerve stimulators (TENS) often resemble pacemaker signals and may be labeled as such by the monitor. The monitor may reject valid QRS complexes which follow misinterpreted TENS signals. To avoid the resulting false asystole or "low rate" alarms that may occur due to this, follow the steps outlined for assuring signal clarity (see "Pacer Detection" on page 8-5). If TENS signals continue to register as pacer spikes, you may wish to disable pacemaker detection.

Patient Preparation

Careful skin preparation and proper electrode placement support strong signals with minimal artifact. In case of a technical alarm (for example, a detached lead), re-prep the patient according to the following recommendations.

Follow the clinical techniques approved at your hospital for preparing the patient's skin. For a good quality signal, change electrodes every 24 to 48 hours. Electrodes may have to be changed more frequently under the following conditions:

- ECG signal degradation
- Excessive patient perspiration
- Patient skin irritation

A wide selection of reusable and disposable electrodes are available. Select the best electrode for the monitoring situation. Dräger recommends Ag/AgCl disposable electrodes. If you are using pre-gelled electrodes, verify that there is enough gel in the electrode gel-filled area. Never use disposable electrodes after their expiration date or when the gel has dried out.

Choose electrode sites in the configuration that will provide the best ECG (P- and T-wave amplitudes should be no more than one third of the QRS amplitude). Select flat, non-muscular sites to maximize electrode contact and minimize muscle artifact. Avoid joints or bony protrusions. Consider the following special conditions when selecting sites for electrode placement:

Surgery — Keep the electrodes as far from the surgical site as possible.

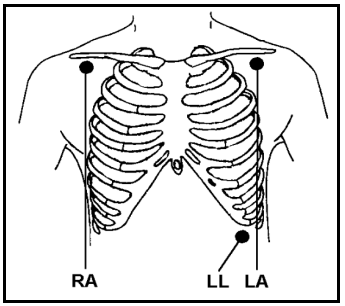
Burn Patients — Use sterile electrodes. Clean the equipment thoroughly. Follow hospital infection control procedures.

Use a piece of waterproof tape (approximately 2 inches wide) or steri-drape to secure electrodes and protect them from fluids. Form a small loop with the lead wire directly beneath connection and secure with tape.

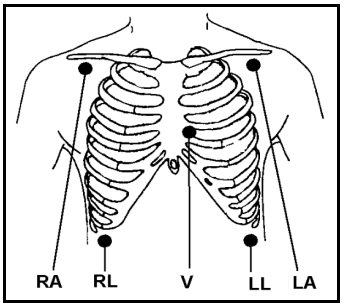
Three-, Five-, Six- and TruST® Twelve-Lead Configurations

The following illustrations show typical ECG lead configurations and color codes designated by the IEC and the AHA/US:

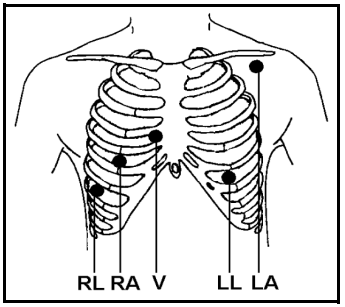
Three-Lead Standard



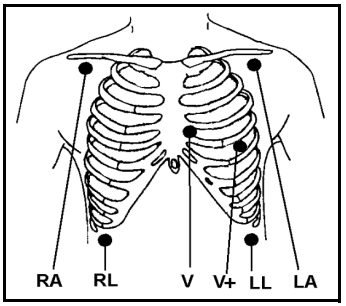
Five-Lead Standard



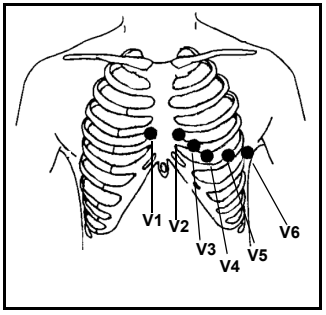
Five-Lead (Paced Patients)



Six-Lead Standard Infinity TruST



Chest Lead Standard



NOTE: For Infinity TruST 12-lead monitoring, the recommended lead placements for **V** and **V+** are V2 and V5 (chest lead).

Lead color-coding for 3-, 5-, 6-lead monitoring

Lead color-coding for 3-, 5-, 6-lead monitoring		
ECG Lead	**IEC**	**AHA/US**
LA	Yellow	Black
LL	Green	Red
RA	Red	White
RL	Black	Green
V	White	Brown
V+	Gray and white	Gray and brown

TruST Twelve-Lead Configuration

Overview

Infinity TruST derived 12-lead ECG monitoring is acquired using a MultiMed 6, a MultiMed Plus, or a MultiMed OR with 6 (instead of 10) electrodes. The TruST leads are constructed from other leads and are intended for real-time assessment of ST segment changes. TruST is available in adult and pediatric modes, but not in neonatal mode.

In general, the signal from a measured lead provides information common to other leads. When this information is appropriately combined, the signal of leads not otherwise configured can be inferred. Appropriate use of this information allows ECG signals to be derived for leads that are not physically available. This type of lead derivation has a high degree of correlation with measured leads, but should not be used for diagnostic 12-lead ECG analysis.

TRUST electrodes are placed in the six-lead standard configuration. As with the six-lead pod, waveforms from eight leads can be viewed on the Delta monitor, but TRUST also processes and displays four additional lead waveforms. These TruST leads are viewable in the same fashion All Leads display (see Show All Leads on page 8-20) as the conventional leads. See “Three-, Five-, Six- and TruST® Twelve-Lead Configurations” on page 8-10 for Six-Lead Standard/Infinity TruST electrode placement.

WARNING:

- **Refer to the conventional lead if the QRS morphology of a TruST lead differs from that of its equivalent conventional lead.**
- **Do not select TruST leads for ECG signal processing.**

TruST Setup

You can select electrode configuration according to TruST twelve-lead format. TruST twelve-lead monitoring is available Delta/Delta XL/Kappa only if you are using the MultiMed 6-lead pod. If a five or twelve-lead pod is connected, the TruST 12-lead selection is ghosted and unavailable.

To select TruST configuration:

1. Click on the **HR** parameter box.
2. Click on **ECG Options**.
3. Scroll to **TruST 12-Lead** and select **ON**.

Twelve-Lead Configurations (Standard and Frank)

You can select electrode configuration according to Standard or Frank Lead format. Twelve-lead monitoring is available only if you are using the MultiMed 12-lead pod.

NOTE: MultiMed 12-lead pod does not support Respiration.

To select 12-lead configuration

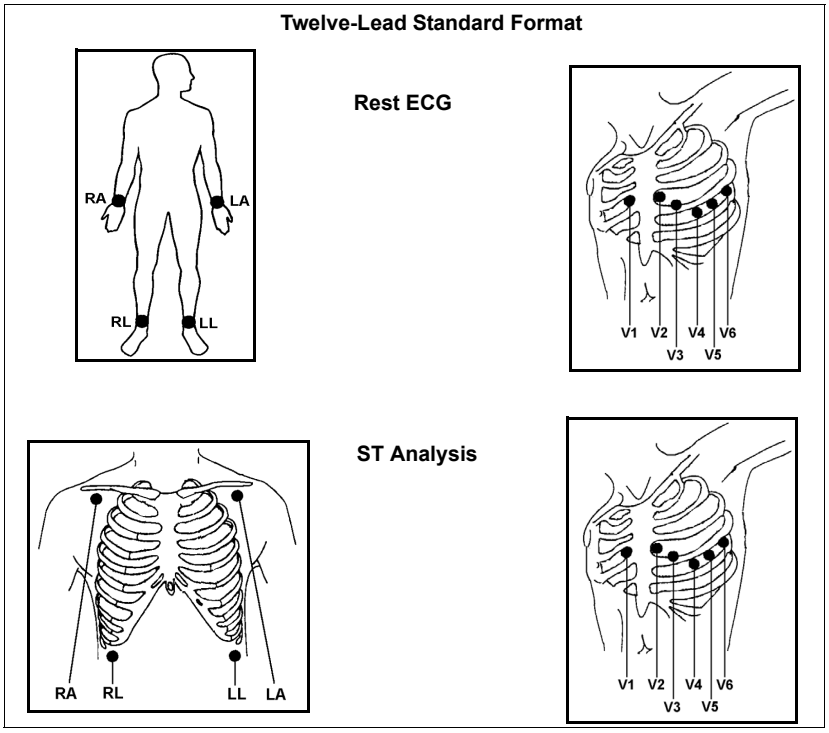
1. Click on the **HR** parameter box.
2. Click on **Lead Setup**.
3. Scroll to **12 Lead Position** and select **Standard** or **Frank**.

Illustrations and guidelines for Frank and Standard lead configuration are provided on the following pages.

Standard 12-Lead Format

1. For standard 12-lead monitoring, place chest electrodes in positions V1 through V6 as shown in the following illustrations.
2. Select **Standard** on the ECG menu as described on page 8.

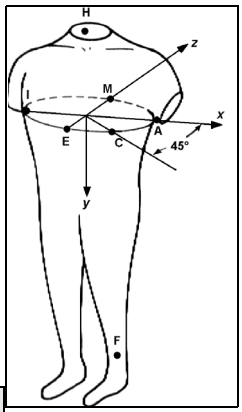
Electrode placement may differ slightly depending on whether you are monitoring ECG or ST, as shown in the following illustrations. The signal morphology for ST Monitoring and Rest ECG configurations may also differ.



Lead set color-coding for standard 12-lead monitoring

Lead set color-coding for standard 12-lead monitoring		
ECG Lead	**AHA/US**	**IEC**
LA	Black	Yellow
LL	Red	Green
RA	White	Red
RL	Green	Black
V1	Brown and red	White and red
V2	Brown and yellow	White and yellow
V3	Brown and green	White and green
V4	Brown and blue	White and brown
V5	Brown and orange	White and black
V6	Brown and violet	White and violet

Frank Lead Format



The Frank lead format shows cardiac activity in three mutually perpendicular directions. Seven Frank electrodes (I, E, C, A, M, H, and F) are combined to produce Frank leads X, Y, and Z (the F electrode is not necessary for Frank leads). The bedside and the central station use the standard and more familiar 12-lead format.

The following tables show Frank electrodes used to derive Frank leads X, Y, and Z, and the correlation between Frank electrode positions and chest electrode positions.

Frank electrodes used to derive Frank leads	
Frank Electrode	**Frank Lead Label**
A, C, I	X
F, M, H	Y
A, M, I, E, C	Z

Correlation between chest and Frank electrode positions	
Chest Electrode	**Frank Position**
V1	I
V2	E
V3	C
V4	A
V5	M
V6	H

When you select **Frank** monitoring (see "Twelve-Lead Configurations (Standard and Frank)" on page 8-12):

- The displayed limb leads are true limb leads. The chest leads remain derived.

NOTE: Only leads I and II are true limb leads (lead III is calculated). If the RA electrode is disconnected, lead III appears as a flat line (Asytole) to alert the clinician to the disconnected electrode. All other leads function as expected.

- Frank leads are converted to standard 12-lead format.
- If a Frank electrode falls off, the monitor displays a *Lead Off* message and the corresponding Frank electrode label.
- Devices connected to the monitor via the network (Central Station and printers) work with data in the 12-lead format.
- Rest-ECG reports are labeled *Derived 12-lead*.

NOTE: In Frank Lead mode, the monitor displays "Derived 12 Lead" in the Rest ECG reports. Note that the report does not represent true measured leads.

ECG Leads

The number of available ECG leads depends on the type of pod and cable set you are using, as shown in the following tables.

Regular ECG Leads

ECG Pod	Cable Set	Channels	Leads Available
NeoMed	3-lead	ECG1	I or II or III
MultiMed 5	3-, 5-lead	ECG1, ECG2, ECG3 [1]	I, II, III, aVR, aVL, aVF, V [2]
MultiMed 6	3-, 5-, 6-lead	ECG1, ECG2, ECG3 [1]	I, II, III, aVR, aVL, aVF, V, V+ [2]
MultiMed 12	5-, 6-, 12-lead	ECG1, ECG2, ECG3 [1]	I, II, III, aVR, aVL, aVF, V1-V6 [2]

[1] ECG3 is available only when HR, ARR, and ST parameter boxes are on the main screen.
[2] V and V+ are chest leads; aVR, aVL, and aVF are augmented leads.

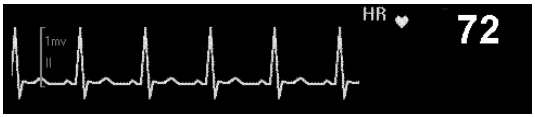
TruST 12-Lead

ECG Pod	Cable Set	Channels	Leads Available
MultiMed 6	6-lead	ECG1 [3]	I, II, III, aVR, aVL, aVF, V [1], V+ [1], V2 [2], V5 [2]
		ECG2 [3]	I, II, III, aVR, aVL, aVF, V [1], V+ [1], V2 [2], V5 [2]
		ECG3	I, II, III, aVR, aVL, aVF, V [1], V+ [1], dV1 [2], V2 [2], dV3 [2], dV4 [2], V5 [2], dV6 [2] **NOTE**: TruST leads are indicated by a prefix “d” before the V lead.
		12-Lead [1]	- -
		Cable Type [1]	- -

[1] Selection unavailable/ghosted when TruST 12-Lead is set to **ON**.
[2] Selection unavailable/ghosted when TruST 12-Lead is set to **OFF**.
[3] Channel does not support display of any TruST leads.

ECG Signal Processing and Display

The monitor identifies QRS complexes with amplitudes between 0.4 and 5.0 mV (0.2 - 5.0 mV for scale settings of 0.5 mV/cm and lower) and a QRS width of 70 to 120 ms for adults (or 40 to 100 ms for neonates; see note in Chapter 8, QRS/ARR Select). It calculates heart rates within a range of 15 to 300 beats per minute, using the R-R intervals of the last 10 seconds and disregarding the two longest and two shortest R-R intervals. It averages the remaining intervals, and displays the result as the current heart rate in the HR parameter box on the main screen.

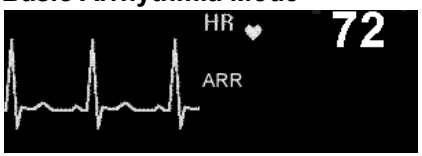


During dual-channel processing, the monitor assigns a weight to each channel depending on its level of artifact (the cleaner channel receives a greater weight). When the noise in one channel exceeds a certain level, the channel is excluded from the composite signal, and the monitor effectively shifts to single-channel processing. The level of artifact on an analyzed channel determines the weight that channel receives. If both channels show excessive noise, the message *ECG Artifact* appears until at least one channel is sufficiently noise-free.

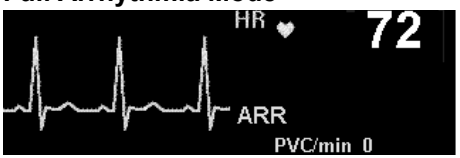
- During brief artifact, the heart rate is blanked. During extended artifact, the heart rate value is displayed as * * *.
- When artifact clears, the monitor resumes QRS processing but does not initiate a relearn.

When you enable arrhythmia monitoring (not available for neonatal patients), the HR parameter box changes accordingly. If you select **Basic**, the four basic arrhythmia calls ASY, VF, VT, and ARTF are available for display. If you select **Full** and you configure the main screen to display two or more ECG channels, a separate **ARR** parameter box appears below the **HR** parameter box (see Chapter 9, Arrhythmia Setup for information about selecting an arrhythmia mode).

Basic Arrhythmia Mode



Full Arrhythmia Mode



Alarms and Alarm Conditions

- Asystole and Ventricular Fibrillation – If ECG monitoring is active and the monitor displays at least one ECG waveform, asystole and ventricular fibrillation alarm conditions are annunciated even when arrhythmia monitoring is set to **OFF**.
- High P-Waves and T-Waves – High-amplitude
  P- or T-waves of long duration may be detected as QRS complexes. To allow the monitor to properly detect low heart rate conditions in such cases, place the lead with the highest R-wave (relative to the T- and/or P-wave) in channel ECG1. If the monitor continues to misinterpret P- or T-waves, reposition the electrodes or use a pulse oximeter to monitor the patient's pulse rate.
- Disconnected Electrodes – If more than one electrode is disconnected, messages are cycled. The monitor displays the following messages, depending on whether the electrode is essential for QRS processing:
  - *ECG Leads invalid – Disconnected electrode is essential*
  - *<XX> Lead Off – Disconnected electrode is not essential*

ECG Setup Menu

Click on the HR parameter box to access the ECG setup menu. Items and settings are described in the following table.

Quick Reference Table – ECG Setup

Menu Selection	Description	Available Settings
Show All Leads	Displays all active ECG leads **NOTES**: • While the **Show All Leads** screen is displayed, other parameter boxes remain visible, and alarms and recordings continue to operate normally. However, you cannot use the rotary knob to access other menus. • You can also access the **Show All Leads** screen using the fixed keys **Fast Access** on the monitor or the **All ECG** button on the remote keypad.	• Click on **Show All Leads** to display all connected available ECG leads. • Click on **Report** at the bottom of the screen to print an ECG report on a network laser printer. • Click on **Notes** at the bottom of the screen to display remarks about the patient's physiological condition. Scroll to the appropriate note and click again. Notes are displayed on the screen and can printed on reports. • Press the **Main Screen** fixed key to return to the main screen.
The **Size ECG** Submenu This submenu allows you to configure the following functions.		
Size ALL ECG	Changes display amplitude of ECG waveforms	Click on **Size ALL ECG** to change the amplitude of all waveforms on the **Show All Leads** and the main screen.
Channel <#> size	**NOTES:** • The monitor's normal QRS detection threshold is approximately 0.4 mV depending on the QRS width. This threshold is used for channel size selections of 1, 2, 4, or 8 V/cm (see page 8-16 for more details). • A channel size selection of 0.25 or 0.5 mV/cm, decreases the QRS detection threshold to approximately 0.2 mV. In this case, these low amplitude QRS complexes may be included in the heart rate calculation if the QRS width is between 70 and 120 ms (or 40 to 100 ms for neonates).	Click on **Channel 1 size, Channel 2 size,** or **Channel 3 size** to change the size of the individual ECG channels. **NOTE**: If you connect a 3-lead cable to the monitor, the selections **Channel 2 size** and **Channel 3 size** are ghosted.

Menu Selection	Description	Available Settings
The Lead Setup submenu This submenu allows you to configure the following functions.		
ECG Channels	Determines the number and format of displayed ECG waveforms **NOTE:** The TruST 12-lead derived leads cannot be displayed as ECG1 or ECG2. They can only be displayed in the Show All Leads view.	• **ECG1** – displays the primary ECG signal. • **ECG1 & 2** – displays two ECG signals. • **ECG1 & 2 & 3** – displays three ECG channels. • **Cascade** – cascades ECG1 data into the second channel.
Channel 1 **Channel 2** **Channel 3**	Selects leads for continuous display in ECG channel(s) on the main screen.	**Channel 1, Channel 2, Channel 3** (scroll through the list of available leads and click to select for display). **NOTE**: The **Cable Type** setting determines the list of available leads for selection.
12 Lead Position	Configures monitor for Standard or Frank 12-lead monitoring (see page 8-14 for more information).	• **Standard** – configures the monitor for standard 12-lead monitoring. • **Frank** – configures the monitor for Frank 12-lead format.
ECG Leads Invalid Alarm	Configures the alarm grade for ECG leads invalid condition **NOTE:** For OR mode the low grade alarm is not persistent (one shot) **NOTE:** This menu will not be available when backwards compatibility is enabled.	• **LOW** (default) • **MED** • **HIGH** ***Caution**: This alarm is disabled when HR Source is selected to anything other than ECG*

Menu Selection	Description	Available Settings
Cable Type	When set to **Auto Detect**, the monitor detects the number of connected lead wires via a MultiMed pod automatically. If **Auto Detect** mode does not detect the connected lead wires (the ECG waveform is not displayed or the message *ECG Leads Invalid* or *V+ Lead OFF* appears in the upper left corner of your screen), you can manually select the cable type. The setting **10** (**12 Lead**) denotes a combination of a 6-lead wire set and a 4-chest lead wire set, or a 5-lead wire set and 5-chest lead wire set for 12-lead monitoring. **NOTE***:* Auto Detect function is not supported when using MultiMed Plus and MultiMed Plus OR Pods **NOTE***:* Verify the **Cable Type** setting whenever you begin ECG monitoring (the monitor remembers the previous **Cable Type** setting). **NOTE**: The TruST selection becomes unavailable when you connect a MultiMed 6, MultiMed Plus or a MultiMed Plus OR cable and the **Cable Type** setting is set to either: **3**, or **5.** **NOTE**: The selection 10 (12 lead) is only available when a MultiMed 12 pod is connected.	• **Auto Detect (default)** – the monitor compensates automatically for one disconnected neutral lead. (This feature is available only with the **Auto Detect** setting.) • **3** • **5** • **6** • **10 (12 Lead)** **NOTE**: The selected cable type determines how many ECG leads are processed regardless of which ECG cable is connected. For example, if you connect a MultiMed 6, MultiMed Plus or MultiMed Plus OR with a 6 lead wire set, but the **Cable Type** is set to '**5**', the monitor will only process and display 7 leads. The V+ lead will not be displayed, trended or broadcast to the network in this case. However, the V+ lead will still be displayed in the Show All screen. To display all 8 leads you must set the **Cable Type** to '**6**'. ECG processing for QRS detection and arrhythmia are still controlled with the QRS/ARR Select menu setting (see page 8-25) and the Lead Setup menu selections for **Channel 1** and **Channel 2**.

Menu Selection	Description	Available Settings
The **ECG Options** Submenu This submenu allows you to configure the following functions.		
Filter	Controls the channel bandwidth and displays a banner in the ECG1 channel if the selection is set to **OFF** or **ESU.** No banner is displayed if you select **Monitor**. ***CAUTION**: When the ESU block or the MultiMed Plus OR cable is in use, the detection of pacemaker spikes could be compromised.*	• Click on **OFF** for maximum bandwidth and greatest sensitivity to noise or artifact. • Click on **Monitor** (default) to reduce baseline drift, muscle artifact, and power line interference (recommended for standard monitoring, display, recording, and analog output). • Click on **ESU** to reduce signal distortion from electrosurgical units (see page 8-7 for information on electrosurgical safety).
Pacer Detection **NOTE**: See page page 8-5 and page 2-26 for more information on pacemaker detection.	Determines the monitor's ability to identify pacemaker pulse. Allows user to enable/disable pacer detection or choose more advanced Fusion selection. ***Caution**: Fusion mode pacer detection is not intended for use with large-signal, unipolar pacemakers. It is intended for use only with biphasic pacemakers. Please observe the following:* • *Select Fusion mode only in situations where it becomes necessary to suppress repeated false asystole and/or false low heart rate alarms.* • *Before selecting Fusion mode, be certain that the patient has a biphasic pacemaker (external or implanted) and that it is accurately programmed as appropriate for that patient.* • *Do not use Fusion mode if you are uncertain as to what type of pacemaker is being used.*	In basic mode: (see page 2-26) • Select **ON** to enable pacemaker detection. • Select **OFF** (default) to disable pacemaker detection. In advanced mode: (see page 2-26) • Select **ON** to enable pacemaker detection. • Select **OFF** (default) to disable pacemaker detection. • Select **Fusion** to enable pacer detection, but minimize pacer tail rejection to reduce missed detection of pseudo-fused paced beats, which results in false asystole alarms.
QRS Sync Marker	The vertical white line that is displayed on each detected QRS complex indicates when it is safe to perform synchronized cardioversion. **NOTE**: Sync output pulses can trigger the timing of defibrillators during synchronized cardioversion.	• Connect the device to the output marked **Sync** on the right side of the monitor. • Select **ON** to enable the **QRS Sync marker**. • Select **OFF** to disable the **QRS Sync marker**.

Menu Selection	Description	Available Settings
Pulse Tone Source	Selects the **ECG** or **SpO2** signal as the source for the pulse tone A blinking heart (♥) displays in the parameter box.	• Click on **ECG** to use the ECG signal as the source for the pulse tone. • Click on **SpO2** to use the SpO_2 signal as the source for the pulse tone. • The pulse visual blip shows no change indicating SpO_2 saturation values.
Pulse Tone Volume	Regulates pulse tone volume	• Click on **OFF** to silence the pulse tone. • Click on volume (**5, 10** to **100** % in 10% increments) to regulate the pulse tone.
TruST 12-Lead	Allows the monitor to perform 12-lead monitoring when a MultiMed 6 pod is used.	• Select **ON** to enable TruST 12-lead monitoring. • Select **OFF** (default) to disable TruST 12-lead monitoring.
ECG Report Setup	Allows you to set up and request Rest ECG Analysis reports on a laser printer (provided the monitor is on the network and is connected to a Infinity CentralStation, has the Aries S/W option installed, and a 12-lead MultiMed pod is connected) **NOTE:** To request a report, you must first configure it at the central station (see the Biomed chapter in the Infinity CentralStation Instructions for Use for detailed information). ***Caution**: Sensitivity and specificity of diagnostic interpretations may be reduced if age and sex information are not entered for Rest ECG reports.*	• **Report** – Generates Rest-ECG report • **Admit** – Allows you to enter patient data (see chapter 4, Admission, Transfer, and Discharge.) • **Sex** – **Unknown**, **Male**, **Female** • **Race** – **Unknown**, **Caucasian**, **Asian**, **African origin**, **Other** • **Medication 1** and **Medication 2 – Unknown, No Meds, Digitalis, Beta Blocker, Quinidine, Procainamide, Amiodarone, Disopyramide, Lidocaine, Other Antiarrhythmics, Diuretic, Psychotropic, Steroid, Other Meds** • **Condition 1** and **Condition 2 – Unknown, Normal, Infarction, Ischemia, Hypertension, Congenital HD, Valvular HD, Pericarditis, Respiratory Disease, Endocrine Disease, Pacemaker, Pulm. Embolism, Post Op Changes, Cardiomyopathy, Other** **NOTE:** (Available when Aries S/W option is installed) • **None, Chest Pain, Chest Pain Increase, Chest Pain Gone, Chest Pain Decrease, Routine ECG, Treatment Change, Start Thrombolytics, Post Thrombolytics, ECG Post Intervention, Post PTCA, Post CABG, Position: Supine, Left Side, Right Side, Up Right, Front; ECG Right Sided; V7-Vx ECG**

Menu Selection	Description	Available Settings
The **Brady Alarm** submenu (Only visible in neonatal mode) This submenu allows you to configure the following functions. **NOTES:** • When in Adult mode, bradycardia (BRDY) is available in the Arrthythmia setup menu • A bradycardia alarm, which is a high-priority alarm, can be configured independently of the HR alarm, which is a medium-priority alarm.		
Brady Detection	Sets the bradycardia detection limit.	• **OFF** • **20 - 100 bpm** in 5 bpm intervals.
Brady Archive	Allows you to store and/or record automatically a bradycardia alarm event. You can later review stored alarms on the Event Recall screen.	• **OFF** • **Record** • **Store (Default)** • **Str./Rec.**
Other ECG Setup functions		
HR Alarm	Accesses Alarm Limits table See chapter 5, Alarms, for more information about setting and displaying alarm limits.	• Click on **HR Alarm** to open the Alarm Limits table with HR-associated alarms prioritized. **WARNING**: When the HR alarm and the ARR monitoring functions are set to **OFF**, the monitor cannot generate ASY/VF alarms. To restore this ability, set ASY/VF alarms to **Always ON** (see page 2-16.
HR Source	Selects the source for the heart rate (especially useful during electrosurgery when artifact interferes with ECG heart rate detection). **NOTES**: When the monitor is part of a network, the rest of the system continues to display the HR label in the ECG parameter box, regardless of the source. For example, even if you select SpO_2 as the HR source at the monitor, the Infinity CentralStation displays HR in the ECG parameter box.	• Click on **ECG** to derive heart rate from ECG signal. • Click on **ART** to derive heart rate from Arterial Pressure signal. HR parameter box label changes to APR and displays values in red. If the monitor cannot detect a signal, it defaults to ECG for the heart rate. • Click on **SpO2** to derive heart rate from pulse oximetry signal. HR parameter box label changes to PLS and displays values in white. • Click on **AUTO** to derive heart rate from ECG signal or other available signals. If an ECG signal is unavailable, the monitor switches to ART, then SpO_2. **WARNING**: The ECG Leads Invalid alarm is disabled if this selection is anything but ECG. **NOTE**: The pulse blip and audio tone are derived from the Pulse Tone Source setting, which is located in the ECG Setup Menu and SpO_2 Setup Menu

Menu Selection	Description	Available Settings
QRS/ARR Select	Facilitates accurate detection of HR and ARR calls by allowing you to select single- or dual-channel processing for maximum signal clarity. This setting affects how the monitor responds to artifact. **NOTES**: • How the monitor responds to artifact depends on whether ECG monitoring is configured for single- or dual-channel processing (see page 8-18). • Regardless of your configuration of this setting, the monitor resumes QRS processing but does not initiate a relearn when an artifact clears. • The **QRS/ARR Select** function is ghosted in neonatal mode.	• Click on **ECG 1** to determine heart rate and arrhythmias based on the single best lead. • Click on **ECG1&2** to determine heart rate and arrhythmias based on the two best leads.
ST Monitoring	Enables/disables ST monitoring (see chapter 10 for more information).	• Select **ON** to enable ST monitoring. • Select **OFF** to disable ST monitoring.
ARR Monitoring	Selects the arrhythmia mode (see chapter 9, Arrhythmia Monitoring for more information).	• Select **OFF** to disable arrhythmia monitoring. • Select **BASIC** to enable basic arrhythmia monitoring. • Select **FULL** to enable full arrhythmia monitoring.
RESP Monitoring	Enables/disables respiration monitoring (see chapter 12, Respiration, for more information).	• Select **ON** to enable respiration monitoring. • Select **OFF** to disable respiration monitoring.
Relearn	Creates a reference template based on identification of dominant QRS pattern **NOTE**: This function is ghosted when the monitor is not processing ECG signals.	Select **Relearn** to initiate a relearning process (see chapter 9, Arrhythmia Monitoring, for more information about relearning a reference template).

Status Messages

Message	Definition and/or Possible Cause	Suggested Action
HR > # *HR < #*	The patient's heart rate is outside the current alarm limits.	• Check the patient and treat, if necessary. • Change the alarm limits.
HR Out of Range (High)	The patient's heart rate is outside the upper measurement range (300 bpm).	Check the patient and treat, if necessary.
LA Lead OFF *LL Lead OFF* *RA Lead OFF* *RL Lead OFF* *V+ Lead OFF* *Chest Lead OFF*	A lead-off condition was detected for the indicated lead. The cause could be one or more of the following: • Broken cable • Loose lead wire • Faulty lead wire • Wrong lead • Dried out gel on electrode(s).	• Inspect and replace defective cables and wires. • Reapply gel on disposable electrode(s). • If a lead or electrode cannot be replaced, select another ECG lead for processing. • If monitoring augmented leads, verify the number of leads selected in the menu.
ECG Artifact	• Patient movement, shivering, tremors • Bad electrode contact • Excessive signal noise • Interference from auxiliary equipment	• Calm the patient. • Check the electrodes and reapply, if necessary. • Make sure the patient's skin is properly prepared. • Isolate the patient from auxiliary equipment, if possible.
Collecting ECG Waveforms	The monitor has begun a 10-second capture of Rest ECG waveforms.	Instruct the patient to lie still.
ECG Leads Invalid	• The QRS processing leads are invalid for > 10 sec. • Bad electrode contact or faulty lead set • Unplugged lead set • The wrong cable type was selected on the ECG Lead setup menu (see page 8-21).	• Inspect and replace defective cables and wires. • Reapply gel on disposable electrode(s). • If a lead or electrode cannot be replaced, select another ECG lead for processing. • Verify that the number of leads selected in the ECG Lead Setup menu matches the applied lead set (see page 8-21).
ECG Report Server Busy-Try Later	The Infinity CentralStation is currently processing a report.	Wait a few minutes, then try again.
ECG H/W Failure	An ECG hardware failure was detected by an 1 mV test at startup.	Contact the hospital's technical personnel or DrägerService.
MultiMed Pod Disconnected	The MultiMed pod is not connected to the monitor during 3, 5, or 6-lead monitoring.	• Check the cables and connection; replace cables, if necessary. • If the MultiMed pod is not in use, press the **Alarm Silence** fixed key.

9 Arrhythmia Monitoring

Overview

Arrhythmia monitoring is available for adult and pediatric patients. The mode you select (Full, Basic, or OFF) determines the events processed. Full arrhythmia is a locked option which must be activated by your hospital's technical personnel. Arrhythmia monitoring is not available for neonates. Arrhythmia monitoring is only available for adult and pediatric patients.

The monitor matches incoming beats against beats previously recorded and stored in a reference template. Through this process, the monitor can verify an arrhythmia event's occurrence, classify it, and draw clinically useful conclusions based on the frequency and morphology of the signal. The monitor considers all beats questionable if a baseline shift exceeds specified limits.

WARNING: Do not rely solely on ECG with seizure-prone patients. Electrical artifacts of non-cardiac origin, such as seizure, may prevent detection of certain arrhythmias.

NOTE: Arrhythmia detection may not work properly in all patients. Refer to Chapter 8, ECG and Heart Rate, for QRS detection threshold requirements. An artifact condition (ARTF) may occur when the ECG signal does not meet these minimums. While continuing to monitor HR, you can turn off ARR monitoring for patients whose QRS complexes do not meet these minimums.

The monitor uses the results of QRS processing for arrhythmia analysis. During multiple-lead arrhythmia processing, each lead's QRS complexes are measured and compared against its learned dominant normal beat. The monitor classifies beats based on information acquired from all available leads.

About the Arrhythmia Template

After you connect ECG cables to the patient, the monitor begins to learn that patient's reference template based on its identification of the patient's dominant QRS pattern. While the monitor is in the learning phase, all arrhythmia alarms and trend collection, except for ASY/VFIB, are suspended. The abbreviation *LRN* appears in the parameter box, and the message, *ARR Relearning* appears in the local message area. This learning phase normally takes 30 to 40 seconds. If the monitor detects more than 100 QRS complexes and less than 16 matching beats, it displays the message *Unable to learn*. However, the monitor continues trying to learn the patient's dominant QRS pattern.

Once the patient's reference template is learned, the monitor removes the learning messages and initiates arrhythmia alarms and trend collection. Subsequent individual beats are classified by comparing them to the patient's learned reference template. In the third and final phase of arrhythmia processing, the monitor compares sequences of valid beats with the template.

Beat and Rhythm Classification

Beat classification refers to the analysis of individual beats. If a new beat's features do not match those of the reference template, the new beat is classified as abnormal, paced, or questionable. The monitor uses all detected beats to calculate the heart rate, eliminating questionable beats from arrhythmia classifications.

Rhythm event classification refers to the analysis of sequences of beats. The monitor compares the sequence of the last eight beats with the sequences stored in the monitor's memory. If it detects two or more events simultaneously, the monitor uses the arrythmia event priority to determine which alarm condition to initiate.

The following table describes available event and beat classifications. Items in this table are ordered based on their event priority:

Label	Event and Beat Classification
ASY	Asystole: 4 seconds pass without the detection of a valid QRS complex
VF	Ventricular Fibrillation: The monitor identifies a sinusoidal waveform with fibrillation characteristics$_1$
VT	Ventricular Tachycardia: N or more PVCs are detected in a time interval T = (60 * (N - 1)) / R, where N is defined as the VT count and R is defined as the VT rate$_{1,2}$
RUN	Ventricular Run: Series of 3 to N-1 consecutive PVCs with a beat-to-beat rate ≥ the VT rate$_{1,2}$
AIVR	Accelerated Idioventricular Rhythm: Series of 3 or more PVCs with a rate less than the VT rate$_2$

Label	Event and Beat Classification
SVT	Supraventricular Tachycardia: N or more consecutive normal beats, with a beat-to-beat rate greater than or equal to the SVT setting
CPT	Ventricular Couplet: Sequence of beats with the pattern: normal, PVC, PVC, normal
BGM	Ventricular bigeminy: Sequence of beats with the pattern: normal, PVC, normal, PVC, normal
TACH	Sinus Tachycardia: N or more consecutive normal beats, with a beat-to-beat rate ≥ TACH rate setting [2,3]
BRDY	Sinus bradycardia: 8 or more consecutive normal beats, with an average rate ≤ sinus bradycardia rate setting [2] **NOTES**: • When in neonatal mode, bradycardia is a high heart rate alarm. • Brady Alarm (neonate only), which is a high alarm, can be configured independently of the HR alarm, which is a medium priority alarm.
PAUS	Pause: Sequence of two beats classified as normal or PVC, with interval ≥ pause rate value in seconds (±100ms)
ARTF	Artifact: More than 50 % of beats in the last minute classified as questionable

[1]Certain ventricular tachycardias have sinusoidal waveforms closely resembling those of ventricular fibrillation. Because of the similarity of these waveforms, the monitor may classify such types of ventricular tachycardia as ventricular fibrillation, the more serious of the two conditions.

[2] "N" is the event count set in the Arrhythmia setup table's count column.

[3]A PVC or other abnormal beat breaks the analysis sequence and restarts analysis.

Automatic Learning and Relearning

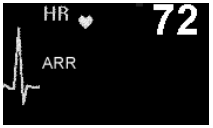
After you connect ECG cables to the patient, the monitor begins to learn a reference template whenever you execute any of the following tasks:

- Turn on the monitor
- Exit standby mode
- Click on ECG Relearn
- Change **ARR Monitoring** or **QRS/ARR Select**
- Change the top-channel lead (ECG 1), or change the ECG2 channel lead during ECG1&2 processing
- Change a 12-lead configuration
- Reattach a processing lead

Arrhythmia Setup

Modes (Full, Basic, OFF)

As shown in the following table, the monitor reports certain arrhythmia events even if you set **ARR Monitoring** to **OFF**. **Basic** arrhythmia mode allows you to expand the list of events reported. When **ARR Monitoring** is set to **Full**, the monitor reports all available arrhythmia events.

ARR Mode	Available Display Parameters	Parameter box
OFF (See WARNING below)	• ASY (asystole) • VF (ventricular fibrillation) • ARTF (artifact)	
Basic	• ARR (label to register arrhythmia occurrence) • ASY (asystole) • VF (ventricular fibrillation) • ARTF (artifact) • VT (ventricular tachycardia)	
Full	• All arrhythmia events (See page 9-3 for a complete list.) • PVC (premature ventricular contraction)	

You can configure the monitor to process arrhythmia according to the number and variety of events you wish to observe.

1. Click on the ECG parameter box to display the ECG menu.
2. Click on **ARR Monitoring**.

WARNING: When HR alarms are disabled and ARR monitoring is turned off, the monitor cannot generate ASY/VF alarms. To restore this ability, set ASY/VF alarms to "Always ON" (see page 2-18).

3. Scroll through the available settings (**Basic, Full**, or **OFF**) and click to verify your selection.

NOTE: If Full monitoring is installed as a locked option, you can select **Full**, **Basic,** or **OFF**. If not, the choices are **Basic** and **OFF**.

Channel - Lead Selection

Appropriate lead selection is essential for accuracy in arrhythmia monitoring. Ideally, you should assign the two best leads to the top two channels on the monitor. See page 8-20 for more detailed information.

Processing options are:

- ECG1 (single-channel option) – Dedicates processing to the lead that occupies the highest ECG channel position on the monitor screen.
- ECG 1 & 2 (dual-channel option) – Instructs the monitor to determine heart rate and arrhythmia based upon the two ECG leads on display (default: II and V).

To configure the monitor for single- or dual-channel monitoring

1. Click on the ECG parameter box to display the ECG menu.
2. Click on **QRS/ARR Select**.
3. Select **ECG1** or **ECG1 & 2** and click.

Arrhythmia Setup Table

When the monitor is operating in Full arrhythmia mode, the ARR setup table allows you to configure arrhythmia monitoring according to your patient's needs. The monitor can detect all events listed in the first column of the table. Using the remaining columns, you can modify the attributes of each event. Fields that are not applicable for a certain event category are blank, while those that cannot be modified are ghosted.

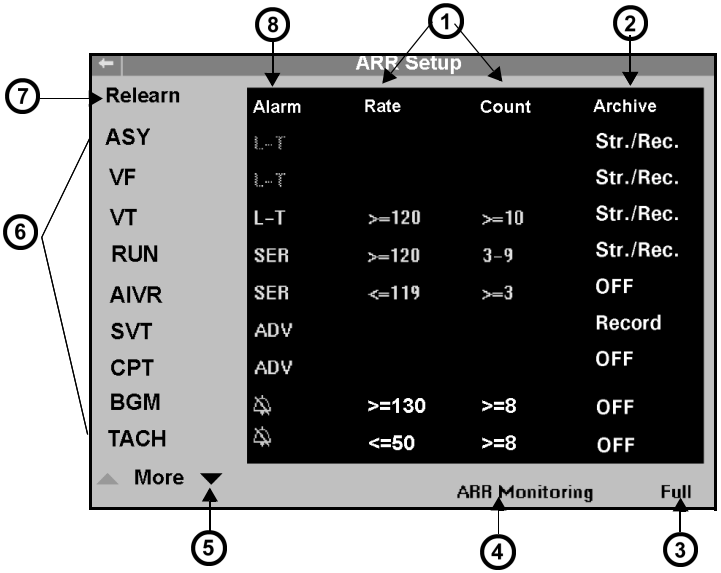
NOTE: The PVC/min current value is only displayed if the monitor is in Full arrhythmia mode. The PVC/min limit is set in the Alarm Limits table. Refer to chapter 5 for more information on setting alarm limits.

To access the ARR Setup table

- Click on the ECG parameter box on the main screen

or

1. Press the **Alarm Limits** fixed key.
2. Click on **ARR** at the bottom right of the Alarm Limits table. The Arrhythmia Setup menu appears.



1	Sets the rate and count
2	Stores or records events/alarms
3	Arrhythmia mode settings
4	Selects the arrhythmia mode
5	Accesses a second page
6	List of parameters
7	Initiates a manual relearn
8	Configures alarms

Modifying Arrhythmia Functions

1. Access the ARR setup table (see page 9-6).
2. Scroll to the parameter whose arrhythmia functions you wish to configure and click.
3. Scroll to the function you wish to modify (the first column, **Alarm**, is highlighted when you first click on a parameter).
4. Click to access settings of the selected arrhythmia function.
5. Dial through settings and click to confirm your selection.
6. Repeat steps 2 - 5 to configure additional arrhythmia functions or parameters.

Quick Reference – Arrhythmia Setup Table

Function	Description	Available Settings
Relearn	Initiates a relearn process. Dräger recommends that you perform a relearn under the following conditions: • A lead is reconnected or electrodes are repositioned. • Eight hours have passed since last reference complex learned. • Questionable arrhythmia calls appear on the patient's ECG. • Other significant changes appear on the patient's ECG.	To learn or relearn the template: 1. Set **ARR Monitoring** to **Basic** or **Full.** 2. Verify the quality of the ECG signal. 3. Check that the patient's ECG displays a normal reference pattern. 4. Click on **Relearn** to begin a new learning phase.
Alarm	Sets the alarm priority (see page 5-4) for an arrhythmia event. **NOTE**: Settings for Asystole (ASY) and Ventricular Fibrillation (VF) cannot be modified.	• **High** • **Medium** • **Low** • (off)
Rate	Together with the count, the rate determines the point at which an event call is triggered **NOTES**: • You cannot modify the rate for the following parameters: ASY, VF, CPT, BGM or ARTF. • RUN and AIVR cannot be modified because their settings derive from VT. They are included to quantify their derivation, based on current VT values.	• **VT**; 100 to 200, increments of 10 • **RUN**; Same as VT Rate • **AIVR**; $\leq VT_{Rate}$ - 1 • **SVT**; 120 to 200, increments of 10 • **TACH**; 100 to 200, increments of 10 • **BRDY**; 30 to 105, increments of 5 • **PAUS**; 1.0 to 3.5s, increments of 0.5s
Count	Together with the rate, the count determines the point at which an event call is triggered **NOTES**: • You cannot modify the count for the following parameters: ASY, VF, CPT, BGM or ARTF. • RUN and AIVR derive their settings from VT and therefore cannot be modified. They are included in order to quantify their derivation, based on current VT values.	• **VT**; 5 to 15, increments of 1 • **RUN**; 3 to VT_{Count} - 1 • **AIVR**; Count ≥3 • **SVT**; 3 to 10, increments of 1 • **TACH**; 5 to 15, increments of 1 • **BRDY**; not applicable • **PAUS**; not applicable

Function	Description	Available Settings
Archive	Determines whether the selected event is stored, recorded, or both. You can view stored events on the Event Recall screen (see page 1-27). **NOTE**: The archive function for ASY (Asystole) and VF (Ventricular Fibrillation) cannot be disabled.	• **Store**; stores the selected event • **Record**; generates an alarm recording of selected event • **Str./Rec.;** stores an event and generates an alarm recording (even when event alarm is turned off) • **OFF**

Status Messages

Message	Event Definition	Suggested Action
PVC/min > UL	The PVC/min value is above the upper alarm limit.	Check the patient.
Cannot Learn Lead <X>	At the end of the Learning phase, the dominant normal complex could not be determined for Lead <X> (one of the two leads selected for QRS processing). Arrhythmia analysis proceeds using the other lead as a source. Lead <X> is ignored until a *Relearn* is initiated.	• Check the leads. • Choose another lead for QRS processing.
Relearning	Monitor is learning a normal QRS complex as a reference template.	Not applicable
Unable to Learn	After 100 beats, monitor cannot determine the dominant normal complex on any lead selected for QRS processing. Learning continues.	Check the electrode preparation.
Baseline Artifact	Artifact is blocking arrhythmia classification.	Check the electrode preparation.

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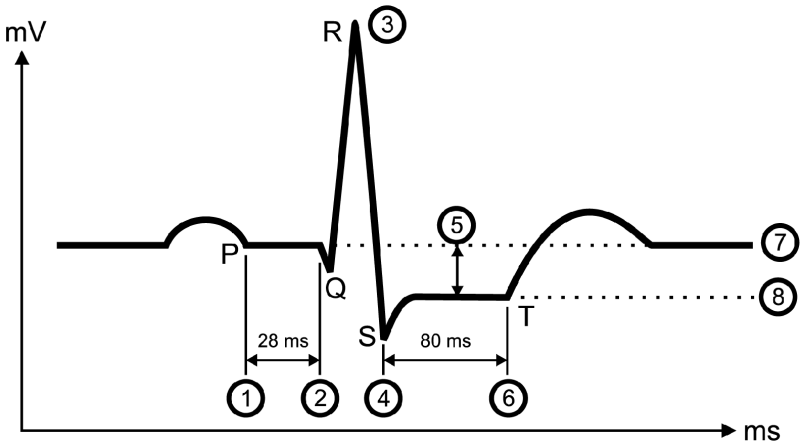
10 ST Monitoring

Overview

ST segment deviation is defined as the displacement (in mm) above or below the isoelectric level. The measurement of deviation compares the isoelectric point to the ST measurement point.

The isoelectric point defines the point of zero voltage (no electrical activity, 0 mm) with a default position of 28 ms before the onset of the QRS complex on the horizontal (time) axis. The ST point occurs in the ST segment between the QRS offset (J point) and the T-wave, at a default position of 80 ms after the QRS offset. The following figure illustrates a typical QRS complex.



1	Isoelectric point (Default = 28 ms before QRS onset)	**5**	ST deviation
2	QRS onset	**6**	ST measurement point (Default = 80 ms after QRS offset)
3	Fiducial point	**7**	Isoelectric level
4	QRS offset	**8**	ST level

The ST analysis feature examines QRS complexes classified as “normal” beats from up to twelve selected ECG leads. The monitor learns each ST lead, combining the measurements and features of normal beats into a composite (or average) QRS complex. It derives the ST segment deviation from this average. When ST monitoring is enabled, current ST values are trended and can be reviewed on the trend display.

NOTE: After power up of the monitor and before start of ST monitoring, a manual relearn is needed in order to start displaying the ST values in the parameter box and trends.

MultiMed Pods for ST Analysis

Six-Lead ST Monitoring

The MultiMed 6, MultiMed Plus, or MultiMed Plus OR cables supports two chest leads (V and V+). Six-lead ST monitoring is almost as accurate as 12-lead monitoring, without some of the difficulties of electrode placement and management associated with 12-lead monitoring.

TruST Twelve-Lead ST Monitoring

Infinity TruST is a Twelve-lead ECG obtained through the MultiMed 6-pod. TruST twelve-lead ST processing requires installation of 12-lead Rest ECG (ARIES S/W) software option. TruST allows you to view the same number of leads as a six-lead monitor with an additional four TruST leads. For more information, see 8-11.

Twelve-Lead ST Monitoring

Twelve-lead ST processing requires installation of 12-lead Rest ECG software option for up to six chest leads (V_1 to V_6) via the MultiMed 12 pod. Twelve-lead display and QRS processing alone do not require this software option.

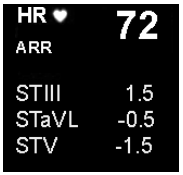
WARNING: The NeoMed and MultiMed 12 pods are not intended for use during electrosurgery. To protect patients from burns, do not use these pods in an ESU environment. See the section entitled "Safety Considerations" on page 8 in these Instructions for Use for other important safety precautions.

Twelve-lead ST monitoring, available for adult and pediatric patients, enhances the accuracy of ST parameters. During 12-lead ST monitoring, the monitor trends all twelve ST leads plus ST Vector Magnitude (STVM) and ST Change in Vector Magnitude (STCVM):

- STVM is the magnitude (mm or mV) of the ST vector (the ECG vector at the ST measurement point). A combination of the ST deviation values from all twelve leads, it measures the ST level throughout the heart. STVM is, therefore, a summary vector and a single parameter which can alert the clinician of a change in ST level somewhere in the heart. It is trended and has its own alarm limits.
- STCVM is the change of magnitude (mm or mV) between the current ST vector and the ST vector at the time of the last reference. STCVM values also show a change in the location of the ST vector over time.

NOTE: If ARIES software is installed, the monitor may generate an ST alarm for leads that are not displayed in the ST parameter box (see page C-8).

ST Display



When ST monitoring and ECG monitoring are enabled, the ST parameter box appears just below the HR parameter box on the main screen.

You can enable and disable ST monitoring on the ST Analysis menu or ECG setup menu (page 8-19). ST deviation values are displayed in the same format as strip recordings, where 1 millimeter (mm) on the grid corresponds to 0.1 millivolt (mV).

ST Analysis Setup

The ST analysis menu allows you to execute most of the functions involved in analyzing the ST segment.

To open the ST Analysis menu

- Click on the ST parameter box (if displayed),

  or

1. Press the **Menu** fixed key on the front of the monitor.
2. Click on **Patient Setup**.
3. Click on **Parameters**. A list of available parameters appears.

NOTE: ST does not appear in the parameter list if ST monitoring has been disabled.

4. Click on **ST**.

Quick Reference: ST Analysis Menu

Menu Item	Description	Settings
ST Monitoring	Enables/disables ST monitoring. **NOTE**: **ST Monitoring** is ghosted if ECG is disabled.	• **ON** • **OFF**
ST Lead1 **ST Lead2** **ST Lead3**	Selects up to three ECG leads as sources for ST analysis and display in ST parameter box, **NOTE**: All ST leads are monitored if ARIES software is installed.	**None, I, II, III, aVR, aVL, aVF, V[1], V+[1], V1[1], V2, V3[1], V 4[1], V5, V6[1], dV1[2], dV3[2], dV4[2], dV6[2], VM, CVM**
ST Mini Trend	Displays up to one hour of trended ST data in mini-trend graphs on the left side of the main screen. **NOTE**: See page 6-7 for detailed information about mini trends.	**None, STI, STII, STIII, STaVR, STaVL, STaVF, STV[1], STV+[1], STV1, STV2, STV3, STV4, STV5, STV6, STdV1[2], STdV3[2], STdV4[2], STdV6[2], STVM, STVCVM**
Relearn	• Purges stored average S-T complexes. • Blanks average S-T complexes currently displayed on the Measuring Points screen. • Learns the patient's arrhythmia and dominant QRS rhythm. • Identifies the new dominant QRS complex.	**NOTES**: • New complexes are displayed on the Measuring Point screen (see page 10-6). • **Relearn** is also accessible from the ECG and ARR setup menus. • All Relearn operations are stored in the trends database. Markers on the trend displays indicate when a Relearn operation occurred.
Show All Leads	Displays the waveforms of all connected ECG leads, as well as TruST leads **NOTE:** Also accessible from the **Main** menu/**Review** submenu and from the **All ECG** fixed key on the remote keypad).	When the Show All Leads screen is displayed: • Leads are displayed on a single "page" except for 12-lead monitoring leads (including TruST leads), which are displayed six each on two pages. • Parameter box display, alarm, and recording functions are not affected. • Rotary knob can only scroll **Show All Leads** menu items. • Parameter boxes are visible, but inaccessible.

[1]Selection unavailable/ghosted when TruST 12-Lead is set to **ON**.
[2]Selection unavailable/ghosted when TruST 12-Lead is set to **OFF**.

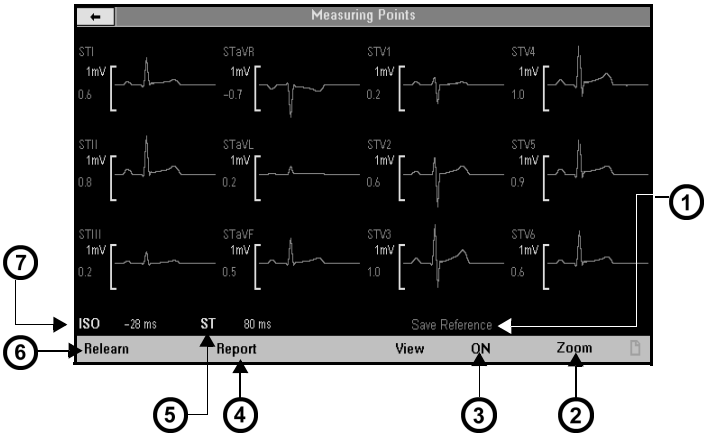
Menu Item	Description	Settings
Measuring Points	Displays the average S-T complex for each monitored ST lead, as well as TruST leads. **NOTE**: See page 10-6 for more information.	• **ISO;** changes the point that defines position of the isoelectric point. • **ST**; **c**hanges the point that defines position of the S-T measurement point. • Recalculates the QRS complex.
ST Alarms	Opens the ST Alarm Limits table.	See page 10-10.

Measuring Points

The Measuring Points Screen

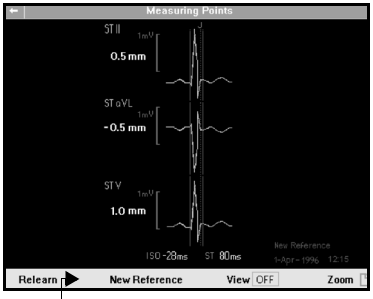
The starting and ending points for the QRS complex are automatically determined. In practice, however, the accurate determination of the isoelectric and ST measuring points requires careful clinical evaluation. On the Measuring Points screen, accessible via the ST Analysis menu (page 10-4), you can change the isoelectric and ST measuring points to achieve an accurate ST deviation measurement.

Measuring Points Screen (12-Lead)



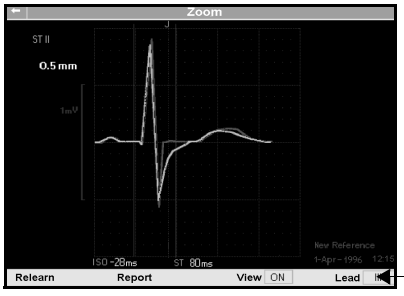
1	Saves displayed S-T complexes as reference
2	Displays individual leads in large format
3	Superimposes reference S-T complexes over current S-T complexes Color code: Reference = magenta; current = green
4	Generates ST report (with S/W ARIES software only)
5	ST measuring point (current value)
6	Recalculates the QRS complex
7	Isoelectric measuring point (with current value)

Measuring Points Screen (3-Lead)



Create reference template

Large Format (Zoom) Screen



Dial to the desired ST lead and click

Changing the ISO and ST Points

When you change the ST and ISO measuring points on the Measuring Points screen, the monitor recomputes the ST deviation value accordingly (see page 10-9 for directions on changing the ST and ISO points). During this procedure, the changing ST deviation values are displayed in yellow beneath the current values, which appear in green. At the bottom of the screen, the placement of the ISO measuring point (in milliseconds) before QRS onset is displayed next to the label 'ISO', while the placement of the ST measuring point (in milliseconds) after QRS offset is displayed next to the label **ST**.

NOTE:

- It is good clinical practice to check the position of the isoelectric and ST measuring points before starting ST monitoring.
- After a Relearn is complete, the QRS onset and offset are locked until you initiate another Relearn.

On all trend displays, markers indicate changes in the placement of measuring points as well as Relearn operations. The labels 'CHG' (Change) and 'LRN' (Relearn) appear in time-stamped columns in the Trend Table and in the ST Trend Graphs. Also in the Trend Graphs, a solid white vertical line in the ST trend graphs marks the time of a measuring point change, while a dotted vertical line marks the time a Relearn operation was initiated. Use the cursor to pinpoint the time of marked changes and Relearn operations (see page 6-3 for instructions on using the cursor in trend graphs).

NOTE: See page 9-4 for information about events and procedures that automatically trigger a relearning period.

The following table describes procedures for changing the ISO (isoelectric) and ST points on the Measuring Points screen:

Changing the isoelectric measuring point	Changing the ST measuring point
1. Click on **ISO** to highlight the position of the current ISO measuring point (in milliseconds). The vertical ISO line changes to yellow. 2. Use the rotary knob to move the vertical ISO line along the horizontal axis. As you move the line, the value (also in yellow) changes. The changing ST deviation values are displayed in yellow beneath the current values. 3. When you reach the desired position on the average S-T complex, click to confirm the new ISO measuring point. • The vertical line and the ISO value change from yellow to white. • For each average S-T complex displayed, the value (in millimeters) for ST deviation changes to reflect the new ISO measurement point. • In the ST Measurement Point menu the line and values are removed. • In the Zoom menu, the line changes from yellow to white but not the value, the yellow value is removed.	1. Click on ST to highlight the position of the current ST measuring point (in milliseconds). The vertical ST reference line changes to yellow. 2. Use the rotary knob to move the ST vertical line along the horizontal axis. As you move the line, the ST value (also in yellow) changes. The changing ST deviation values are displayed in yellow beneath the current values. 3. When you reach the desired position on the average S-T complex, click to confirm the new ST measuring point. • The vertical line and the ST position value change back from yellow to white. • For each average S-T complex displayed, the value (in millimeters) of ST deviation changes to reflect the new ST measuring point. • In the ST Measurement Point menu the line and values are removed. • In the Zoom menu, the line changes from yellow to white but not the value, the yellow value is removed.
The ISO and ST labels are ghosted if no ST complex is valid. The ST parameter box displays the new ST deviation value after changes are completed.	

ST Alarms Table

The ST Alarms table allows you to modify the alarm limits of multiple ST parameters in a single location. ST alarms are subject to the same alarm guidelines as other parameters (see chapter 5). In addition, control keys at the bottom of the screen allow you to execute the following alarm functions at the ST alarm table:

Menu Item	Description	Settings
Auto Set	Changes the upper and lower limits (mm or mV) for all active ST leads **NOTE**: The main Alarm Limits menu's Auto Set feature also uses this calculation to adjust alarm limits of active ST parameters (see page 5-16).	• Upper alarm limit Current value + 2mm (or 0.2mV) • Lower alarm limit Current value - 2mm (or 0.2mV)
Event Duration	Determines the time that a potential alarm condition must persist on ST leads before the monitor classifies it as a valid alarm condition	• **OFF, 15, 30, 45, 60 s**
Relearn	Initiates a Relearn of the QRS template (see page 10-5).	Not applicable

To access the ST Alarms setup table

1. Press the **Alarm Limits** fixed key on the front of the monitor.
2. Click on the **ST** control key at the lower right of the screen.
3. Follow the guidelines for modifying alarm limits on page 5-8.
4. Use the control keys at the top of the parameter list (**Auto Set**) and bottom of the screen (**Event Duration**, **Relearn**) to perform other ST alarm functions.

Status Messages

Message	Possible Cause	Suggested Action
ST <x> Out of Range High *ST <x> Out of Range Low*	The ST algorithm has calculated values ±15 mm (or ±1.5 mV) outside the high or low end of the ST measurement range.	• Check the isoelectric and ST measuring points. • Observe the patient and treat if clinically indicated.
Cannot Analyze ST	The monitor cannot determine ST values because of the following conditions: • Absence of normal beats • Artifact	• Perform a relearn. • Calm the patient. • Check electrodes; re-apply, if necessary. • Make sure that the patient's skin is properly prepped. • Isolate the patient from auxiliary equipment if possible.
ST <x> > <#> *ST <x> < <#>*	The ST value is outside the upper or lower alarm limit.	• Observe the patient carefully and treat if clinically indicated. • Change the alarm limits.
ST <x> Lead Invalid	Bad electrode contact or faulty lead wire.	• Inspect and replace defective cables and wires. • Reapply gel on reusable electrode(s). • Reapply electrodes. Make sure the patient's skin is properly prepped. • If a lead or electrode cannot be replaced, select another ST lead for processing.
Cannot Derive STVM *Cannot Derive STCVM*	• At least one of the 12 leads is disconnected. or • STVM was invalid at the time the reference value was saved.	• Inspect and replace defective cables and wires. • Reapply gel on reusable electrode(s). • Reapply electrodes. Make sure the patient's skin is properly prepped. • STCVM: Do a Save Reference.
MultiMed 12 Pod Disconnected	The MultiMed 12 pod is not connected to the monitor during 12-lead monitoring.	Check the cables and the connection; replace the cables, if necessary. **NOTE:** Not supported when TruST is enabled.
MultiMed Pod Disconnected	The MultiMed pod is not connected to the monitor during 3, 5, or 6-lead monitoring.	• Check the cables and the connection; replace the cables, if necessary. • If the MultiMed pod is not in use, press the **Alarm Silence** fixed key.

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11 EEG Monitoring

Overview

When used with the EEG pod, the monitor measures up to four EEG signals. Each EEG waveform has its own parameter box, and each parameter box displays up to three selectable parameters. EEG parameters can be trended, printed, and displayed on a central station.

Each EEG lead is a differential measurement between two electrodes (positive and negative). For example, a lead label of Fp-Cz means the positive electrode is at the Fp site and the negative electrode is at the Cz site.

NOTE:

- "EEG pod H/W Failure" message appears if the EEG pod software and the monitor software are not compatible.
- The EEG pod is intended for use with surface electrodes only.
- The **Test Pulse** feature on the Biomed menu (see chapter 2) allows your hospital's technical personnel or DrägerService to confirm the accuracy of EEG signals.

Precautions

NOTE:

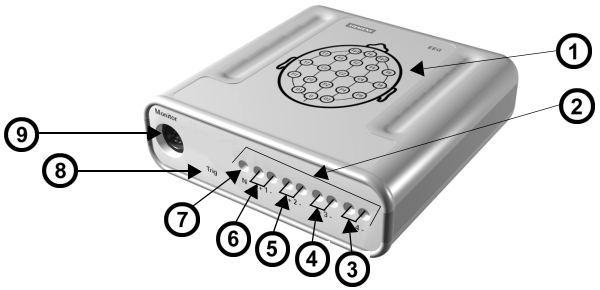
- EEG parameters do not alarm.
- EEG channel 1 is required for EEG monitoring to occur.

The following precautions apply to EEG monitoring during electrosurgery:

- Place EEG electrodes above the mastoid bone.
- Do not perform electrosurgery above the mastoid bone.
- Caution simultaneous use of other patient connected equipment that apply electrical potentials to the patient may cause interference on EEG signals. Change filter settings to minimize interference or discontinue use of conflicting devices.

Connecting the EEG Pod

Connect the EEG pod to the monitor using the Hemo/Aux or Aux connector. For a complete list of Dräger EEG accessories available with this product, see page C-20.



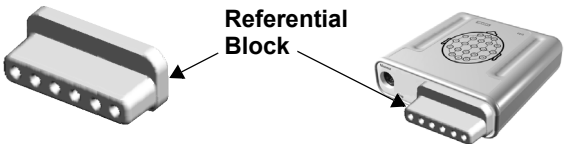
1	Lead diagram	**6**	Channel 1
2	Electrode connections	**7**	Neutral
3	Channel 4	**8**	“Trig” (area reserved for future use; not yet functional)
4	Channel 3	**9**	Cable to monitor
5	Channel 2		

Differential vs. Referential Measurement

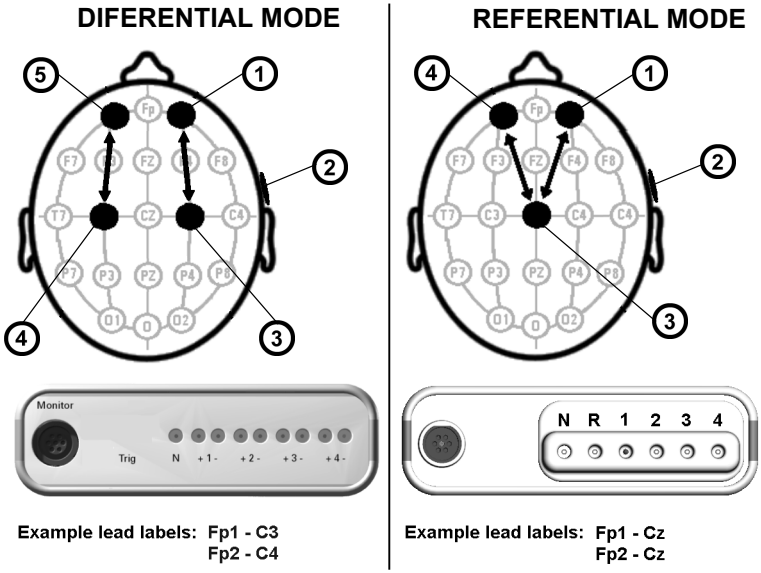
There are two modes of measuring EEG.

Differential mode uses two electrodes for each channel, measuring the differential between each pair. For example, channel one has a positive (+) and a negative (-) connection; channel two has a positive (+) and negative (-) connection; and so forth. The displayed measurement for channel one is the differential between the 1+ and the 1- electrode.

Referential mode uses one electrode for each channel, and all four channels share the reference (R) electrode. For example, channel one has a positive (+) connection; channel two has a positive (+) connection; and both share the same reference connection. Use the referential block, which fits onto the front of the EEG pod as shown in the following illustration, to monitor EEG in referential mode.



The following diagram compares differential and referential modes.



1	Channel 2+ electrode	**1**	Channel 2 electrode
2	Neutral electrode	**2**	Neutral electrode
3	Channel 2- electrode	**3**	Reference electrode
4	Channel 1- electrode	**4**	Channel 1 electrode
5	Channel 1+ electrode		

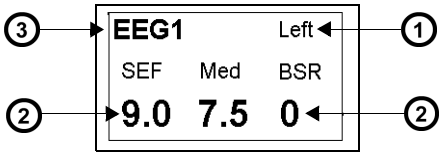
In differential mode, each channel (1, 2, 3, and 4) has two electrodes, a positive and a negative. In referential mode, all channels use the same reference electrode and only use one numbered electrode (positive).

EEG Setup

To display the EEG setup menu

1. Press the **Menu** fixed key to display the main menu.
2. Click on **Patient Setup**.
3. Click on **Parameters**.
4. Click on **EEG1**, **EEG2**, **EEG3**, or **EEG4**. The associated EEG menu appears.

You can display up to four EEG channels at the same time. All four EEG menus show the same settings for the various channels (EEG1, EEG2, EEG3, EEG4). The monitor displays each EEG waveform next to its respective parameter box (see page 2-5 for information about displaying parameter boxes). A typically configured EEG parameter box is shown below:

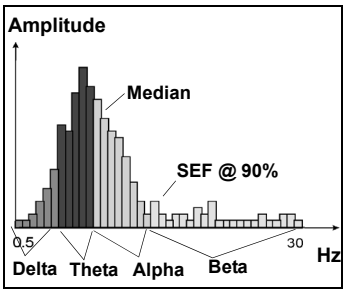


1	Lead label
2	Parameters with current values
3	EEG channel

Quick Reference – EEG Setup

The following table describes available EEG setup functions.

Menu Item	Description	Available Settings
Lead Label	Allows you to select a lead label according to the current measurement mode (differential or referential) – see page 11-4. **NOTE**: Proper skin preparation and careful electrode positioning are essential for reliable results in EEG monitoring. Follow the same recommendations as for ECG monitoring (see page 8-9).	You can select either a generic or a specific site label. If you select a specific site label, the cursor moves to the other half of the pair. Choose another site label and click to confirm. • Generic site labels: **None, Left, Right, Front, Back, Left Front, Left Back, Right Front, Right Back** • Specific site labels: **Fp, Fp1, Fp2, Fz, F3, F4, F7, F8, Cz, C3, C4, T7, T8, Pz, P3, P4, P7, P8, O, O1, O2** **NOTE**: Refer to the diagram on top of the EEG pod for site locations.
Size	Determines the amplitude of each EEG waveform.	• **5**, **10**, **25**, **50**, **100**, **250**, or **500 µV**
Size ALL	Determines the amplitude of all EEG waveforms simultaneously.	• **5**, **10**, **25**, **50**, **100**, **250**, or **500 µV**
EEG Channels	Allows you to display up to 4 channels for EEG monitoring.	• **1, 2, 3**, and **4**
EEG Options	Opens new menu with selections for EEG related settings. **NOTE**: See “EEG Options Submenu” below.	• **Parameter 1** • **Parameter 2** • **Parameter 3** • **EEG MiniTrend** • **SEF Setting** • **Low Filter** • **High Filter** • **Notch Filter** [1]Selection is grayed out if EEG pod is software version VE0.
Power Spectra	Shows frequency distribution data for channels selected on EEG setup menu.	Not applicable **NOTE:** The power spectra display consists of 4 histograms showing the frequency distribution for each channel, plus all 8 derived parameters for each channel.

Menu Item	Description	Available Settings
Check Impedance	Tests quality of EEG electrodes' connection to patient, allowing you to troubleshoot noisy EEG signals Impedance control is important when monitoring EEG, where the signal is hard to measure. A poor signal may be due to improper placement of the electrodes or poor patient preparation.	Not applicable **NOTES**: • The EEG Impedance menu classifies the status of each electrode connection as follows: **Disconnected**: Appears (for both of a channel's electrodes) if either of a channel's electrodes is disconnected or has an impedance value > 250 kOhms. **Cannot Measure**: Appears if the Neutral electrode is disconnected or if the channel 1 amplifier pair is open. • Always check impedance when applying electrodes. Recommended electrode value is < 5k ohms.
The EEG Options Submenu		
Parameter 1 **Parameter 2** **Parameter 3**	Allows you to select up to three parameters for display in the EEG parameter boxes All EEG channels display the same parameters. The figure below shows the median and spectral edge frequencies, as well as the distribution of the Delta, Theta, Alpha, and Beta frequency bands, as shown in the Power Spectra screen.  	• **Med** (Median) – Frequency at median point, where 50% of the energy lies above and below • **SEF** (Spectral Edge Frequency) — Frequency below which user-defined percentage of the power lies If **SEF** is set to 90%, 90% of the power lies (for example, if SEF is set to 90%, 90% of the power lies below the marked bar). • **BSR** (Burst Suppression Ratio) — Percentage of time the EEG waveform is flatlined over the last 60 seconds (when flatline EEG alternates with "bursts" of activity) • **Power** (Total Power) — Sum of total EEG energy (not the amount of power at each frequency) displayed in decibels (dB) • **Delta** (Delta Power) —Percentage of Total Power between 0.5 and 4 Hz (cycles per second) • **Theta** (Theta Power) — Percentage of Total Power between 4 and 7 Hz • **Alpha** (Alpha Power) — Percentage of Total Power between 8 and 13 Hz • **Beta** (Beta Power) — Percentage of Total Power between 13 and 30 Hz

Menu Item	Description	Available Settings
EEG Mini Trend	Allows you to select parameters for display in mini-trends (see page 6-7 for more information on mini-trend display)	1) Press the **Fast Access** fixed key. 2) Click on **Split Screen**. 3) Click on **10 Min Trends** or **60 Min Trends**. 4) Open the EEG menu as described on page 11-6. 5) Click on the setting of your choice: **Med, SEF, BSR, Power, Beta, Alpha, Theta,** or **Delta**
SEF Setting	Determines Spectral Edge Frequency (SEF**)** level	• **75, 85, 90, 95, 97, or 98 %**
Low Filter[1, 2]	Allows user to compensate for excessive baseline drift.	• **0.5 Hz** (Default) • **1.0 Hz**
High Filter[1, 2]	Allows user to compensate for electrical noise artifact.	• **15 Hz** • **30 Hz** (Default) • **Off**
Notch Filter[1, 2]	Allows user to compensate for power line noise artifact.	• **On** (Default) • **Off**

[1] Caution: Only qualified personnel should access Filter functions.
[2] Selection is grayed out if EEG pod is software version VE0.

Status Messages

Message	Possible Cause	Suggested Action
EEG Check Electrodes	An EEG channel has degraded, suggesting poor electrode contact.	Replace the electrodes.
EEG Pod Initializing	The EEG pod is warming up.	Wait until the pod has warmed up before attempting to measure.
EEG Pod Disconnected	The EEG pod is not connected to the monitor.	Check the cable and connection. Replace the cable, if necessary.
EEG Pod Software Failure	An EEG pod software problem has been detected.	Call your hospital's technical personnel or DrägerService.
EEG Pod Hardware Failure	Loss of communication or hardware problem detected.	• Check that the EEG pod software is compatible with the monitor software. • Check the EEG pod connection. • Call your hospital's technical personnel or DrägerService.

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12 Respiration

Overview

The monitor measures impedance respiration by passing a harmless high-frequency current between two ECG electrodes on the patient's chest. Electrical resistance (impedance) between the electrodes varies with the chest's expansion and contraction during inspiration and expiration. You can derive a respiration waveform and rate from these impedance changes.

The monitor can use ECG leads I or II for breath detection regardless of the lead selected for QRS processing. The measurement range for impedance respiration monitoring is 0 to 155 breaths per minute. The range for alarm settings is 5 to 150 breaths per minute. In neonatal and pediatric mode, the monitor can detect central apnea. Using the appropriate accessories, you can also monitor heart rate, SpO_2, and tpO_2/O_2* and display associated values on an oxycardiorespirogram (see page 12-9 for more information).

RESP Precautions

For general safety precautions regarding electrosurgery, see “Safety Considerations on page 8 of these Instructions for Use.

WARNING:

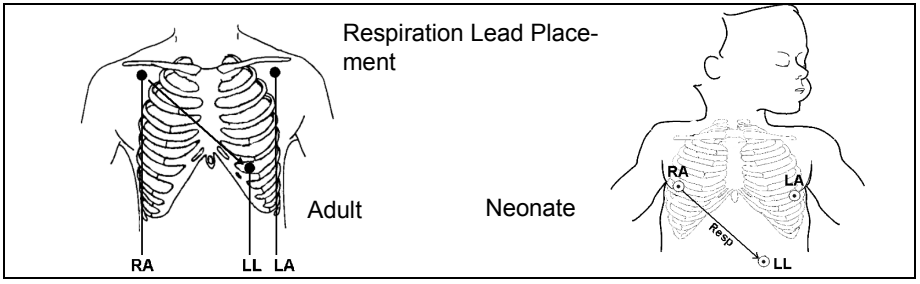
- **The safety and effectiveness of the respiration measurement method in the detection of apnea, particularly the apnea of prematurity and apnea of infancy, has not been established.**
- **This device does not monitor obstructive apnea. Patients at risk for respiratory crises should be observed closely.**
- **The monitor reports an apneic event when no breaths are reported within the established apnea time period. Therefore, do not rely on impedance respiration monitoring as the sole method for detecting cessation of breathing. Dräger recommends the monitoring of additional parameters that indicate the patient’s oxygenation status, such as $etCO_2$ and SpO_2. Heart rate limit alarms should also be enabled and set appropriately.**
- **While the ESU block or the MultiMed Plus OR cable is in use, impedance respiration monitoring is inoperative and the detection of pacemaker spikes could be compromised. If pacemaker detection is enabled, the ESU interference may be detected as pacemaker spikes.**
- **Large amplitude pacemaker pulses (100 mV or greater) may interfere with the monitor’s ability to measure or detect respiration.**

Patient Preparation

Proper skin preparation and careful electrode positioning are essential for reliable results in impedance respiration monitoring. Follow the same recommendations as those for ECG monitoring (see page 8-9).

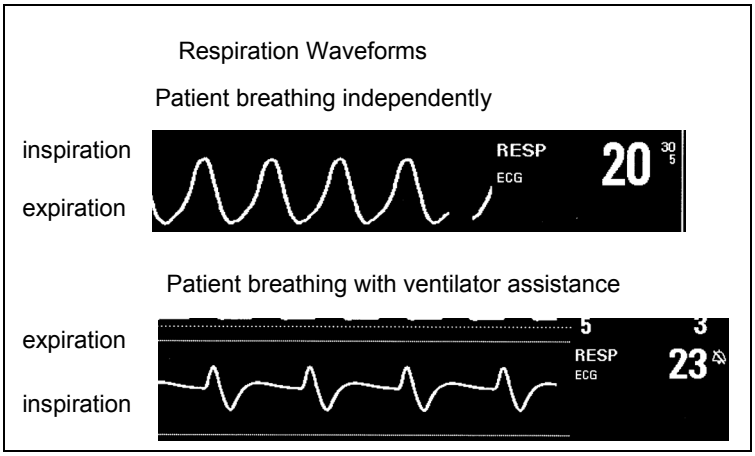
As a rule, place electrodes so that they generate the clearest possible signals with a minimum of artifact. Electrodes that adhere tightly and have a large conductive area give the best results. Use a 5-lead cable set (with RL as a neutral electrode) to improve the RESP signal. You may want to position the electrodes to span the maximum expansion and contraction of the lungs, especially in the case of deep abdominal breathers.

For neonates, place the RA and LA electrodes at nipple level, midaxillary line. Position the LL electrode below the diaphragm and umbilicus. Avoid the liver area and ventricles of the heart to prevent artifacts caused by pulsatory blood flow. The following figure illustrates the recommended placement of ECG leads for impedance respiration on an adult and a neonate:

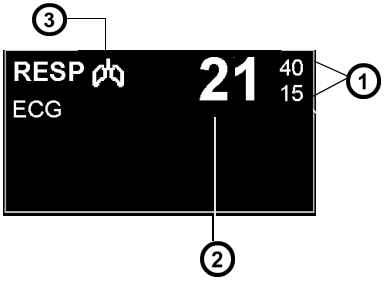


Display Features

Impedance changes are reflected in the respiratory waveform displayed to the left of the RESP parameter box. Waveform morphology differs depending on whether the patient is breathing with or without a ventilator, as shown below.



In the RESP parameter box, a lung symbol ( ) blinks whenever a breath is detected. The display of respiration alarms, alarm limits, and parameter values follows the standard display of other parameters.



1	Alarm limits
2	Respiration rate
3	Breath is detected

RESP Setup Menu

All impedance respiration functions are controlled from the RESP setup menu, which you can open in one of two ways:

To access the RESP setup menu

- Click on the **RESP** parameter box on the main screen

or

1. Press the **Menu** fixed key on the front of the monitor.
2. Click on **Patient Setup**. A list of available patient setup functions appears.
3. Click on **Parameters** in the second column. A list of available parameters appears.
4. Scroll to **RESP** and click to display the RESP setup menu.

Quick Reference Table – Respiration Setup

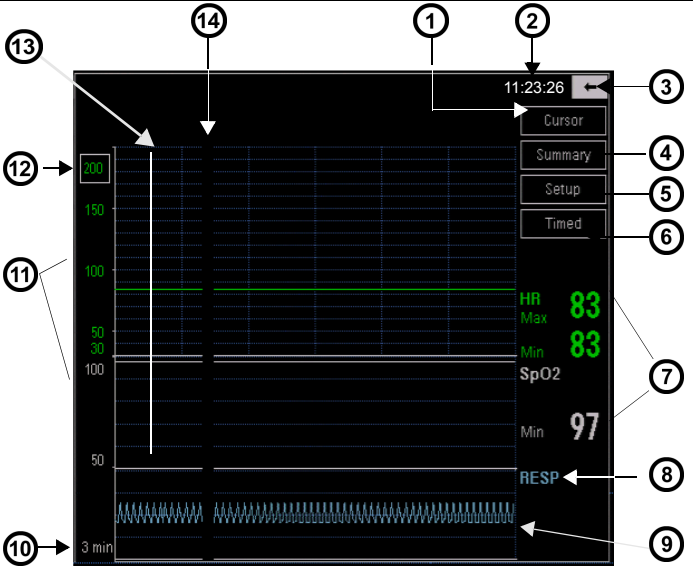
The Respiration Setup Menu		
Menu Item	**Description**	**Settings**
RESP Lead	Determines respiration lead	**I**, **II**
Mode	Determines processing mode for breath-related impedance changes **WARNING: If the respiration waveform size is set too low, shallow breaths may not be counted. If it is set too high, cardiac artifact will be counted as breaths. Therefore, always use the respiration marker to verify breath detection at the desired amplitude.**	• **Auto** – Optimal breath-detection threshold calculated at the beginning of RESP monitoring. Intended for patients with regular breathing patterns. • **Manual** – The monitor does not set a breath-detection threshold at the beginning of RESP monitoring. Instead, the adjustments you make to the waveform Size (see the **Size** setting, below) set the monitor's breath detection sensitivity. Intended for adult or pediatric patients whose breathing patterns show excessive variation; or for neonates whose breathing rhythms tend to be irregular, and whose respiration signals may not be reliably detected in **Auto** mode.
Size	**Auto** mode – Adjusts the waveform size. **Manual** mode – Adjusts the waveform size and the breath-detection threshold.	• **5 - 100 %** (in 5 % increments)

The Respiration Setup Menu		
Menu Item	**Description**	**Settings**
RESP marker	Superimposes a vertical line on the RESP waveform when the monitor detects a breath. If the monitor displays the RESP marker because of artifact or other interference, set the breath detection threshold to only count valid breaths: 1. Set the mode to **Manual**. 2. Enable **RESP Marker**. 3. Click on **Size.** 4. Set the Size value at the lowest value where the RESP marker appears. **NOTE**: • RESP markers are not transmitted over the network and do not appear on remote views or recordings. • The RESP marker indicates the time of breath detection, not the beginning or end of respiration.	• **ON** • **OFF**
Coincidence Detect	Identifies when the respiration rate is within 20% of the heart rate, indicating that the monitor may be counting heart beats as respiration. **WARNING: Respiration/heart rate coincidence could mask an apnea condition.** **NOTE**: Enable respiration alarms before setting Coincidence Detect to **ON**.	• **ON;** The *RESP Coincidence* message appears whenever respiration/heart rate coincidence is detected (default for Neonatal patient monitoring). • **OFF;** the monitor does not detect respiration/heart rate coincidence (default for adult and pediatric patient monitoring).
RESP Monitoring	Enables and disables respiration monitoring. This can also be done from the Main Screen and ECG setup menus (see pages 2-5 and 8-19).	• **ON** • **OFF**
Apnea Time	Sets the time the monitor waits before reporting a cessation of breathing as an apnea event and sounds an alarm.	• **OFF**, **10 s**, **15 s**, **20 s**, **25 s**, **30 s** **NOTE**: This feature is available in Neonatal and Pediatric patient mode only.
Apnea Archive	Allows user to store and/or record automatically an apnea alarm event. User can later review stored alarms on Event Recall screen.	• **OFF**, **Record**, **Store** (default), **Str./Rec**. **NOTE**: This feature is available in Neonatal and Pediatric patient mode only.

The Respiration Setup Menu		
Menu Item	**Description**	**Settings**
RESP Leads OFF Alarms	Configures the Alarm grade for RESP Lead OFF condition. NOTE: This menu will not be available when backwards compatibility is enabled.	• **LOW** (default) • **MED** • **HIGH**
Relearn	Learns the patient's respiration pattern when the **Mode** selection is set to **Auto** **NOTE**: Initiate a relearn if electrodes have been repositioned and/or if your patient's breathing pattern changes.	Not applicable **NOTE**: The selection **Relearn** is ghosted in manual mode.
RESP Alarm	Displays respiration alarms on the Alarm Limits table (see page 5-8).	Not applicable

OxyCRG (OCRG) Monitoring

The monitor can display an oxycardiorespirogram (OxyCRG, or OCRG) in neonatal mode. The OCRG displays three or six minutes of a continuously updated beat-to-beat Heart Rate trend (bbHR), SpO_2 or tpO_2/O_2* trend, and respiration/$etCO_2$ waveform, as well as apnea events. The monitor continues to update main screen parameters, announce alarms, and initiate alarm recordings.



1	Activate cursor	**8**	Respiration/$etCO_2$ label (Apnea label appears when an apnea event occurs and is displayed.)
2	Cursor time	**9**	Respiration/$etCO_2$ waveform
3	Exit OCRG display	**10**	Time base
4	Display OCRG Review, Summary menu (see page 12-10)	**11**	Values at cursor time
5	Display OCRG Setup Menu (see page 12-12)	**12**	Scale
6	Trigger a timed recording of displayed parameters	**13**	Cursor
7	Current parameter values	**14**	Eraser bar

NOTE: When two tpO_2/CO_2 pods are connected, each displays a parameter box on the main screen. The labels of the second pod are marked by an asterisk (*), hence the parameter label tpO_2*. (For screen display, the tpO_2/CO_2 parameter label is sometimes shortened to tpO_2.)

To display the OCRG screen

1. Set the patient type to **Neonatal** (see page 2-5).
2. Connect SpO_2 sensors, HR leads, and respiration or $etCO_2$ leads.
3. Set the apnea time on the RESP menu (see page 12-7).
4. Press the **Fast Access** fixed key.
5. Click on **OxyCRG** to display the OCRG screen.

Scale

To change the bbHR scale

1. Using the rotary knob, highlight the value at the top left corner of the grid and click.
2. Dial to desired scale setting and click.

Values are shown in the following table (you can modify only the HR scale).

Parameter	Scale	Definition
bbHR	10-180 bpm (lowest setting) 130 - 300 bpm (highest setting)	Highest (max) and lowest (min) bbHR value over the last three minutes
SpO_2	50 -100 %	Lowest saturation value over last three minutes
tpO_2/ tpO_2*	30 - 110 mmHg (4 - 16 kPa)	Lowest tpO_2/tpO_2* saturation value over last three minutes

Cursor

When you click on **Cursor**, a vertical bar appears on the trend area of the screen, and cursor time is displayed in the upper right corner. The numbers on the left side of the screen no longer represent scale values, but rather parameter values at the time marked by the cursor. The monitor continues to display current (real-time) values on the right of the screen. When you move the cursor to the right or the left with the rotary knob, the cursor-time values and the cursor time are modified and displayed accordingly.

Review Summary Screen Overview

Use the Review Summary screen to view stored bradycardia, SpO_2, and apnea events. This screen also allows you to access data associated with each event. The monitor stores up to 75 total events, but only retains associated data from the 50 most recent OCRG events (new data overwrites the old).

When an OCRG trigger event occurs, an orange bar appears in the appropriate parameter graph on the OCRG Review Summary screen. Whenever an OCRG event occurs, the monitor automatically captures bradycardia, SpO_2, and apnea event data (if available). Event data associated with the trigger event appears in the other two rows (BRDY, SpO_2, or Apnea) color coded as follows:

- Bradycardia - green
- SpO_2 - white
- Apnea - blue

Accessing Review Summary Screen

To access the OCRG review screen

- Enter the alarm history table and click on quick access key **OxyCRG Review**.

or

- Click on the **Summary** button on the OCRG screen.

NOTE: The OCRG Review Summary screen does not time-out and does not update automatically. This screen remains displayed until the user removes it.To update the display, click the back arrow, then click the **Summary** button again.

.

1	Cursor
2	Button for scrolling to the right page by page
3	Cursor button
4	Horizontal scroll bar
5	Time interval setting
6	Button for scrolling to the left page by page
7	Time bar
8	Back arrow

Scrolling through OCRG data

You can scroll through data on the OCRG Review Summary screen in two ways:

Using the left or right arrow buttons:

1. Turn the rotary knob until the left or right facing arrows are highlighted.
2. Click the rotary knob to scroll through OCRG Review Summary data without blanking the data.

Using the horizontal scroll bar

1. Turn the rotary knob until the scroll bar is highlighted.
2. Click once.
3. Turn the rotary knob to update the time bar. This blanks the data until the end of the next step.
4. Once the time bar shows the time frame desired, click the rotary knob again and the data refreshes.

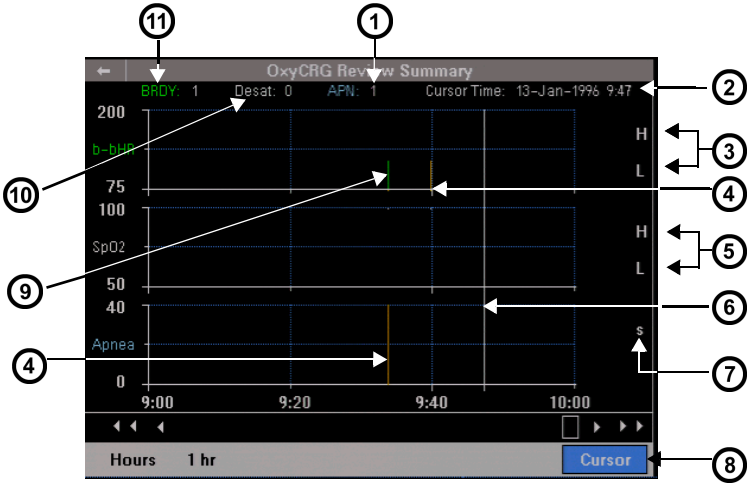
Time interval setting

To change the time interval scale on the time bar, use the Hours button on the OCRG Review Summary screen. Time intervals of 1, 2, 4 (default), 6, 12, or 24 hours are available.

1. Turn the rotary knob until the **Hours** button is highlighted.
2. Press rotary knob to click the **Hours** button.
3. the rotary knob to select time interval.
4. Click the rotary knob to update the screen to new time interval.

Using the cursor

To view the Event Recall menu, use the **Cursor** button on the OCRG Review Summary screen.



1	Number of apnea events for data on display	**7**	Apnea time
2	Cursor date/time	**8**	Cursor button
3	BRDY high/low values	**9**	Associated data (green)
4	Trigger event (orange)	**10**	Number of desaturation events for data on display
5	SpO_2 high/low values	**11**	Number of bradycardia events for data on display
6	Cursor		

To access the Event Recall menu from the OCRG Review Summary screen

1. Turn the rotary knob until **Cursor** button is highlighted.
2. Press the rotary knob to click **Cursor** button. The cursor and the cursor time appear on the screen.
3. Turn the rotary knob to move the cursor along the data graphed.
4. Move the cursor until it overlaps a trigger event. BRDY and SpO_2 high/low data (if available) is displayed. The apnea time (if available) appears.

5. Press the rotary knob to display the Event Recall menu for this event.

NOTE:

- An error tone sounds and the message *Event Data Not Available* appears if the event cannot be viewed. For more information on the Event Recall screen, see page 1-26.
- If you have difficulty displaying the trigger event with the cursor, set the time interval scale to a shorter time interval (see page 12-12).
- If the cursor is not overlapping an event, pressing the rotary knob cancels the cursor mode.

Quick Reference Table – OCRG Review Summary

The OCRG Review Summary Menu		
Menu Item	**Description**	**Settings**
Left Paging button (Double Arrows)	Scrolls left through the data without blanking the data.	Not applicable
Right Paging button (Double Arrows)	Scrolls right through the data without blanking the data.	Not applicable
Horizontal Scroll Bar	Turning the rotary knob moves a horizontal frame within the scroll window. This updates the **Time bar**, blanking data. Pressing the rotary knob after the time bar update restores review screen data.	Not applicable
Hours	Changes time interval for data on OCRG Summary screen. Press knob to select **Hours** button. Turn the rotary knob to select the time interval setting. Press the rotary knob again for new time interval data to display.	**• 1 min** **• 2 min** **• 4 min** **• 6 min** **• 12 min** **• 24 min**
Cursor	Displays **Cursor** and **Cursor date/time**. Turning the rotary knob moves the cursor. When the cursor rests on an event, press the rotary knob and the Event Recall menu appears for this event. If there is no data for the event, an error tone sounds, and the message *Event Data Not Available* appears.	Not applicable

OCRG Setup Menu

Settings for the second and third channel and the time base for the OxyCRG menu are controlled from the OCRG setup menu.

To Open OCRG Setup

1. Press the **Fast Access** fixed key.
2. Click on **OxyCRG** to display the OCRG screen.
3. Click the **Setup** button on the OCRG screen.

NOTE: The OCRG setup menu does not time-out. It remains displayed until the user removes it.

Quick Reference Table – OCRG Setup

The OCRG Setup Menu		
Menu Item	**Description**	**Settings**
Parameter 2	Displays a list of label choices for updating the second channel of the **OCRG** menu.	• **SpO2** • **tpO2** • **tpO2***
Parameter 3	Displays a list of label choices for updating the third channel of the **OCRG** menu.	• **RESP** • **etCO2**
Time	Displays **Time Base** choices. **NOTE:** Selecting **Time Base** displays the clinical password menu. The new **OCRG Time Base** takes effect after the password is entered.	• **3 min** • **6 min**

Second and Third Channel Label

You can set the second and/or third channel of the OCRG menu as follows:

1. Click the **Setup** button on the OCRG screen.
2. Click **Parameter 2** and select **SpO2, tpO2,** or **tpO2***.

or

3. Click on **Parameter 3** and select **RESP** or **etCO2**.

Time Base

You can select either a three minute or a six minute OCRG time base. The default time base is three minutes.

To change the OCRG time base to six minutes

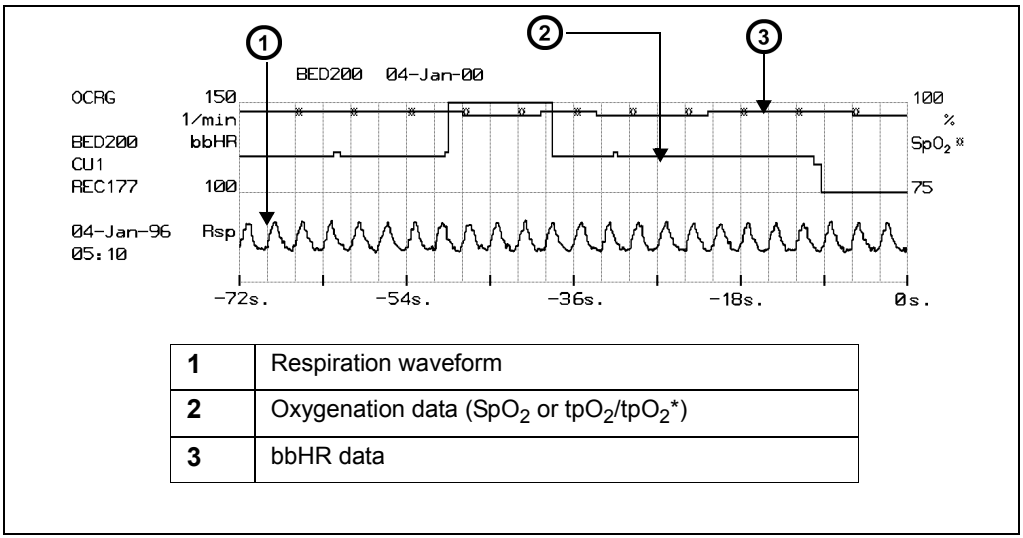
1. Click the **Setup** button on the OCRG screen.
2. Click **Time Base**.
3. Click on **6 min**.
4. Enter clinical password.

NOTE:

- The clinical password menu does not time out. It remains displayed until you click on **Accept**.
- After the clinical password is entered, the new OCRG time base takes effect and is displayed on the lower left of the OCRG menu.

Recordings

The monitor prints OxyCRG alarm and manual (timed) recordings only when the oxycardiorespirogram is displayed. If no recorder is connected, the monitor stores OxyCRG alarm recordings for later printing. For more information about manual and alarm recordings, see chapter 7, Recordings. The following illustration shows a typical OCRG recording.



1	Respiration waveform
2	Oxygenation data (SpO_2 or tpO_2/tpO_2*)
3	bbHR data

Status Messages

Message	Possible Cause	Suggested Action
RESP > #	The respiration rate is above the upper alarm limit.	• Check the patient and treat, if necessary. • Check the placement of electrodes. Change their position, if necessary. • Move the electrodes away from the source of interference.
RESP < #	The respiration rate is below the lower alarm limit.	• Check the patient and treat, if necessary. • Check the placement of electrodes. Change their position, if necessary.
RESP Out of Range (High)	• The respiration rate exceeds 150 breaths per minute. • The monitor may be counting artifacts as valid breaths. • The monitor may be counting interference caused by faulty equipment.	• Check the patient and treat, if necessary. • Check the placement of electrodes. Change their position, if necessary. • Move the electrodes away from the source of interference.
RESP Apnea (neonatal or pediatric mode only)	No respiration has been detected for <XX> seconds.	• Check the patient and treat, if necessary. • Check the placement of electrodes. Change their position, if necessary. • Carry out a RESP relearn. • Reset breath-detection sensitivity to manual mode.
RESP Coincidence	The patient's heart rate and respiration rate fall within 20% of each other.	• Observe the patient and treat, if necessary. • Check and change the electrode placement if you receive a coincidence message until you obtain a clear respiration signal.
RESP: Can't detect coincidence	• The RESP coincidence feature is enabled but there is excessive ECG artifact. • ECG leads maybe disconnected.	• Calm the patient. • Make sure the patient's skin is properly prepped. • Isolate the patient from auxiliary equipment. • Check the electrodes. Reapply gel or change the electrode, if necessary. • Inspect and replace defective cables and wires. • If a lead or electrode cannot be replaced, select another lead for processing (from the ECG menu).
RESP Signal Saturated	RESP signal detected by monitor has excessive baseline shift.	• Check the patient cable and lead wires carefully. • Replace any cable or lead wire that is suspect. • Reapply gel or change the electrode. • Check the MULTIMED pod and replace, if necessary.

Message	Possible Cause	Suggested Action
RESP Lead Off	The cause could be one or more of the following: • Broken cable • Loose lead wire • Faulty lead wire • Dried out gel on electrodes • MULTIMED pod defective	• Check the patient cable and lead wires carefully. • Replace any cable or lead wire that is suspect. • Reapply gel or change the electrode. • Check the MULTIMED pod and replace it, if necessary.
RESP Relearning	The user has turned on respiration monitoring or has clicked on Relearn.	None required
RESP Artifact	Persistent artifact	• Check the patient cable and lead wires carefully. • Check the electrode placement. Change their position, if necessary.
RESP H/W Failure	Not applicable	Call your hospital's technical personnel or DrägerService.

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13 Non-Invasive Blood Pressure

Overview

The monitor can acquire and process non-invasive blood pressure (NBP) signals and display the results. Blood pressure measurements are determined by the oscillometric method and are equivalent to those obtained by intra-arterial methods, within the limits prescribed by the Association for Advancement of Medical Instrumentation, Electronic Automated Sphygmomanometers (AAMI/ANSI SP-10). NBP can also be used during electrosurgery.

The monitor's NBP system inflates and then deflates a pneumatic cuff wrapped around the patient's arm or leg. A hose links the cuff to the monitor, which determines systolic, diastolic, and mean blood pressures for adult, pediatric, or neonatal patients. The monitor can initiate blood pressure measurements singly, at set intervals, or continuously over a 5-minute period.

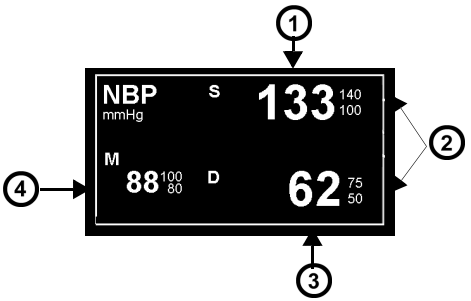
NOTE: NBP should be calibrated yearly by your hospital's technical personnel or other qualified personnel as described in the monitor's Service manual (see "Safety Considerations" on page 8).

The monitor can be configured to sound an attention tone whenever an NBP measurement is completed (see page 2-10 for information).

Display Features

The monitor displays non-invasive blood pressure in the form of numerical values and trends. There is no NBP waveform. For information on trended data, see chapter 6, Trends.

The NBP parameter box shows the latest readings for mean, systolic and diastolic pressure. See page 2-5 for more information on prioritizing and displaying parameter boxes.



1	Systolic pressure
2	Alarm limits (crossed bell icon if alarm is disabled)
3	Diastolic pressure
4	Mean pressure

NBP Setup

Safety Considerations

WARNING: Obstructions may cause the cuff to inflate and deflate improperly and result in inaccurate readings. Check the hose and cuff for damage and dirt. Do not allow the hose and cuff to come in contact with fluids, and make sure that they are not compressed or kinked.

Software and Hardware Cuff Pressure Cutoffs

The cuff deflates automatically if a measurement takes longer than 2 minutes in **Adult/Pediatric** mode or 90 seconds in **Neonatal** mode. To protect the patient from excessive pressure, inflation limits have been established in all patient categories; see Appendix B, for more information.

Cuff Selection, Placement and Application

The quality of NBP monitoring depends largely on the quality of the signals received by the monitor. It is important to select the correct cuff size for your patient. For proper cuff selection, placement and application, refer to the accompanying instructions for use. .

WARNING: Accurate NBP measurements depend on the correct size and type of the blood pressure cuff in relation to the patient's arm circumference. The wrong sized cuff, or cuffs outside the range or size manufactured by Dräger, can cause inaccurate measurements. Use only Dräger approved cuffs and make sure that the correct size is used for each patient.

WARNING:

- **Obstructions may cause patient harm due to blood flow interference and/or inaccurate readings due to improper cuff inflation or deflation.**
  Check the hose and cuff for damage and dirt. Do not allow the hose and cuff to come in contact with fluids, and make sure that they are not compressed or kinked.
- **Do not place the cuff on injured or breached skin because cuff compression could further damage the tissue.**
- **Do not place the cuff on a limb with either an intra-arterial line or a vascular prosthesis because cuff compression will impede perfusion.**
- **Do not perform blood pressure measurement on the upper arm of the side of a mastectomy.**
- **When measuring blood pressure and another parameter simultaneously at the same limb, the measurement of the other parameter can be temporarily interrupted.**
- **To reduce the possibility of pumping air into the patient's blood vessels, never connect pneumatic connectors to an intravascular system.**
- **Before monitoring neonates and infants:**
  - **Select the correct cuff size and hose.**
  - **Select the neonatal or pediatric patient category, if not already selected. This protects neonates, infants, and pediatric patients from high cuff pressures used for adults.**

NOTE: The accuracy of the oscillometric blood pressure signal can decrease (up to loss of measurement) under the following conditions:

- weak pulses
- irregular pulses
- patient movement artifacts
- tremor artifacts
- respiratory artifacts

NOTE: A systolic blood pressure higher than the current high inflation limit may trigger an NBP low inflation limit message. When this occurs, manually check the blood pressure of the patient and select the next higher inflation limit, if appropriate.

NOTE: Place the cuff so that it does not apply pressure to joints.

On a patient with hypertension who is not in a lying position, perform the resting blood pressure measurement as follows:

- Comfortable seating position
- Legs not crossed
- Feet flat on the floor
- Leaned back and arms resting
- Center of the cuff is applied at the level of the right atrium
- If possible, the patient should be relaxed and should not talk during measurement
- If possible, wait for 5 minutes before performing the first measurement

NOTE: The accuracy of blood pressure measurement can be affected by the measuring site, the lying position, movement of the patient, and the physiological condition of the patient.

NOTE: Blood pressure measurement can be affected by arrhythmias (e.g., atrial and premature ventricular contraction), atrial fibrillation, low perfusion, diabetes, renal diseases, trembling, and shivering. In case of implausible measurement values check the abovementioned points and perform another blood pressure measurement if necessary. If possible, wait for a few minutes before performing another measurement at the same measuring site.

The accuracy of blood pressure measurement can be affected if the cuffs are stored or used outside the specified environmental conditions (temperature, relative humidity), see section “Technical Data”.

To assure accuracy of measurement, minimize movement of upper arm or thigh and cuff. During measurement avoid contact with cuff and extension hose, because this would influence the accuracy of the measurement as well. Do not kink the hose. Avoid compression or restriction of the extension hose.

1	Cuff size indicators	**4**	Range labels
2	Artery label	**5**	Label: this side to patient
3	Index line		

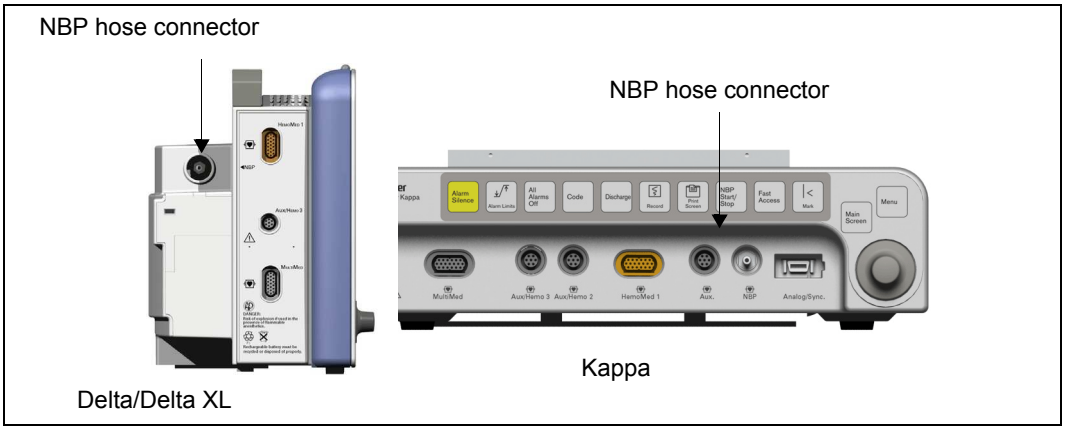
To avoid kinks in the hose, center the cuff bladder on the artery so that the hose is to the left or to the right of the artery. Ideally, blood pressure measurements should be

taken with the cuff positioned at heart level. If the cuff is not placed at heart level, adjust the displayed systolic and diastolic readings +8mmHg for each 10cm above the heart and -8mmHg for each 10cm below the heart.

In selecting a monitoring site, make sure patient connections do not interfere with each other. Dräger recommends that you do not put an NBP cuff on a limb that is already used for other measurements.

To connect the Hose:

- Push the hose end fitted with the plastic collar firmly into the connector on the left side of the monitor (see figure below).



NOTE: There are separate hoses for pediatric/adult and neonatal patient categories. Select the appropriate hose based on intended monitoring application.

Setup Menu and Quick Reference Table

To access the NBP setup menu

- Click on the NBP parameter box on the main screen;

or

1. Press the **Menu** fixed key on the monitor.
2. Click on **Patient Setup**.
3. Click on **Parameters** in the second column.
4. Click on **NBP**. The NBP menu appears.

The following table briefly describes functions available on the NBP menu.

Function	Description	Settings
Interval Time	Sets interval for series of single NBP measurements	• **OFF, 1, 2, 2.5, 3, 5, 10, 15, 20, 25, 30, 45, 60, 120, 240 min**
Venous Stasis	Stops blood flow to lower part of cuffed limb for a fixed time	• **OFF** • **ON**
Continuous Mode	Initiates successive NBP measurements for 5 minutes	• **OFF** • **ON**
Inflation Limit	Sets threshold for maximum cuff inflation, initial inflation will be less.	• Neonatal patient category: **140 mmHg** • Pediatric patient category: Pediatric - **180 mmHg** Neonatal - **140 mmHg** • Adult patient category: Adult - **270 mmHg** Pediatric - **180 mmHg** Neonatal - **140 mmHg** **NOTE**: The inflation limit can be set equal to or below the maximum for the selected patient category (see above). No other parameter functions are affected.

Function	Description	Settings
Calibrate Mode	Configures NBP calibration ***CAUTION***: *Only qualified DrägerService personnel should access this function.* *If you leave NBP Cal Mode ON accidentally, NBP will default to an NBP inactive state. To restore NBP to normal operating mode, power cycle the monitor.*	• **OFF** • **ON**
NBP Alarms	Accesses NBP alarms and associated variables on Alarm Limits table	Not applicable
NBP Chime	Produces a tone when NBP measurement is complete	• **OFF** • **ON**

Taking NBP Measurements

WARNING: Press the NBP Start/Stop fixed key to deflate the cuff rapidly if an adverse effect occurs on the patient.

Single Measurements

To perform a single measurement:

- Push the **NBP START/STOP** fixed key on front of monitor.

The cuff inflates, then deflates. When an NBP measurement is in progress, the background turns white and the foreground turns black.

When the measurement is complete, a chime sounds (if selected by user) and new data appears. To stop a single measurement in progress, push the **NBP START/STOP** fixed key.

NOTE: If an NBP reading is undetermined, the value of the previous reading in the parameter box is blanked or the value displays as ***.

Interval Measurements

You can take a series of single measurements at specific intervals. The interval time is measured from the start of one measurement to the start of the next. To take a series of measurements:

To start interval measurements

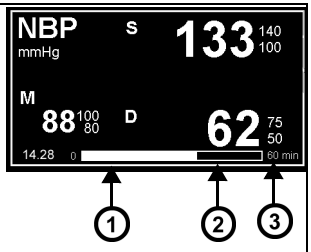
1. Open the NBP menu (see page 13-7).
2. Click on **Interval Time**.
3. Dial to the time interval you want to use.
4. Click on the interval to confirm it.
5. Press the **NBP Start/Stop** fixed key

NOTE: To take the monitor out of interval mode press the **NBP Start/Stop** fixed key twice within one second.

If a series of measurements is already in progress, setting a new interval time resets the timer.

After the first measurement, the NBP parameter box displays results. A countdown bar indicates the amount of time left before the next measurement.

You can take additional single or continuous measurements without affecting the interval cycle. The minimum interval is 30 seconds between the end of one measurement and the start of another to allow for reperfusion of the limb. To stop an interval measurement in progress, press the **NBP Start/Stop** fixed key. The monitor stops the current measurement and resumes the cycle on schedule with the next interval measurement.



1	Time remaining
2	Time elapsed
3	Interval Time

Continuous Measurements

In continuous mode the monitor takes NBP measurements continuously over a period of five minutes.

To start continuous measurements

1. Open the NBP menu (see page 13-7).
2. Click on **Continuous Mode**.
3. Click to toggle the mode **ON**. The monitor takes NBP measurements for five minutes and continuously updates the NBP parameter box. The previous measurement displays until the current one is complete.

The monitor waits at least two seconds between the end of one measurement and the start of another to achieve reperfusion of the limb. The entire continuous measurement cycle is aborted if there is an NBP alarm.

To stop a continuous measurement in progress, click again on **Continuous Mode** in the NBP menu or press the **NBP Start/Stop** fixed key. The entire measurement cycle is canceled.

WARNING:

- **Rapid, prolonged cycling of non-invasive pressure measurements have on occasion been associated with petechia, ischemia, purpura, or neuropathy. Make sure that the cuff is properly attached and check the cuff site regularly to prevent cuff pressure from impeding the blood flow.**
- **When using continuous mode, observe the patient closely and verify limb perfusion clinically. Be extra vigilant when using continuous mode on neonates or hemodynamically compromised patients.**

Retried Measurements

If a measurement is unclear AND the patient category and selected inflation limit are Adult - 180 or 270 mmHg, the monitor aborts the measurement and tries again. The monitor displays an error message if a second attempt fails. Error messages may affect display or measurement, as follows:

- *Mean Only* –The monitor only displays a mean pressure in the parameter box (the systolic and diastolic values display as ***) for some conditions including very low systolic and diastolic pulse amplitudes or significant motion
- *Cannot Measure* – The monitor stops measurement and replaces all NBP values with * * *
- *No Pulsation* – The monitor stops measurement
- *Open Line* – The monitor stops measurement
- *Measurement Timeout* – The monitor stops measurement

Venous Stasis

By inflating and maintaining a constant pressure in the cuff, the monitor stops the flow of blood to the lower extremity of the cuffed limb long enough to cannulate the patient. The cuff in venous stasis mode will occlude the limb for about as long as an NBP measurement (approximately two minutes for adult and approximately one minute for neonatal patients).

WARNING: Do not use venous stasis on a limb that is unsuitable for NBP measurements (for example, an arm with a catheter). If the patient experiences adverse reactions, immediately press the NBP Start/Stop menu button to deflate the cuff.

To begin cuff inflation, click on **Venous Stasis**. Click again to terminate the procedure and deflate the cuff. During Venous Stasis, the monitor displays the cuff pressure in the lower right corner of the screen, while the label *STASIS* and time remaining are displayed in the NBP parameter box.

You cannot enable **Venous Stasis** if you are currently taking continuous measurements. Interval measurements are suspended during **Venous Stasis** but resume immediately after the cuff deflates.

The monitor determines initial and maximum cuff inflation pressure and inflation time according to the category of the patient, as shown in the following table:

Inflation	Adult	Pediatric	Neonatal
Initial and Maximum Inflation Pressure (mmHg)	80 ± 5	60 ± 4	40 ± 3
Inflation Time (sec)	120 ± 5	120 ± 5	60 ± 2.5

NOTE: Perform Venous Stasis on a different arm from that used to measure SpO_2 to assure proper SpO_2 monitoring.

Status Messages

Message	Possible Cause	Suggested Action
NBP s/d/m > # *NBP s/d/m < #*	The NBP value (systolic, diastolic, mean) exceeds alarm limits.	• Check the patient and treat, if necessary. • Change current alarm limits for patient.
NBP Low Inflation Limit	The patient's systolic pressure is higher than the maximum allowed inflation limit.	Select the next higher NBP inflation limit setting.
NBP Check Cuff Size	The patient's pulsations are too small to determine blood pressure.	Check the cuff size. Move the cuff to another limb.
NBP: Venous stasis started	Venous stasis mode is enabled.	No action is required.
NBP: Venous stasis ending	There are 10 seconds remaining in venous stasis mode.	No action is required.
NBP: Venous stasis ended	Venous stasis mode is disabled or completed.	No action is required.
NBP Check Hose Connection	• The pressure cannot be maintained in the cuff. • The inflation time is too short due to a blocked or kinked hose.	• Check connection between cuff and hose for debris. • Check hose and cuff for obstructions or kinking and replace, if necessary.
NBP Hose Unplugged	The NBP hose is unplugged.	Reconnect the hose.
NBP Mean Only	The patient's pulse is too low for the monitor to derive systolic and diastolic pressure values but large enough to report a mean pressure value.	• Check the patient and treat, if necessary. • Check the hose and cuff. • Check size and placement of cuff.

Message	Possible Cause	Suggested Action
NBP Cuff Cannot Deflate	Pneumatic failure.	• Check hose and cuff for obstructions and replace, if necessary. • If the message does not clear, contact the hospital's technical personnel or DrägerService.
NBP Cuff Deflation Error	NBP pump or valves have been energized for longer than 2 minutes (Adult or Pediatric mode) or 90 seconds (Neonatal mode).	• Disconnect and reconnect cuff. • Check hose and cuff for obstructions and replace, if necessary. • If the message does not clear, contact the hospital's technical personnel or DrägerService.
NBP Cuff Leak	The drop in cuff pressure after the end of the inflation cycle is too great.	• Check hose and cuff for leaks and replace, if necessary. • Restart the measurement. If the message does not clear, contact the hospital's technical personnel.
NBP Cannot Measure	The pulse profile is too poor to make a reliable measurement (usually due to persistent motion artifact).	• Check the patient and treat, if necessary. • Move the cuff to a limb with less movement. • Restart measurement. If the message persists contact the hospital's technical personnel or DrägerService.
NBP Blocked Line	The inflation rate is too high during the inflation cycle or the time to dump the residual cuff pressure at the end of the deflation cycle is too short.	• Select a different cuff. • Check the hose and cuff for damage. • Restart the measurement. If the message does not clear and contact the hospital's technical personnel or DrägerService.
NBP Cannot Zero	The monitor is unable to zero transducer within 30 seconds from start of NBP program, usually because of motion artifact.	• Check the patient and treat if necessary. • Move cuff to a limb with less movement. • If the message does not clear, contact the hospital's technical personnel.
NBP Measurement Timeout	A measurement was aborted (usually due to motion artifact) because it lasted longer than two minutes (adult or pediatric) or 90 seconds (neonatal).	Repeat the measurement.
NBP No Pulsation	Weak signal. The monitor is unable to detect a sufficient number of pulsations of adequate amplitude within two minutes.	• Check the patient and treat, if necessary. • Check the hose and cuff. • Check for proper size, placement of cuff.

Message	Possible Cause	Suggested Action
NBP Open Line	The inflation time during cuff inflation cycle is too long or the inflation rate is too low.	Check that the hose and cuff are properly connected to the monitor.
NBP Out of Range	The values are reported, but are out of specified range.	No action is required.
NBP Overpressure	The cuff pressure is over 270 mmHg (Adult), 180 (Pediatric) or 140 mmHg (Neonatal). The cuff deflates automatically.	• Check the patient and treat, if necessary. • Check the cuff for obstructions. • Retry the measurement.
NBP Retrying	The monitor failed to detect sufficient pulsations, aborted the measurement, then started a new one.	No action is required.
NBP Overpressure Circuit Failure	The cuff overpressure circuit has failed.	Contact the hospital's technical personnel or Dräger DrägerService.
NBP Meas. Circuit Failure	Software or hardware failure. A persistent alarm of low priority sounds, and NBP measurements are no longer possible.	• Power cycle the monitor. • Contact the hospital's technical personnel or DrägerService if the error persists.

14 Continuous Non-Invasive Arterial Blood Pressure (CNAP) Pod

General WARNINGS and CAUTIONS

The following WARNINGS and CAUTIONS apply to general operation of the device. WARNINGS and CAUTIONS specific to subsystems or particular features appear with those topics in later sections of the manual.

Note on EMC/ESD risk for the device function

General information on electromagnetic compatibility (EMC) pursuant to international EMC standard IEC 60601-1-2: 2007

Electromedical devices are subject to special precautionary measures concerning electromagnetic compatibility (EMC) and must be installed and put into operation in accordance with the EMC information included in the technical documentation which is available from DrägerService on request.

Portable and mobile RF communications equipment can affect medical electrical equipment.

WARNING:

WARNING: Connector pins with an electrostatic discharge (ESD) warning sign should not be touched and no connections should be made between these connectors without implementing ESD protective measures. Such precautionary procedures may include antistatic clothing and shoes, the touch of a ground stud before and during connecting the pins or the use of electrically isolating and antistatic gloves. All staff involved in the above shall receive instruction in these ESD precautionary procedures.

WARNING: CNAP is not currently supported in the following environments: magnetic resonance imaging (MRI) environments, aircraft, ambulance, home, hyperbaric chamber environments or with x-ray equipment.

WARNING: When placing the CNAP pod in the patient's room, assure adequate ventilation/heat dissipation and avoid direct contact of the patient with the pod's exterior surface. The CNAP pod requires regular air circulation. Do not cover the CNAP pod with bedsheets or blankets.

WARNING: To prevent burns, make sure that the Cuff Controller does not contact the patient's skin. The Cuff Controller must be in the cradle attached to the forearm strap whenever the controller is placed on the patient's arm.

WARNING: If the CNAP signal is interrupted by strong electrical noise/interference, the blood pressure detection could be faulty.

WARNING: The pod is not designed to be used in explosive surroundings that can arise from the usage of flammable anesthetics, skin detergents, and skin disinfectants. Do not use the CNAP pod in a combustible atmosphere (25% oxygen or nitrous oxide gas).

NOTE: The disposal of the CNAP pod, accessories, and packaging must comply with local regulations.

Continuous Non-Invasive Arterial Blood Pressure (CNAP) pod

Intended use

The Infinity CNAP (Continuous Non-Invasive Arterial Pressure) pod provides continuous, non-invasive monitoring for arterial blood pressure, on adult patient populations.

It is intended for use with patient monitors of the Delta series (Delta, Delta XL, Kappa, SC 7000, SC 8000 and SC 9000XL).

NOTE: Siemens SC 7000, SC 8000 and SC 9000XL monitors with software level below VF4 and the following hardware revisions require Memory Expansion Board (7494557): Siemens SC 7000 below 14, SC 8000 below 17, and SC 9000XL below 6.

NOTE: The Infinity CNAP SmartPod is available in selected markets. Contact your local sales representative for details and availability.

Indications for use

The Infinity CNAP pod provides the following parameters:

- CNAP-S (systolic pressure)
- CNAP-D (diastolic pressure)
- CNAP-M (mean pressure)

Site of operation

The site of operation must meet the temperature, humidity and atmospheric pressure requirements listed in "Environmental Requirements"

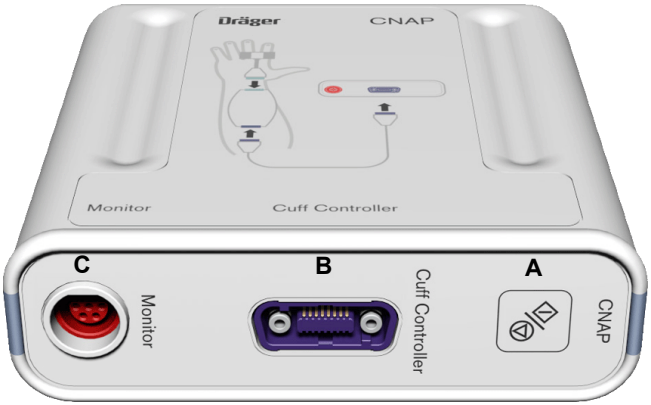
Alarm validation

This validates alarm conditions to limit nuisance alarms due to artifact or motion/ movement by delaying time to alarm. CNAP has an upper alarm limit of 4 seconds and a lower alarm limit of 10 seconds.

Overview of CNAP monitoring

The Continuous Non-Invasive Arterial Blood Pressure (CNAP) pod provides continuous, non-invasive monitoring of arterial blood pressure. CNAP measurements are for adult patients.

CNAP works with a light-emitting diode and detector located in an occluding sensor cuff placed around the patient's fingers. The sensor detects changes in blood volume under the cuff based on the amount of transmitted light. With the sensor cuff inflated to mean arterial pressure, the signal output varies directly with any change in blood volume. Systemic blood pressure is then calculated beat to beat after calibration against an arterial pressure obtained via a standard oscillometric NBP measurement from a Dräger Infinity Delta/Delta XL/ Kappa monitor. The resulting derived arterial values and pressure waveforms are then displayed on the monitor.



A CNAP start/stop button

B Cuff controller connector

C Monitor connector

NOTE: The display update rate of the monitor for CNAP is lesser than or equal to 2 seconds.

CNAP precautions

WARNING: Do not place the CNAP sensor cuff on fingers with vascular implants for CNAP measurements. Doing so could cause injury to the underlying vessels in the fingers.

WARNING: The CNAP pod is designed for the concurrent measurement of only one patient/proband at the same time.

WARNING: Never connect the CNAP pod's pneumatic connectors to an intravascular system. CNAP has built in pneumatic components and doing so could damage the system.

WARNING: The user must make sure that prolonged impairments of the patient's blood circulation during measurement are prevented by inspecting the limbs. If the finger during measuring shows any signs of total arterial compression, abort the measurement immediately by pressing the STOP button on the pod.

NOTE: Use of electrosurgical devices may cause interference and temporarily affect CNAP readings.

Symbols

	ESD Warning, comply with the ESD Warning above.	CE 0123	Complies with the *European Medical Device Directive 93/42/EEC*

Patient preparation for CNAP monitoring

Sensor cuff

Use the cuff selection template on the cuff controller to identify the correct cuff size (small, medium or large) for each patient. Use of an incorrect sized cuffs can cause measurement error or result in no measurement. If a finger falls between two cuff sizes, use the larger cuff size.

The sensor cuff should be positioned over the index and middle fingers. Do not place the sensors over either of the phalangal joints. Placing the sensors over the joints will result in improper or no measurements. If it is not possible to place the cuffs at the described position, you can alternatively use the middle and ring fingers or try the other hand.

WARNING: Pain or severe discomfort are not normal and not attributable to the CNAP measurement as such, and should lead to an immediate discontinuation of CNAP monitoring.

CAUTION: *Avoid strong ambient lights shining at the sensor cuff during use. This could affect CNAP measurements.*

CAUTION: *Compressing or bending the cables could impair the quality of the measuring signals. Check the setup periodically and adjust if necessary.*

CAUTION: *To avoid mechanical damage to the sensor cuff and components, do not use sharp objects and remove all objects (e.g. rings) from the fingers before measuring.*

CAUTION: *Avoid starting measurements without fingers in the sensor cuff to avoid damaging the sensor cuff.*

CAUTION: *When taking the sensor cuff off the fingers, make sure to STOP CNAP measurements first to avoid damage to the sensor cuff.*

CAUTION: *CNAP performance may be negatively affected in situations where the flow of blood to the finger is severely inhibited, or in the presence of pathologically increased stiffness of the finger arteries. Included as examples:*

- *cases of severe shock or pronounced hypothermia*
- *severe arteriosclerosis of the upper extremities*
- *primary or secondary Raynaud's syndrome and related diseases*
- *endarteritis obliterans*
- *collagenosis affecting peripheral arteries*

NOTE: Before connecting the sensor to the patient, visually inspect all components for wear or damage. Replace any components that are damaged.

Oscillometric NBP cuff

Choose the appropriate oscillometric NBP cuff (small, medium or large). The NBP cuff should fit the patient's upper arm properly. The NBP cuff can be placed on either arm.

WARNING: Do not use the oscillometric cuff on limbs with vascular prosthesis. This could cause injury to the patient.

CAUTION: *The accuracy of the oscillometric blood pressure signal can decrease (up to loss of measurement) under the following conditions:*

- *weak pulses*
- *irregular pulses*
- *patient movement artifacts*
- *tremor artifacts*
- *respiratory artifacts*
- *This could affect the CNAP readings measurements.*

CAUTION: *Due to pressure differences within the arterial system, CNAP measures pressure in the finger and calibrates it to the pressure of the brachial artery in the arm. To minimize measurement errors, place the CNAP and NBP cuffs on the same arm or prescreen the patient for any clinically meaningful interarm differences in blood pressure before affixing CNAP measurements and NBP cuffs in contralateral positions.*

CAUTION: *CNAP monitors and detects any beat-to-beat change in the arterial pressure of the finger. When the amplitude of the pressures in the finger are calibrated to those of the brachia, CNAP provides a continuous measure of any change in systolic, diastolic and mean arterial pressures which correlates to within ±5 mmHg of an intra-arterial measurement. During calibration and prior to intervention, verify the patient's pressure with an oscillometric measurement.*

NOTE: Apply the oscillometric NBP cuff to the patient before starting CNAP measurement. The quality of the oscillometric blood pressure measurement can be affected by an NBP cuff that is poorly positioned or too loose/tight, which will affect CNAP measurement readings.

Connection of the CNAP System

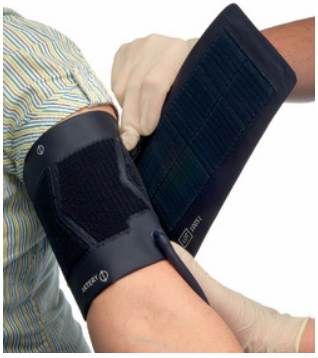


Figure 1

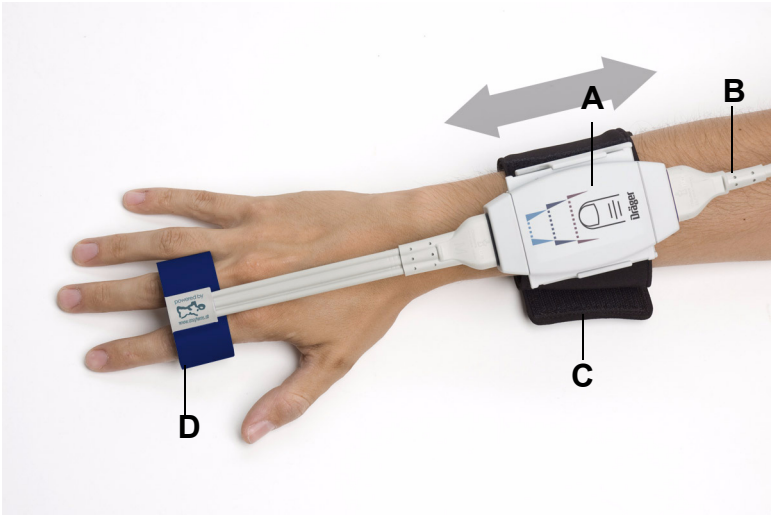


Figure 2

A Cuff controller with sliding mount

B Cuff controller cable

C Forearm strap

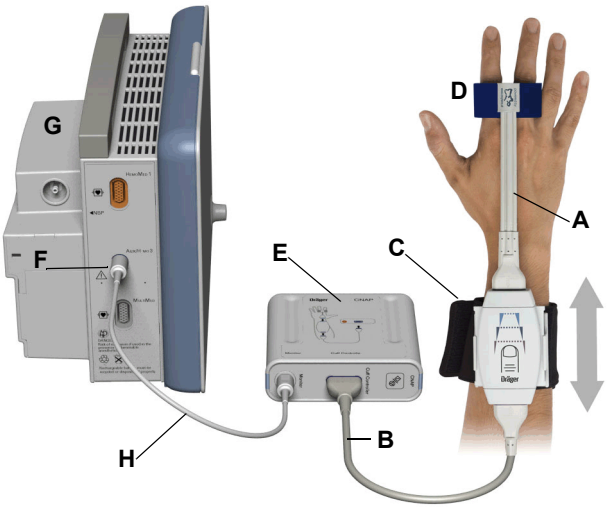
D Sensor cuff

Connecting components to the patient

1. Select and apply an appropriately sized oscillometric NBP cuff to either arm (see Figure 1, above).
2. Select and apply the appropriately sized sensor cuff (D).

NOTE: Place the cuff on the finger so that the cuff cable runs on top of the hand (see Figure 2, above).

3. Connect the sensor cuff (D) to the cuff controller (A).
4. Connect the cuff controller (A) to the CNAP pod, via the cuff controller cable (B).
5. Secure the cuff controller (A) to the forearm with the forearm strap (C).



A Cuff controller with sliding mount

B Cuff controller cable

C Forearm strap

D Sensor cuff

E CNAP pod

F Aux/Hemo or PodCom connector

G Monitor

H PodCom cable

Connecting CNAP components to the monitor

1. Connect the CNAP pod (E) to the monitor's Aux/Hemo or PodCom connector (F) via the PodCom cable (H).
2. Connect the cuff controller cable (B) to the CNAP Pod (E).
3. Connect the cuff controller cable (B) to the Cuff Controller (A).
4. Connect the sensor cuff (D) to the cuff controller (A).

NOTE: Place the patient's fingers in the finger cuffs before connecting the sensor cuff to the cuff controller. Do not connect the Cuff Controller to the CNAP pod until after this is done. Connect the CNAP pod to the monitor after connecting the Cuff Controller.

Patient fingers must be placed in finger cuffs before connecting to the cuff controller.

Setting up the CNAP parameter on the Display

Configure NBP on display before setting up CNAP. Both parameters can be accessed via the monitor setup menu.

To configure NBP on the display

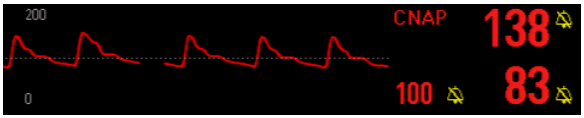
1. Press the **Menu** fixed key.
2. Click on the **Patient Setup**.
3. Click on **Parameters** to display a list of available parameters.
4. Click on **NBP**.

To configure NBP or CNAP on the display

- Click on the NBP or CNAP parameter box

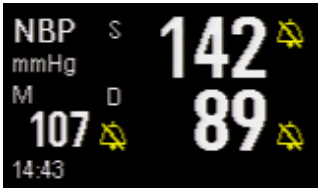
or

1. Press the Menu fixed key.
2. Click on the Patient Setup.
3. Click on Parameters to display a list of available parameters.
4. Click on NBP or CNAP.



To access the NBP setup menu

- Click on the NBP parameter box



To access the CNAP setup menu

- Click on the CNAP parameter box

CNAP application

The NBP and CNAP must be configured on the display, the NBP cuff applied and the CNAP pod connected to both monitor and patient before starting a CNAP measurement.

WARNING: Press the NIBP Start/Stop fixed key to deflate the cuff rapidly if an adverse effect occurs on the patient.

To start CNAP measurement

- Press the **Start/Stop** fixed key on the pod.

or

1. Press the **Menu** fixed key.
2. Click on **Patient Setup**.
3. Click on **Parameters** to display a list of available parameters.
4. Click on **CNAP**.
5. Click **Start CNAP**.

CNAP Calibration

Each time a CNAP measurement is started or the inflation pressure is alternated between the dual finger cuffs, CNAP will automatically calibrate. Calibration consists of a pulse determination phase followed by an NIBP correlation measurement. During calibration a square wave is displayed in the CNAP waveform area and the message "CNAP: Calibrating" will be displayed and the CNAP values will be blanked. After a successful NIBP measurement is obtained, the CNAP waveform will appear and CNAP values will be displayed.

CAUTION: *Calibration phase is an important part of CNAP monitoring. For optimum results, minimize patient motion during calibration phase.*

CNAP Relearn

A CNAP Relearn may be manually obtained at any time by pressing the NIBP START/STOP fixed key. The system may otherwise be configured to automatically Relearn CNAP every 5, 10 or 15 minutes as desired by the user.

NOTE: For CNAP firmware versions 2.9.14 and earlier, CNAP will also automatically perform a NBP measurement(Relearn) whenever the CNAP and NBP values differ by more then 25 mmHg.

To manually trigger a CNAP relearn

- Press the **NBP Start** fixed key.

To configure automatic CNAP relearns

1. Click the CNAP parameter box.
2. Click **Automatic CNAP Relearn**.

or

1. Press the **Menu** fixed key.
2. Click **Patient Setup**.
3. Click **Parameters** to display a list of available parameters.
4. Click **CNAP**.
5. Click **Automatic CNAP Relearn**.

CAUTION: *Movement or repositioning of the patient, which could result in change in position in the CNAP finger cuff relative to the heart level, will have immediate influence on CNAP absolute pressure values. To compensate for these physical effects (hydrostatic height offsets) perform a CNAP relearn by manually triggering NBP measurement using the start NBP fixed key on the monitor.*

CNAP Averaging

The CNAP parameter provides a continuous, non-invasive, beat-to-beat assessment of arterial blood pressure, which utilizes an equivalent averaging and update interval as the invasive, intra-arterial blood pressure (IBP) measurement. This interval is calculated as follows:

$Y(i) = ((N-1)\ Y(i-1) + x(i))/N$

- where x is input
- Y is output
- Y(i-1) is previous output
- N is the averaging constant
- For Normal averaging, N = 8
- For Slow averaging, N = 16

NOTE: If a new parameter received status is not valid, then X(i) = Y(i-1). Using this method, there is not a large discrepancy in the first new average because the previous value is likely to be 0 (an invalid state).

Quick Reference Table - CNAP Setup

Click on the following items to execute CNAP setup functions:

The CNAP setup menu			
	Menu Item	**Description**	**Settings**
	Start CNAP	Starts CNAP measurement.	N/A
	Stop CNAP	Stops CNAP measurement. **CAUTION!** When taking the finger cuff off the fingers, make sure to STOP CNAP measurements first, to avoid damage to the sensor cuff.	N/A
	Scale	Sets CNAP scale	5, 10, 15, 20, 25, 30, 35, 40, 50, 75, 100, 125, 150, 175, 200 (default), 225, 250, 300 mmHg (1, 2, 3, 4, 5, 6, 8, 12, 16, 20, 24 (Default), 32, 40 kPa)
	Automatic CNAP Relearn **Note**: 15 minutes is the maximum interval between relearns. Once the CNAP pod reaches 15 minutes time, it will automatically perform a relearn.	Sets the timer for automatically triggering oscillometric NBP correlation measurements for relearning.	– 5 min – 10 min – 15 min (default)
	[1] **Manual Change Finger**	Manually allows you to change the finger on which the measurement is taken.	N/A
	[1] **Auto Change Finger**	Allows the user to set the interval for an automatic finger change. Sets the interval for automatically triggering change-finger.	– 15 min – 30 min (default)

[1] Only one finger is used at a given time for measurement.

The CNAP setup menu			
	Large Mean	Turns Large Mean ON or OFF. When turned on, this function increases the display size for CNAP Mean parameter in the parameter box in relation to the CNAP-S and CNAP-D parameter.	– ON – OFF
	[a]Averaging	Determines the averaging of CNAP values.	– Slow – Normal (default)
	CNAP Alarms	Allows User to display/set CNAP parameter alarms limits.	N/A

a. For details on averaging CNAP, see "CNAP Averaging" on page 16

Status Messages

	Fault	Cause	Remedy
	CNAP: Pod Initializing	CNAP pod is initializing.	– Wait until initialization is complete.
	CNAP: Calibrating	CNAP calibration is in progress.	– Wait until calibration in complete. **NOTE:** This could take up to 2.5 minutes. A rectangular waveform (pod firmware version ≤ 2.9.14) or intermittent ascending/descending angled lines (pod firmware version 2.14.14) are displayed when calibration is in progress. Since 15 minutes is the maximum time between recalibrations and includes this 2.5 minutes, the actual useful duration for CNAP monitoring is 12.5 minutes. This represents an 83 % duty cycle.
	CNAP: Relearning	– NBP measurement/ Relearn in progress (NBP measurement initiated by the user or auto CNAP Relearn triggered based on interval time selected)	– Wait until Relearn is complete
	CNAP: TimeOut/Restart CNAP	– Could not calibrate – CNAP calibration failed or aborted – CNAP could not find a good signal during determination phase for more than 5 minutes	– Check for correct cuff size. – Check position of sensor on finger. – Change the location on finger. – Change the sensor and restart measurement.

	Fault	Cause	Remedy
	CNAP: Check NBP/Relearn	– No NBP readings registered – NBP disconnected from patient – No values reported – NBP Mean Only values reported	– Check that NBP cuff is properly positioned. – Check NBP cuff size and replace with appropriate cuff size if necessary. – Check for blockage. – Restart NBP manually.
	CNAP: Sensor Cuff Leak	Cuff leakage detected (drop in the pressure)	– Check cable and cable connections. – Check sensor cuff. – Replace cable/cuff if necessary. – Check sensor. – Replace sensor and restart measurement.
	CNAP: Sensor Overpressure	Finger cuff has exceeded the overpressure limit (300 + 10% mmHg for more than 0.5 sec) 40 kPa + 10%	– Check sensor for blockage. – Check for correct cuff size. – Replace sensor and restart measurement.
	CNAP: Sensor Expired	Sensor (finger cuff) life expired	– Replace expired cuff and restart measurement.
	CNAP: Unrecognized Sensor	Sensor (finger cuff) invalid	– Check for valid sensor and replace accordingly.
	CNAP: Sensor Failure	– CNAP LED failure on left/right side – Self-test sensor cuff, failure – Invalid sensor cuff – Expired sensor cuff	– Check connections. – Disconnect and examine sensor/cuff. Replace if necessary.
	CNAP: Check Sensor	– No fingers in the cuff **NOTE:** Start CNAP unavailable/ghosted – Excessive ambient light reaching the sensor cuff	– Place fingers in cuff – Check connections – Disconnect and examine sensor cuff – Replace sensor cuff/cable if necessary – Cover the sensor to avoid direct exposure to light

	Fault	Cause	Remedy
	CNAP: Check Cuff Size/ No Pulsation	Pulse amplitude too small to derive measurements (finger light amplitude too small).	– Check sensor cuff positioning and size. – Reposition cuff sensor and restart CNAP. – Replace sensor cuff if necessary.
	CNAP: Check Connections	– Cable/sensor disconnected or no significant increase in sensor cuff pressure during inflation cycle. – Loose connections.	– Check cable and cable connections. Make sure all connections are secure. – Check sensor cuff. – Replace cable/cuff if necessary.
	CNAP: Cuff cannot Deflate/ Blocked Line	– Sensor cuff cannot deflate due to blocked line detected – Cable/sensor bent or kinked	– Check cable and cable connections. Make sure cable/sensor is not kinked or occluded. – Check sensor cuff. – Replace cable/cuff if necessary.
	CNAP-S < LL	CNAP systolic value is below lower limit.	– Check patient. – Change alarm limits as appropriate. – Check cable and cable connections. – Check sensor cuff. – Replace cable/cuff if necessary.
	CNAP-D < LL	CNAP diastolic value is below lower limit.	
	CNAP-M < LL	CNAP mean value is below lower limit.	
	CNAP-S> UL	CNAP systolic value is above upper limit.	
	CNAP-D > UL	CNAP diastolic value is above upper limit.	
	CNAP-M> UL	CNAP mean value is above upper limit.	
	CNAP-S Out of Range	CNAP-S value out of range.	– Check patient. – Check cable and cable connections. – Check sensor cuff. – Replace cable/cuff if necessary. – Reposition sensor cuff if necessary.
	CNAP-D Out of Range	CNAP-D value out of range.	
	CNAP-M Out of Range	CNAP-M value out of range.	

	Fault	Cause	Remedy
	CNAP: Artifact	Measurement cannot be determined because of the presence of an interfering artifact, motion or movement.	– Isolate patient from any extraneous movement or vibration. – Isolate patient from any other equipment causing interference. – Check sensor cuff. – Replace cable/cuff if necessary.
	CNAP: Disconnected	CNAP pod disconnected.	– Check cable and pod connection. – Replace cable if necessary. – Acknowledge message if intentional.
	CNAP: Pod Hardware Failure	– CNAP pod hardware communication failure. – Excessive pressure on sensor cuff detected. – Pod Processor not responding.	– Check pod and pod connections. – Check cable and cable connections. – Remove sensor cuff from patient. – Check the sensor cuff for proper size. – Unplug and replug in the pod. – Replace sensor cuff, cable, or pod if necessary. – If problem persists, call DrägerService.
	CNAP: Fault	– Pod/cuff controller self test failure. – Sensor cuff -pressure limit exceeded. – No signal found during initial phase/calibration for 5 mins. – CNAP pod internal fault detected. – Pump, tubing and/or valve leak.	– Unplug and reconnect the pod or cuff controller. Repeat the measurement. If message persists, replace the pod and contact DrägerService. – Reposition sensor and restart CNAP.

	Fault	Cause	Remedy
	CNAP: Pod Failure	– CNAP pod software failure.	– Check CNAP pod connections. – Unplug and plug in the pod. – Call your technical personnel or DrägerService.

Infinity CNAP SmartPod starter kit	MS17075
Includes	
Infinity CNAP SmartPod	MS16905
NOTE: Requires VF7 software or higher.	
CNAP Cuff Controller and Cradle	MS26125
CNAP connection cable	MS15893
Cuff controller forearm strap	MS26122
1 sensor cuff – large [1]	MS15896
1 sensor cuff – medium [1]	MS15895
1 sensor cuff – small [1]	MS15894
Port communication cable, 3 m	3368425
Universal pole mount	MS19705

[1] The cuffs are designed to last for approximately 12 months of cumulative operation depending on usage, which is monitored with a chip inside each cuff. The cuff usage is a measure of the inflate-deflate cycles which is monitored through each detected pressure pulse as the cuff is typically inflated and deflated between systolic and diastolic pressure within heart beat. When the cuff deteriorates to a point below which proper function cannot be maintained, a message is indicated on the Dräger monitor to replace.

15 Invasive Blood Pressure

Overview

The monitor acquires invasive blood pressure (IBP) signals from Y-cables, hemodynamic pods, or a combination of these devices. A transducer, connected to the cable or pod/MPod, converts pressure data into electronic signals for monitor use.

These signals are automatically filtered to reduce the artifact generated by the fluid-filled catheter and tubing system, as well as by motion and catheter fling. The monitor detects individual beats by establishing thresholds based on running averages of systolic and diastolic pressures. The monitor can process up to twelve IBP signals to which it assigns standard, generic, or automatic pressure labels. See page 15-16 to assign pressure labels. Description of standard and automatic IBP labels follows:

IBP Labels

Label	Pressure Type	Measured Pressures	Measurement Range
ART	Arterial	Systolic, diastolic, mean	-50 to +400 mmHg **NOTE**: see status messages, page 15-22.
LV	Left Ventricular	Systolic, diastolic, mean	
PA	Pulmonary Arterial	Systolic, diastolic, mean	
RV	Right Ventricular	Systolic, diastolic, mean	
CVP	Central Venous	Mean	
RA	Right Atrial	Mean	
LA	Left Atrial	Mean	
ICP	Intercranial	Mean	
ICP2	Intercranial	Mean	
ICP3	Intercranial	Mean	
ICP4	Intercranial	Mean	
CPP	Cerebral perfusion pressure	Mean	
CPP2			
CPP3			
RA	Right atrial pressure		
LA	Left atrial pressure		
GP1	Generic pressure 1	Systolic, diastolic, mean	
GP2	Generic pressure 2	Systolic, diastolic, mean	

NOTES:

- During PWP measurements, the monitor displays only mean PA pressure.
- The monitor only displays mean pressure if it detects a static pressure. This occurs when a pulsatile pressure signal's maximum and minimum values differ by less than 3 mmHg.
- If both ART and ICP are connected, the Cerebral Perfusion Pressure (CPP) appears. CPP is mean ART - ICP.

Precautions

The following precautions apply to IBP procedures. Refer to your hospital's clinical guidelines for further information. For general precautions regarding the use of accessories and peripheral devices, see "Safety Considerations" on page 8 of these Instructions for Use. For a complete list of Dräger provided IBP accessories available with this product, see page C-21. Any use of non-approved transducers may compromise the correct functioning of the device.

WARNING: To prevent patient injury, never reuse a single-use transducer.

Hardware Setup

Tubing

For maximum signal strength, choose the shortest possible length of high-pressure tubing for connection to the patient. Shorter tubing reduces signal attenuation and the effects of motion artifacts. High-pressure tubing limits signal dampening. Follow your hospital's clinical procedures in assembling the tubing system. Be sure to remove all bubbles from the system, as they dampen the signal and could lead to incorrect systolic pressure measurements.

Transducers

Transducers are available in a variety of shapes and sizes. (For a complete list of Dräger provided IBP accessories available with this product, see page C-21.) For information on connecting the transducer to the monitor and pod or Y-cable (see page 15-6).

Zeroing

You can either zero a single transducer at a time or use the "Smart Zero" function to zero all static transducers simultaneously.

You should zero a transducer under the following conditions:

- Immediately after you introduce the catheter into the patient's vascular system
- After you initially connect the transducer to a pressure pod
- Before each monitoring session
- Before you enter a calibration factor
- Whenever you change the tubing or transducer dome
- When the message *<IBP> Zero Required* is displayed

The following table outlines zeroing procedures:

<table>
<tr><th>Single Transducer Zero</th><th>Simultaneous "Smart Zero"</th></tr>
<tr><td colspan="2">1. Make sure the transducer is at heart level. Dräger recommends securing the transducer holders on the front of the hemodynamic pod for proper height.</td></tr>
<tr><td colspan="2">2. Close the transducer stopcock to the patient and open it to air.</td></tr>
<tr><td>3(a). Click on the parameter box associated with the transducer you want to zero. The parameter setup menu appears.
NOTE: You can also access the parameter menu as follows:
1) Press the Menu fixed key to display the main menu.
2) Click on Patient Setup.
3) Click on Parameters.
4) Scroll to the desired parameter and click.
4. Click on Zero.</td><td>WARNING: Do not use the 'Smart Zero' function if any pressure waveform is flat (nearly static). Only use the 'Smart Zero' function when all the stopcocks are opened to air.
3(b). Press the →0← key on the hemodynamic pod/MPod you wish to zero. The monitor determines which of the pod's transducers are open to air and zeroes them.
NOTE: If you use step 3(b) and are unable to zero a particular IBP with the →0← key, use the associated parameter box as described in 3(a). This method can be more effective.</td></tr>
<tr><td colspan="2">NOTE: If the procedure is successful, the monitor displays the message: <IBP> zero accepted. If the procedure fails, the monitor displays the message: <IBP> did not zero. Check the waveform. If spikes exceed three millimeters, repeat the procedure. If procedure fails after two attempts, replace the transducer or consult your hospital's technical personnel.</td></tr>
</table>

Calibration Procedures

Calibration procedures differ depending on whether you are using a disposable (single-use) or reusable transducer. You do not need to calibrate disposable transducers, which are already calibrated at the factory to the monitor's default value of 100. Prolonged use of reusable transducers, however, may adversely affect accuracy.

When using reusable transducers, you must re-enter the calibration factor periodically, as follows:

1. Open the setup menu of the IBP parameter you wish to monitor (see pages 15-2 and 15-14).
2. Scroll to **Cal Factor** and click.
3. Dial the calibration factor and click to confirm.

CAUTION: *Always zero a reusable transducer before calibration. You must calibrate the transducer within five minutes of a zero to obtain accurate measurements.*

You or your hospital's technical personnel can obtain the calibration factor using one of the following methods. Using either method, you must first zero the transducer. Always record the new calibration factor so it is available to future users of the transducer.

Calibration Using a Manometer or Simulator

To recalculate the calibration factor using a manometer or a pressure simulator:

1. Open the setup menu of the IBP parameter you wish to monitor (see page 15-14).
2. Connect manometer or pressure simulator to the transducer.
3. Close transducer to the patient and open it to the manometer.
4. Use the manometer or simulator to create a pressure on the transducer within the associated pressure range.
5. Click on **Manometer Cal** when the pressure on the transducer is stable.
6. Use the rotary knob to highlight the reading on the manometer or simulator and click. The monitor calculates the new factor and displays it as the **Cal Factor** value.

Calibration Using a Water Column

1. Add extension tubing if necessary, so the length of the tubing used to connect the transducer to the patient is at least 136 cm (136 cm of H_2O = 100 mmHg).
2. Fill the tubing with sterile flush solution, ensuring that there are no air bubbles.
3. Align the level of the tubing tip and the transducer membrane.
4. Open the transducer to the tubing.
5. Tape the tubing tip to an IV pole at a level 136 cm above the transducer dome.
6. Follow the procedure outlined above for the manometer, using 100 mmHg as the manometer value.
7. Remove excess calibration tubing before reconnecting the lines to the patient.

Hemodynamic Pods

The following hemodynamic pods are available for measuring invasive blood pressure:

- HemoMed pod
- Hemo2 pod
- Hemo4 pod
- PiCCO pod
- MPod – Quad Hemo

Pressure labels that represent two or four monitor pressure channels appear in LCDs on the Hemo2 and Hemo4 and PiCCO pods (For more information on the PiCCO pod, see chapter 27). The HemoMed and the MPod – Quad Hemo, which also support four monitor IBP parameters, does not have LCDs for pressure labels.

NOTE: The monitor automatically assigns P1a-d, P2a-d and P3a-d as temporary pressure labels when pressure transducers are initially connected. These temporary pressure labels must be relabeled with an appropriate permanent label corresponding to the pressure site being monitored.

NOTE: These temporary pressures are not included in graphical and tabular trends on the monitor until they are assigned a permanent label.

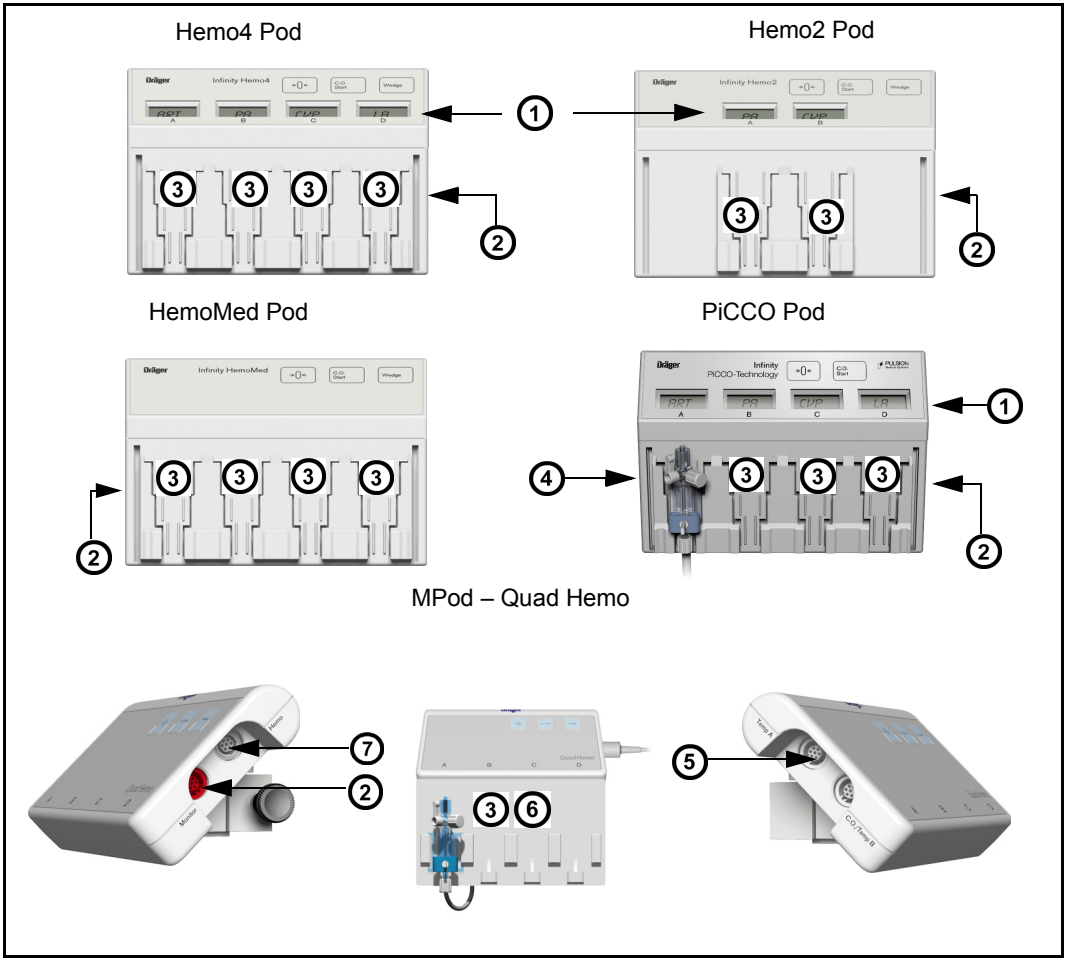
Fixed keys, located along the top of each hemodynamic pod, allow you to execute the following functions:

→0← — "Smart Zero" zeroes all transducers connected to pod and open to air.

— **Wedge** — Starts a pulmonary wedge pressure measurement (not available on the PiCCO pod).

— **C.O. Start** — Starts a cardiac output measurement.

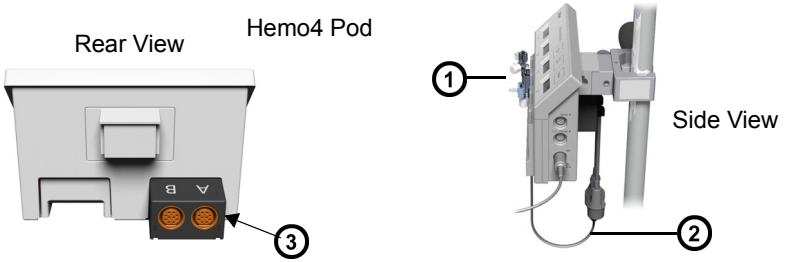
NOTE: C.O. for the PiCCO pod is derived differently than the Hemo2, Hemo4, HemoMed pods, or the MPod – Quad Hemo.



1	Pressure label LCDs
2	Connector to monitor on side panel. NOTE: All hemo pods connect to one of the round "Aux" connectors on the monitor, using a pod comm connection cable. HemoMed and the IBP Y-cables plug to the Orange "HemoMed" connector using a Hemo connection cable.
3	Transducer slots (on the MPod – Quad Hemo, the transducers are attached to a separate transducer plate which are available from the applicable manufacturer; purchase them locally or contact your Dräger representative for information. See C-1 for information on available transducer manufacturer plates for HemoMed, Hemo 2/4 and PiCCO pods)
4	Transducer
5	Temperature connectors

6	Transducer plate (MPod – Quad Hemo only)
7	Connector reserved for future use, not functional

Transducer cables plug into adapter blocks on the back of the pod and can be mounted on the front panel. Slide the transducer into the slot nearest the associated pod connector. With the MPod – QuadHemo, the transducers are attached to intermediate cables which are fastened to the back of the MPod.



1	Transducer
2	Transducer cable
3	Adapter blocks

To connect the hemodynamic pod to the monitor

1. Plug one end of the cable into the appropriate monitor connector.

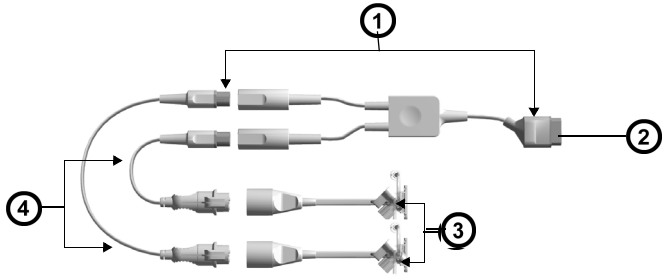
1	Hemo2, Hemo4 or MPod – Quad Aux/Hemo (second connector optional on Delta) or Picco pod connector
2	HemoMed connector (allows connection of HemoMed or IBP Y-cable)

2. Connect the other end of the cable into the hemodynamic pod connection port.

IBP Y-Cables

The IBP Y-cable increases the monitoring capabilities of the Hemo2 or Hemo4 pod or allows two IBP parameters to be measured without a hemodynamic pod. When plugged into the monitor, the Y-cable can accommodate up to two transducers, letting you take two IBP measurements simultaneously. The monitor automatically assigns P1a-d, P2a-d and P3a-d as temporary pressure labels when pressure transducers are initially connected. These temporary pressure labels must be relabeled with an appropriate permanent label corresponding to the pressure site being monitored.

NOTE: These temporary pressures are not included in graphical and tabular trends on the monitor until they are assigned a permanent label.



1	IBP Y-cable	**3**	IBP transducers (not supplied by Dräger)
2	Plug into HemoMed connector on monitor	4	Intermediate cables (not supplied by Dräger)

To connect the IBP Y-cable to the monitor

1. Plug a transducer into the intermediate cable as shown.
2. Plug the other end of the intermediate cable into the Y-cable (7 or 10 pin).
3. Repeat steps 1 and 2 for a second transducer.

4. Plug Y-cable into the monitor's HemoMed connector..

NOTE: For a complete list of Dräger IBP accessories available with this product, see page C-21.

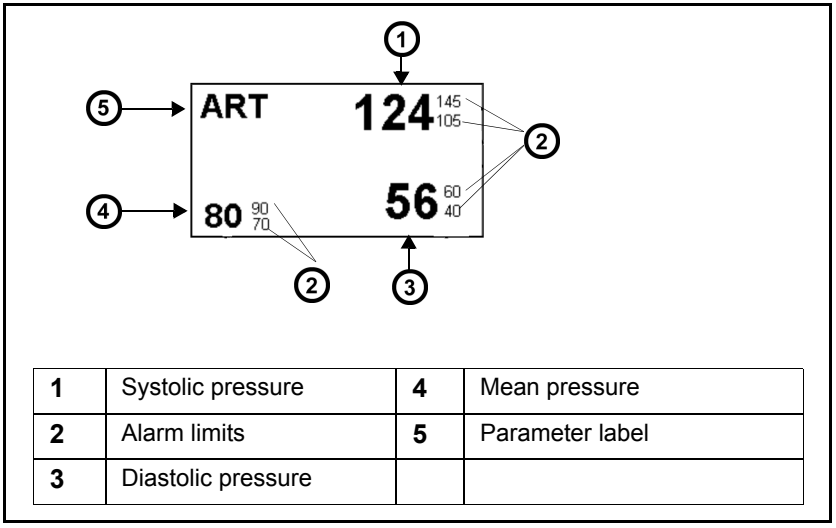
Display Features

Special features characterize the display of IBP parameter values and waveforms. Parameter boxes vary in appearance according to whether the parameter is pulsatile or non-pulsatile. Parameter boxes for pulsatile pressures (ART, LV, PA, RV, GP1, GP2, and temporarily assigned labels P1a-P3d) display systolic, diastolic, and mean pressure values.

NOTE: The monitor automatically assigns P1a-d, P2a-d and P3a-d as temporary pressure labels when pressure transducers are initially connected. These temporary pressure labels must be relabeled with an appropriate permanent label corresponding to the pressure site being monitored.

NOTE: These temporary pressures are not included in graphical and tabular trends on the monitor until they are assigned a permanent label.

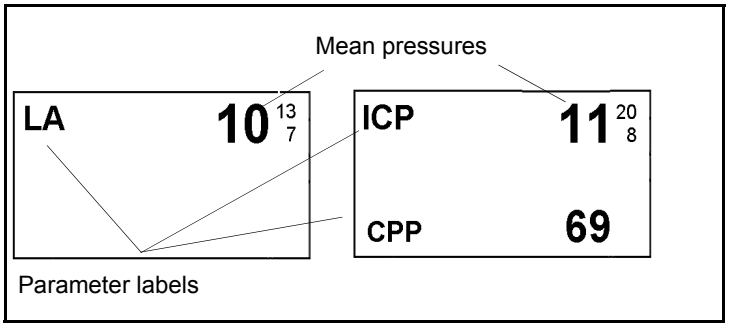
A typical pulsatile pressure parameter box is shown below:



1	Systolic pressure	**4**	Mean pressure
2	Alarm limits	**5**	Parameter label
3	Diastolic pressure		

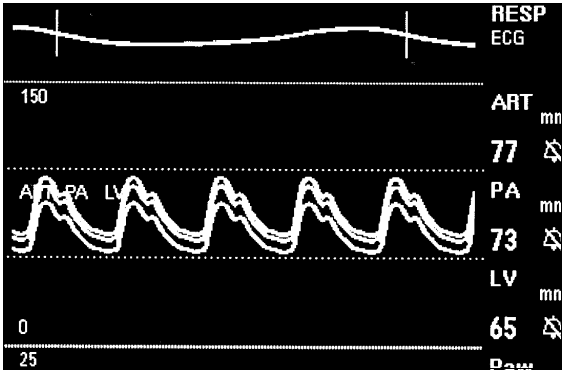
NOTE: Page 2-13 describes how to increase the size of the mean pressure value in the IBP parameter box.

Parameter boxes for non-pulsatile pressures (LA, RA, CVP, ICP, ICP2, ICP3, ICP4) display mean pressures only:



The CPP parameter is calculated and displayed whenever the ICP and ART parameters are monitored simultaneously (CPP = ART_{mean} - ICP). CPP/CPP2/CPP3/CPP4 is displayed in the bottom of the ICP/ICP2 /ICP3/ICP4 parameter box.

IBP waveforms can be displayed in standard or overlapping format. When IBP waveforms are overlapped, you can show scale values for the overlapped parameters side by side (the order of the display corresponding to the priority of the parameter boxes) by setting the **Common Scale** setting to **OFF** on the IBP setup menu (see page 15-15). The following figure shows overlapped IBP waveforms when the **Common Scale** setting is set to **ON**.



IBP Setup

IBP setup is a two-phase process involving the following procedures. After configuring individual IBP parameters, you must assign them to connected IBP channels.

To access an IBP parameter setup menu

- Click on the respective parameter box on the main screen;

or

1. Press the **Menu** fixed key to display the Main menu.
2. Click on **Patient Setup**.
3. Click on **Parameters**.
4. Scroll to the IBP parameter you want to configure (ART, LV, PA, RV, CVP, RA, LA, ICP, ICP2, ICP3, ICP4, GP1, or GP2) and click. The setup menu appears, with the name of the parameter you have selected displayed at the top of the menu.

Quick Reference – IBP Setup

Available functions, present on all IBP setup menus, are described in the following table:

IBP Setup Menus		
Menu Item	**Description**	**Available Settings**
Zero	Zeroes the transducer and displays time and date of last zeroing operation (see page 15-3).	Not applicable (read-only)
Scale	Sets the upper values of the IBP waveform scale.	• **ART, CVP, LV, GP1, GP2, ICP, ICP2, ICP3, ICP4, LA, P1-3 (a-d), PA, RA and RV: 5, 10, 15, 20, 25, 30, 35, 40, 50, 75, 100, 125, 150, 175, 200, 225, 250,** and **300 mmHg**
Filter	Adjusts the filter applied to the IBP signal.	**8, 16,** and **32 Hz**
Cal Factor	Determines the calibration factor.	**80 – 120**
Last Cal Factor	Displays the time of the last successful calibration.	Not applicable (read-only)

IBP Setup Menus		
Menu Item	**Description**	**Available Settings**
Manometer Cal	Allows you to enter the manometer or simulator reading and start calibration (see page 15-5).	**10 – 300**
Pressure Overlap	Allows you to view up to four IBP parameters on a single baseline.	• **ON** • **OFF**
Common Scale	Sets the waveforms to one scale.	• **OFF, 5, 10, 15, 20, 25, 30, 35, 40, 50, 75, 100, 125, 150, 175, 200, 225, 250, and 300**
Large Mean	Increases size of all IBP mean values.	• **ON** • **OFF**
Cath Disconn Detection (ART setup menu only)	Enables or Disables the detection of ART catheter disconnected (from the patient) condition. If selection is Enabled and ART limit alarms are ON, the monitor will annunciate a High grade alarm for this condition. If the ART limit alarms are OFF, the monitor will only display a status message in the message area. If selection is Disabled, no alarm or status message is displayed or annunciated.	• **Enabled** (default) • **Disabled**
Cath Disconn Archive (ART setup menu only)	Allows you to store and/or record automatically an alarm event for ART catheter disconnected (from the patient) condition. **NOTE:** The archive for this condition shall follow the ART S, D or M alarms (i.e. the Cath Disconn selections shall be active only if the ART limit alarms are ON) **NOTE:** The Cath Disconn Archive setting will be ghosted/unavailable when the ART Cath Disconn detection is Disabled.	• **OFF** (default) • **Record** • **Store** • **Store/Record**
Wedge Start (PA setup menu only)	Starts a wedge pressure measurement Same function as the Wedge fixed key on a hemodynamic pod (see page 15-20), **NOTE:** Not available on the Picco pod.	Not applicable
Min Scale (ICP, ICP2, ICP3, ICP4 setup menus only)	Sets the ICP waveform scale to +/- 25 mmHg (+/- 3.3 kPa). **NOTE:** When the **Min Scale** setting is set to **ON**, the **Scale** selections are unavailable.	• **ON** • **OFF**

IBP Setup Menus		
Menu Item	**Description**	**Available Settings**
Pressure Labels	Displays the Pressure Label screen (see page 15-16).	Not applicable
<IBP Parameter> Alarms	Displays alarms for parameter and associated variable on Alarm Limits table.	Not applicable

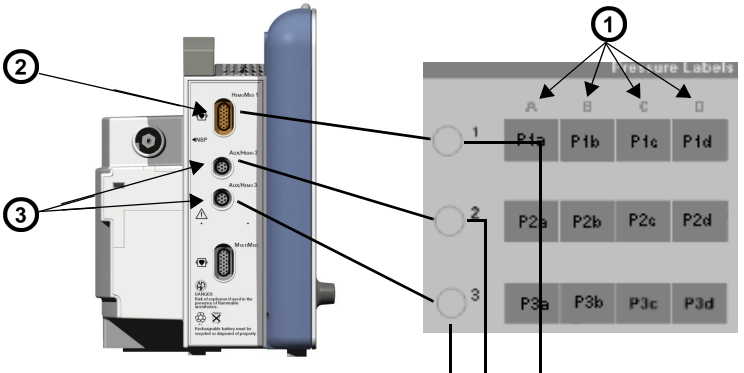
Labeling Pressure Channels

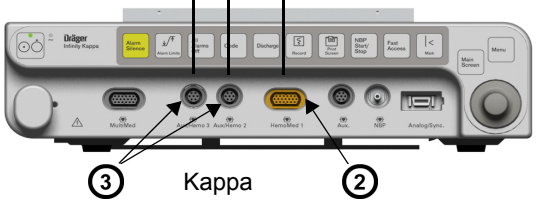
The pressure label determines how a signal is analyzed and reported to the monitor. For detailed information about the various types of pressure labels, see page 15-2.

When you assign a new label to a pressure channel, the monitor clears the parameters and conditions set for the previous label (including alarms and waveform scales) and replaces them with settings for the new label. Trends are stored according to the assigned label. **Zero**, **Cal Factor**, and **Cal Date & Time** settings are associated with the pressure channel and are kept even during a label change.

The **Pressure Labels** screen can display up to twelve IBP sources in a 3 x 4 matrix. The monitor assigns an automatic pressure label (**P**[**1**-**3**][**a**-**d**]) to each box.

Signal sources are displayed in rows [1-3], with Row 1 representing data received from the HemoMed pod or Y-cable, and Rows 2 and 3 representing data from the Hemo2, Hemo4, MPod – Quad Hemo or PiCCO pod, either of which may be connected to an Aux/Hemo connector of the monitor. The letters [a-d] identify the transducer location on the pod.



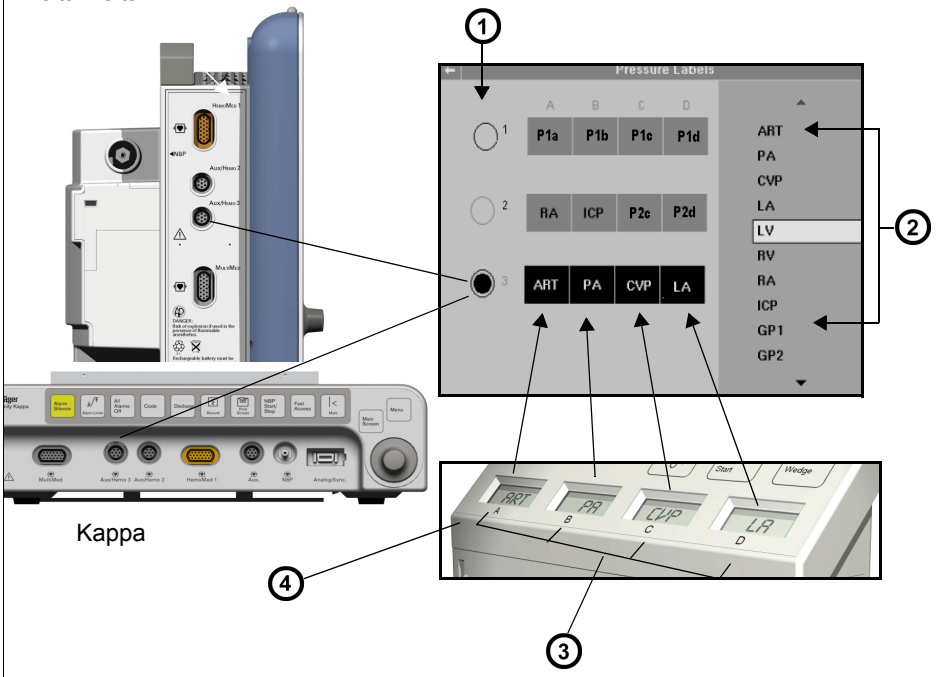


1	Transducer location letter
2	HemoMed 1 or Y-cable connector
3	Aux/Hemo2, Aux/Hemo 3, Hemo4, MPod – Quad Hemo or PiCCO connector

To assign a label to a pressure channel

1. Access an IBP setup menu (see page 15-14).
2. Scroll to **Pressure Labels** and click.
3. Scroll to the channel you wish to label and click. The first label in the column on the right side of the menu is highlighted.
4. Scroll to the desired label and click.
5. Repeat steps 3 and 4 to assign other pressure labels.

Delta/Delta XL



Kappa

1	Signal source: 1 – HemoMed or Y-cable; 2 & 3 – Hemo2, Hemo4, Infinity MPod – Quad Hemo, or PiCCO
2	Select labels
3	Transducer location A, B, C, D labels Note: not visible on the HemoMed pod (label from left to right)
4	Hemo4 pod (example only) showing Aux/Hemo3 monitor connection and parameter labels on

Pressure labels are color-coded within this window to indicate their status. To assign a label, the hemodynamic pod or Y-cable must be connected to the monitor.

Color-Coding for Pressure Labels		
Background	**Text**	**Status**
Black	Green	• Pod or Y-cable connected to monitor • Transducer connected
	White	• Pod or Y-cable connected to monitor • Transducer not connected
Gray	White	• Pod or Y-cable not connected to monitor • Transducer not connected

NOTE: For Hemo2 pods, the pressure label screen shows two ghosted fields, because the pod monitors two pressures.

Pressure Label Conflicts

Each pressure label can be assigned to one location. If you try to reuse a label, the monitor displays a caution informing you that the label is in use and asks if you want to continue. If you choose **YES**, the monitor puts the label in the currently selected box and places an automatic pressure label (P1a– P3d) in the previous location.

NOTE: The HemoMed pod does not store any pressure labels assigned by the monitor.

Pod-Monitor Label Conflicts

Hemo2, Hemo4, PiCCO pods, and MPod – Quad Hemo and the monitor store pressure label assignments. When a pod with previously stored labels is connected to a monitor, the pod and the monitor may be storing different pressure labels for the same channel, causing a conflict.

The label stored in a pod prevails if a transducer is connected to the pod. The pod keeps the label, and the monitor assigns that parameter label to the **Pressure Labels** screen. If a transducer is not connected to the pod, the label stored in the monitor memory has priority.

Duplicate Label Conflicts Between Pods

Conflicts also occur when two Hemo2, Hemo4, MPod – Quad Hemo or PiCCO pods are configured for the same labels and transducers are connected to the pods. Scenarios for duplicate label conflicts may vary. They may be detected when a second pod is connected to an operating monitor, in which case the label of the first connected pod prevails. If two pods storing duplicate labels are connected to a monitor prior to start-up, the pod connected to the lowest-numbered pod port on the monitor (Aux/Hemo2 or Aux/Hemo3) has priority, while the other pod is assigned an automatic label (P1a–P3d).

Pulmonary Wedge Pressure Display

NOTE: PWP is not available with the PiCCO pod.

WARNING: During wedge pressure measurements:

- **Alarm monitoring for the PA invasive pressures, if enabled, is temporarily disabled to prevent nuisance alarms. The parameter box does not display an alarm paused icon because alarm monitoring is automatically re-enabled upon completion of a wedge pressure measurement.**
- **For the safety of the patient keep the balloon-inflation time to the minimum necessary to acquire an accurate PWP value. Prolonged inflation of the balloon can result in pulmonary hemorrhage or infarction.**
- **Do not over-inflate the balloon because an over-inflated balloon can rupture the pulmonary artery.**
- **The PA catheter may move into the wedge position before the balloon is inflated. One sign of this "catheter drift" is that the PWP waveform becomes wedge shaped. Follow your hospital's clinical guidelines to correct the catheter's position.**

The monitor has a special display that accommodates taking pulmonary wedge pressure measurements. The monitor averages the PA waveform values for 10 seconds and calculates a wedge pressure value (PWP). During the measurement, the PA parameter box shows no systolic or diastolic values, and PA alarms are disabled.

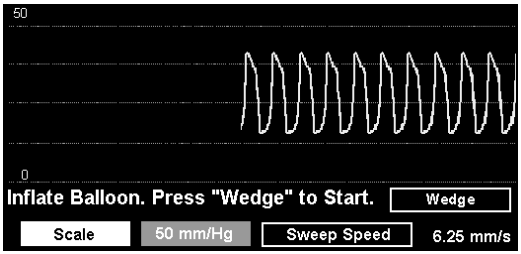
Follow your hospital's procedures for setup, then take a PWP measurement as follows:

1. Verify that a PA catheter has been properly inserted and the catheter tip is situated in the pulmonary artery.
2. Press the **Wedge** fixed key on the pod acquiring the PA signals.

   or

   Open the **PA** setup menu, scroll to **Wedge Start** and click.

The following screen appears:



3. Click on **Scale**.
4. Scroll to the desired waveform scale (**5, 10, 15, 20, 25, 30, 35, 40, 50, 75, 100, 125, 150, 175, 200, 225, 250,** or **300 mmHg**) and click.
5. Click on **Sweep Speed**.
6. Scroll to the desired sweep speed (**6.25**, **12.5**, **25**, or **50 mm/s**) and click.
7. Inflate the balloon and click on **Wedge** to start the measurement. The message, *Wedge in Progress*, appears.

   When the calculation is complete, the PA and RESP waveforms stop, a horizontal cursor line through the PA waveform indicates the new PWP value, and the monitor instructs you to deflate the balloon.

NOTE: You can also press the **Wedge** fixed key again to save the PWP value.

Control keys at the bottom of the screen allow you to save, navigate or quit the display. After four minutes, the monitor automatically saves the PWP value and exits to the main screen. The PA and RESP waveforms resume their previous size and sweep speed, PA systolic and diastolic values are restored, and PA alarms are automatically enabled.

Status Messages

Message	Possible Cause	Suggested Action
<xx> S <#> *<xx> D <#>* *<xx> M <#>*	The pressure value is outside the alarm limits.	• Check the patient and treat, if necessary. • Access the Alarm Limits menu and change the alarm limits. • Check the equipment and replace it, if necessary.
<xx> Out of Range (High) *<xx> Out of Range (Low)*	The pressure signal is out of the measurement range.	• Check the patient and treat, if necessary. • Access the Pressure Labels menu and assign the correct label. • Check the equipment and replace it, if necessary.
<xx> Please Check Zero	The IBP zero value stored in the monitor may not correspond to the peripheral device.	Zero the transducer.
<xx> Static Pressure	Static pressure was detected on a pulsatile signal, owing to one of the following conditions: • A physiological condition, for example, asystole. • The transducer was turned off to the patient. • A catheter tip lodged against a vessel wall. • A clot on the catheter tip.	• Check the patient and treat,if necessary. • Open the system to the patient by turning the stopcock. • Follow hospital procedures for dislodging catheters. • Follow hospital procedures for clotted catheters.
<xx> Unplugged	The pressure transducer for the specified parameter is either unplugged or defective.	• Active pressure: reconnect or replace the cable. • Inactive pressure: turn off alarms.
<xx> Zero Required	The pressure transducer for the specified parameter requires zeroing.	Zero the transducer.
<xx> Zero Accepted	The zeroing of the transducer was successful	No action is required.
<xx> Did Not Zero	The zeroing of the transducer failed because of one of the following conditions: • Excessive signal noise • A non-static waveform	• Keep all tubing motionless, then rezero. • Change the transducer. • Check the stopcock, then rezero.
<xx> Did Not Zero - Offset Error	The zeroing of the transducer failed because static pressure was too high or too low.	• Rezero the transducer. • Loosen and retighten the transducer dome, then rezero the transducer. • Replace the transducer.
NOTE: <xx> represents the IBP parameter label associated with the displayed message.		

Message	Possible Cause	Suggested Action
<xx> Calibrating	Mercury calibration is in progress.	Complete the calibration before you begin monitoring the patient.
<xx> Cal. Accepted	Mercury calibration succeeded *or* the user-entered calibration factor was accepted.	No action is required.
<xx> Cal. Failed - Not Static	The mercury calibration failed because the input pressure was not static.	• Make sure the transducer is closed to patient. • Check for leaks. • Keep all tubing motionless. • Rezero the transducer. • Refer to the calibration procedures (see page 15-5). • Loosen and retighten the transducer dome, then rezero the transducer. • Replace the transducer.
<xx> Cal. Failed - Out of Range	The mercury calibration failed because the measured value was too high or too low.	• Make sure the transducer is zeroed, then retry. If the retry fails, replace the transducer. • If calibration requires a factor outside this range, replace the transducer.
<xx> Zero before Cal.	During calibration, more than 5 minutes have elapsed since the last successful zeroing of the transducer.	Zero the transducer.
<xx> H/W Failure	IBP channel hardware failure.	• Check the hardware and replace it, if necessary. • Call the hospital's technical personnel or DrägerService.
Hemo Pod [n] Disconnected	The hemo pod [1, 2, or 3] is not connected to the monitor.	Check the cables and connections and replace it, if necessary.

Message	Possible Cause	Suggested Action
<xx> Transducer Failure	Transducer failure (IBP transducer electrically open or shorted) or electrical interference due to electro-surgery equipment. **NOTE**: This error condition will not be displayed if the following IBP pods are used: • Hemo2 • Hemo4 • QuadHemo hardware revision 9 or lower • HemoMed in combination with an A105 monitor main processor board • If IBP (S,D, or M) limit alarms are ON, the monitor will annunciate a Med grade alarm for this condition. If the IBP (S,D, or M) limit alarms are OFF, the monitor will only display a status message in the message area.	Check the transducer cable and/or transducer and replace if necessary. Make sure there is no direct electrical interference present.
ART CATH Disconnected?	A sudden drop in arterial pressure to a value less than 10 mmHg (flat line) detected due to arterial catheter becoming detached from patient or from a stop cock on the IV line opened to air. **NOTE:** This status message will not be available when backwards compatibility is enabled. • Enables or Disables the detection of ART catheter disconnected (from the patient) condition. If selection is Enabled and ART (S,D, or M) limit alarms are ON, the monitor will annunciate a High grade alarm for this condition. If the ART limit alarms are OFF, the monitor will only display a status message in the message area. If selection is Disabled, no alarm or status message is displayed or annunciated.	Confirm ART catheter is properly placed. Re-zero transducer as necessary. Follow hospital procedure to reinsert the ART catheter as necessary.
NOTE: <xx> represents the IBP parameter label associated with the displayed message.		

16 Cardiac Output (C.O.)

Overview

The monitor uses thermodilution to measure the blood flow pumped by the heart. A solution of known temperature and volume is injected into the blood stream in the right atrium. The injectate mixes with and cools the surrounding blood. The blood temperature reaches its minimum relatively quickly and then warms up slowly until it returns to the blood temperature baseline. The total drop in the patient's blood temperature is inversely related to the patient's cardiac output: the lower the cardiac output, the more the injectate cools the blood down, and vice versa. A thermistor in the catheter tip continuously measures the temperature of the blood as it leaves the heart.

The monitor restores C.O. settings to their default values when you discharge a patient or select **New Patient** after turning on the monitor. If you subsequently press the **C.O. Start** fixed key (or if you press **C.O. Start** after a catheter is disconnected), the monitor displays the C.O. setup menu, sounds a tone, and requests that you confirm the current setup data. Press the **C.O. Start** fixed key within 30 seconds to confirm the current setup data, display the C.O. Averaging screen and begin measuring cardiac output.

Blood flow is measured in liters per minute. In computing cardiac output, the monitor takes the following factors into account:

- Injectate volume, temperature, density, and specific heat
- Blood baseline temperature, density, and specific heat
- Temperature changes of the blood-injectate mixture
- Area under the temperature curve

Accuracy

To optimize cardiac output measurement:

- Follow the recommendations made by the manufacturer. Dräger recommends you place the prefilled syringes or the closed injectate delivery system into an ice bath.
- Check the ice bath regularly and add ice as needed to maintain a temperature between 0 °C and 5 °C. Dräger recommends cold (refrigerated) saline solution.
- Verify the injectate volume.
- Verify the computation constant. An incorrect computation constant is a common cause of error.
- Use an in-line injectate system. Systems that measure the temperature of the injectate in the ice bath may introduce error, since the injectate temperature changes in the time between its removal from the ice bath and injection. Use an in-line temperature sensor to eliminate this source of error.
- If you hand-fill your syringes, fill them with the same volume each time. The recommended amount is 10cc for adults and 5cc for pediatric patients. Avoid touching the body of the syringe. The warmth of your hand will warm the injectate very quickly.
- Inject the entire volume in one swift, continuous motion.
- Perform the injection at end-expiration. Taking successive cardiac output measurements at different points in the respiratory cycle can give different measurements, especially for patients on mechanical ventilators.
- Discard results that are widely different from the general trend, and those associated with irregularly-shaped (for example, notched) curves.

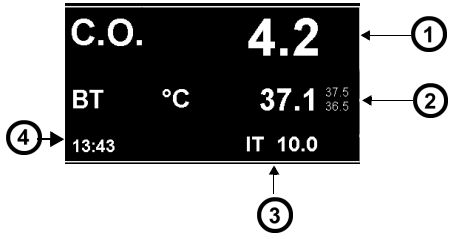
NOTE: If you use a room temperature injectate, use 10 cc for the injectate volume, unless clinically contraindicated. However, measurements are more reliable when using cold (refrigerated) saline solutions.

Main Screen Display

When Cardiac Output (C.O.) measurements are available, the most recently saved C.O. average appears in the upper right of the C.O. parameter box on the main screen.

- Cardiac Output (C.O.) — Average of the last series of measurements saved in liters per minute (L/min).
- Blood temperature (BT) — Patient's blood temperature acquired from the Hemo2 or Hemo4 pod currently used to measure C.O.
- Time of the C.O. Average — Time the currently displayed C.O. average was taken.
- Injectate temperature **(IT)** — Temperature of the injectate solution acquired from the hemodynamic pod being used for C.O. measurements.

The following diagram shows a typical C.O. parameter box.



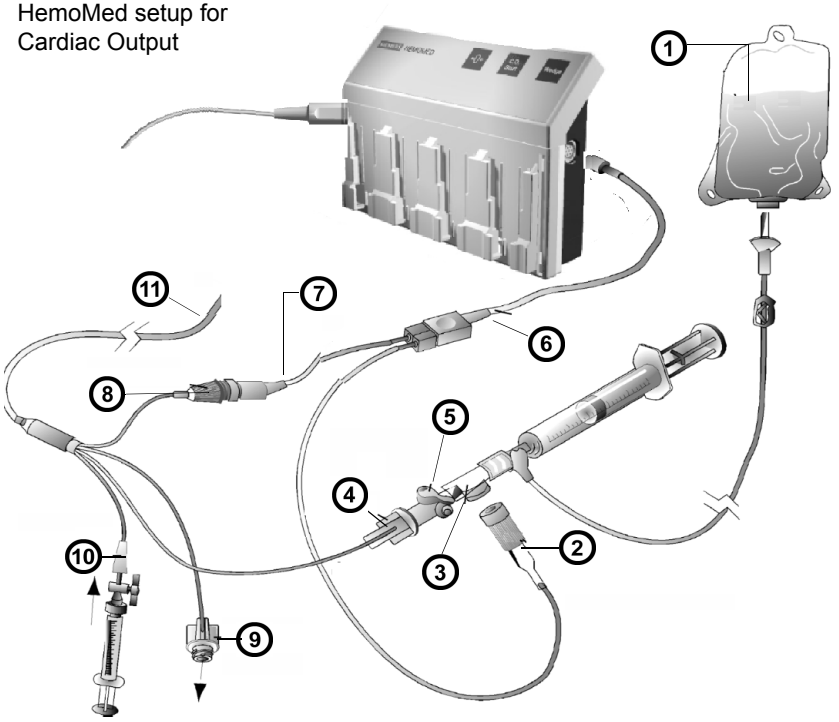
1	Last saved C.O. average
2	Blood temperature (reading and alarm)
3	Injectate temperature
4	Time of last saved C.O. average

NOTE: If no new measurements have been taken for 24 hours, the C.O. average and time stamp are blanked.

C.O. Setup - Hardware

The Hemo2, Hemo4, MPod – Quad Hemo and HemoMed pods are used with the monitor for cardiac output monitoring. The following illustration shows a typical cardiac output setup using the HemoMed pod:

HemoMed setup for Cardiac Output



1	Injectate solution	**7**	C.O. catheter cable
2	Injectate temperature probe	**8**	Thermistor port
3	Thermistor T-piece	**9**	Distal lumen
4	Proximal lumen	**10**	Balloon lumen
5	Stopcock	**11**	Thermodilution catheter
6	C.O. Y-cable		

NOTE: Hemo2 and Hemo4 pods have an additional and clearly marked connector for body temperature monitoring only. For more information on hemodynamic pods, see page 14-6.

Cardiac output signals, injectate temperature (IT), and blood temperature (BT) can be obtained from the 2-pressure pod (Hemo2) or the 4-pressure pod (Hemo4, or MPod – Quad Hemo). You can acquire cardiac output signals but not body temperature signals from the HemoMed.

NOTE: Both IT and BT signals must be obtained from the same pod.

C.O. Setup Menu

To access the C.O. setup menu

- Click on the C.O. parameter box on the main screen.

or

1. Press the **Menu** fixed key to display the Main menu.
2. Click on **Patient Setup**.
3. Click on **Parameters**.
4. Scroll to **C.O.** and click to display the C.O. setup menu.

Quick Reference – C.O. Setup

Menu Item	Description	Available Settings
C.O. Start	Starts a C.O. measurement (see page 16-10)	• Not applicable
Catheter Type	Displays the currently selected catheter type. **NOTE**: Due to corporate mergers, Baxter cardiac output catheters and accessories may be labelled as being from Edwards. Ohmeda cardiac output catheters and accessories may be labelled as being from Becton Dickinson (BD). Contact Edwards and/or BD if there is any doubt as to the identity of the cardiac output catheters or accessories.	Click on one of the following to change the catheter type: • **BD/Ohmeda** • **Edw./Baxter** • **Arrow** • **Other**
Catheter Size	Displays the currently selected catheter size. **NOTE**: If Other is selected for Catheter Type, this field is ghosted.	Click on one of the following to change the catheter size: • **5, 7,** or **7.5 F**

Menu Item	Description	Available Settings
Injectate Volume	Displays the currently selected volume of the injectate used to measure cardiac output. **NOTE**: If **Other** is selected for **Catheter Type**, this field is ghosted.	• **3.0**, **5.0**, **10.0 cc**
Comp. Constant	Compensates for discrepancies in catheters; see page 16-8 for more detailed information.	Not applicable
Mode	Determines the mode of measurement for cardiac output; see page 16-7 for more detailed information	• **Auto** • **Manual**
BT Alarm	Opens the Alarm Limits table beginning with temperature parameters.	Not applicable

Measurement Mode

Procedures for measuring cardiac output differ according to the mode of measurement you select. You ordinarily measure C.O. in automatic mode. If unstable blood temperatures, artifact, or other conditions prevent an automatic measurement, you can still take C.O. measurements by selecting manual mode. (**Manual** is the default setting on the C.O. setup menu.)

In automatic mode, the *READY* message appears when the monitor determines that the baseline blood temperature is stable. Do not make a C.O. injection before this message appears (this message indicates that the monitor is ready to detect the injectate's decreased temperature). An unstable blood temperature removes the READY message. It does not reappear until the patient's blood temperature is stable again.

In both manual and automatic modes, the monitor sounds an attention tone when the C.O. value has been computed. On the C.O. Averaging screen, the value is displayed in the next available box, and the **Save AVG** field is updated. The value in the main screen parameter box does not change until you save the C.O. average.

To change the measurement mode, open the C.O. setup menu as described on page 16-6 and select the desired mode. Procedures for measuring C.O. in automatic or manual mode are described on the following page.

Catheters (Comp. Constant)

WARNING: An incorrect computation constant may yield incorrect C.O. measurements and put the patient at risk. Confirm that the manually entered computation constant is correct for the catheter you are using.

The monitor compensates for discrepancies in catheters used to measure C.O. The catheter compensation factor is listed as Comp. constant on the C.O. setup menu.

If you use an Edwards/Baxter, BD/Ohmeda, or Arrow catheter, the computation constant is automatically chosen for you. You can, however, enter a different value (whenever, for instance, you change either injectate volume or temperature). Choosing a catheter type determines the available choices under **Catheter Size** and **Injectate Volume**. The following tables list the computation constants for Edwards/Baxter, BD/Ohmeda, and Arrow catheters.

Edwards/Baxter				
		Injectate Temperature (IT) Sensor connected		IT Sensor disconnected
Catheter Size	Injectate Volume	IT = -5° to +16°	IT = 16° to 27°C	IT = 0°C
7F	10 cc	0.561	0.608	0.542
7F	5 cc	0.259	0.301	0.247
7.5F	10 cc	0.574	0.595	0.564
7.5F	5 cc	0.287	0.298	0.257
5F	5 cc	0.285	0.307	0.270

BD/Ohmeda				
		Injectate Temperature (IT) Sensor connected		IT Sensor disconnected
Catheter Size	Injectate Volume	IT = -5 °C to +16 °C	IT = 16 °C to 27 °C	IT = 0 °C
7.5F	10 cc	0.579	0.628	0.566
7.5F	5 cc	0.281	0.309	0.270
7.5F	3 cc	0.160	0.181	0.151
7F	10 cc	0.579	0.628	0.566
7F	5 cc	0.281	0.309	0.270
7F	3 cc	0.160	0.181	0.151

BD/Ohmeda				
		Injectate Temperature (IT) Sensor connected		IT Sensor disconnected
Catheter Size	Injectate Volume	IT = -5 °C to +16 °C	IT = 16 °C to 27 °C	IT = 0 °C
5F	5 cc	0.291	0.316	0.279
5F	3 cc	0.170	0.188	0.160

Arrow			
		Injectate Temperature (IT) Sensor connected	
Catheter Size	Injectate Volume	IT = -1 °C (±1 °C)	IT = 24 °C (±1 °C)
7.5F	10 cc	0.532	0.586
7.5F	5 cc	0.249	0.265
7.5F	3 cc	0.131	0.155
7F	10 cc	0.541	0.601
7F	5 cc	0.250	0.273
7F	3 cc	0.134	0.156
5F	5 cc	0.267	0.303
5F	3 cc	0.157	0.192

If you choose **Other** as the catheter type, you must enter a computation constant in order to display or select the catheter size and injectate volume. Consult the documentation included with the catheter for computation constants, and select one that corresponds to the injectate volume and temperature being used.

To enter a computation constant

1. From the C.O. menu, click on **Comp. Constant**. A data-entry screen appears on the menu's right side:
2. Enter the computation constant and click on **Accept** to confirm your entry. The manually entered computation constant is displayed to the right of the Comp. Constant key.

NOTE: If the monitor detects that a new Edwards/Baxter, BD/Ohmeda, or Arrow catheter is connected, the monitor automatically chooses the correct computation constant for you. If the C.O. setup menu is displayed when that occurs, the monitor does not update its displayed computation constant value until the next C.O. measurement is taken. The correct value is used for the C.O. measurement, however.

C.O. Measurement Procedures

To measure C.O. in automatic mode

1. Press the **C.O. Start** fixed key on the hemodynamic pod to display the C.O. averaging screen. A tone sounds and a *READY* message appears when the monitor detects a stable blood temperature.
2. Inject the saline solution into the patient's bloodstream after you see the *READY* message. A thermodilution curve appears, displaying the change in blood temperature.

NOTE: If the *READY* message fails to appear or appears only intermittently, switch to Manual mode and repeat step 2.

3. Repeat step 2 to take an additional measurement, making sure you wait for the *READY* message. If a temperature drop is not is detected within four minutes, the Averaging screen closes, and you must repeat steps 1 and 2 for additional C.O. measurements.

To measure C.O. in manual mode

1. Press the C.O. Start fixed key on the hemodynamic pod or select C.O. Start on the C.O. setup menu. The *READY* message appears for 30 seconds or until a blood temperature drop is detected.
2. Immediately inject the saline solution and wait for the monitor to calculate a C.O. value. The monitor begins to calculate a C.O. value as soon as it detects a blood temperature drop.

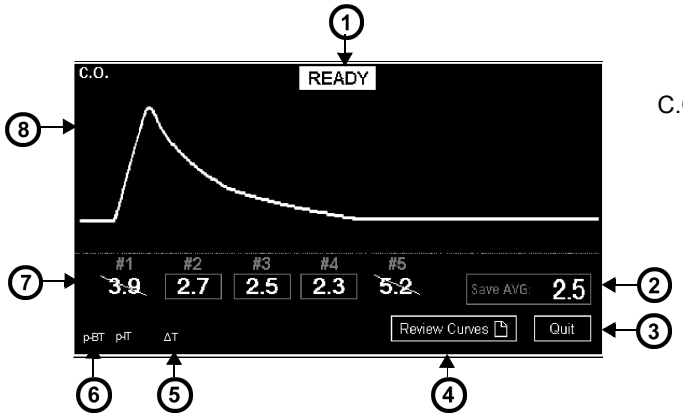
   If the monitor fails to detect the temperature drop caused by the injectate, the waveform disappears after 30 seconds. An attention tone sounds, an error message appears in the local message area, and three asterisks (*** * ***) appear in the **Save AVG** field. Repeat steps 1 and 2 for additional measurements.

NOTE: **C.O. Start** is only available as a menu item in manual mode. As soon as you initiate a C.O. measurement, the **C.O. Start** key is disabled and the **C.O. Start** menu item is ghosted until a value is reported.

Averaging C.O. Measurements

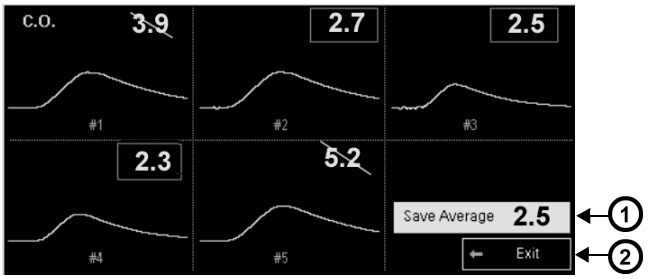
Differences in injection technique can cause variations in measurements performed on the same patient. To compensate for such discrepancies, you can review results of up to five measurements and use them to compute a C.O. average. The C.O. Averaging screen is displayed whenever you begin a C.O. measurement.

The Review Curves screen duplicates the five values displayed on the C.O. Averaging screen with their corresponding thermodilution curves.



C.O. Averaging

1	Stable blood temperature detected (see page 16-8)	5	Current injectate temperature
2	Current average of C.O. values (Click to save; displays *** if values are out of range)	6	Current blood temperature
3	Exit C.O. Averaging screen (C.O. value not stored)	7	C.O. measurement values (Newest value at right; click on value to exclude it from average and mark with slash)
4	Access Review Curves screen (see below)	8	Thermodilution curve; Highest point represents lowest blood temperature (measured at exit from the heart)



1	Current average of C.O. values (click to save average; *** appear if the values are out of range)
2	Button for returning to C.O. Averaging screen

Review Curves

Saving a C.O. Average

Click on **Save AVG** to save the average of all indicated values and end the C.O. measurement session. The average is written to trends and updated in the Main Screen parameter box to the time of the latest measurement included in the average. You also save the calculated average any time you quit the C.O. Averaging screen by accessing another menu or the Main Screen, or whenever four minutes to pass without a C.O. measurement.

Status Messages

Message	Possible Cause	Suggested Action
BT > UL *BT < LL*	The blood temperature is outside the alarm limits, due to one of the following conditions: • A physiological condition • Inappropriate alarm limits • A defective sensor or cartridge	• Check the patient and treat, if necessary. • Change the alarm limits. • Check the equipment and replace it, if necessary.
BT Out of Range (High) *BT Out of Range (Low)*	The blood temperature is outside the measurement range (25 °C to 43 °C), because of a defective sensor or cartridge.	Check the equipment and replace it, if necessary.
C.O. Already In Use	The catheter and injectate probe are connected to different hemo pods.	• Disconnect the intermediate cables from the hemo pods. • Connect both the catheter and the injectate probe to the same cable and reconnect them. • Discard the unused intermediate cable.
C.O. Out of Range (High) *C.O. Out of Range (Low)*	The cardiac output value is greater than 20 liters/min or less than 0.5 liter/min because of the following conditions: • A physiological condition • Unstable baseline • Incorrect injectate volume, catheter size, or Comp. Constant • Defective catheter, cable, or cartridge	• Check the patient and treat, if necessary. • Use cooler injectate. • Enter the correct values in the C.O. menu. • Repeat the measurement. If the message persists, replace the defective components.
C.O. Injectate Too Cold	The injectate is cooler than –5 °C.	Use an injectate within the range of –5 °C to +30 °C.
	Defective cable or hemodynamic pod.	Check the equipment and replace it, if necessary.
C.O. Injectate Too Warm	The injectate is warmer than +30 °C.	Use an injectate within the range of –5 °C to +30 °C.
	The injectate probe is not connected.	Check probe connection. If problem persists, replace the probe.
	Defective cable or hemodynamic pod.	Repeat the measurement. If the problem persists, replace defective part.

Message	Possible Cause	Suggested Action
C.O. No Temperature Change	The detected temperature change was < 0.1 °C, because of the following conditions: • **C.O. START** was pressed but no injection was made • The injectate volume was too small • Defective catheter • The injectate temperature was too warm.	• Repeat the measurement. • Use a larger injectate volume. • Repeat the measurement. If problem persists, replace the catheter. • Use colder injectate.
C.O. Use Cooler Injectate	• < 5 °C difference exists between patient's blood temperature and the injectate temperature. • Injectate temperature of greater than 30°C.	Use a cooler injectate.
C.O. Injectate Set to <IT value>!	**C.O. START** was pressed, but no injectate probe is connected.	Connect injectate probe.
C.O. Average Saved	The C.O. average has been saved.	None required.
C.O. Transducer Unplugged	A cable or transducer has become disconnected.	Reconnect the cable or transducer. If message persists, replace defective part.
C.O. Poor Baseline	The temperature curve did not return to baseline within 30 seconds of pressing **C.O. START** because of the following conditions: • Unstable patient temperature • Defective catheter, cable, or cartridge	• Follow hospital procedures. • Repeat the measurement. If message persists, replace the defective components.
C.O. Pod Fault - Bad Ref.	The pod reference resistance is either too high or too low.	Remove and reconnect the pod. Repeat the measurement. If message persists, replace the pod and contact DrägerService.
C.O. Catheter Fault - Bad Ref.	• The catheter reference resistance is too low. • Unknown catheter type.	• Check the catheter and replace if defective. • Contact the hospital's technical personnel or DrägerService.
C.O. Check Injectate Probe	the injectate temperature probe is not connected or was disconnected during a measurement.	Connect the probe and repeat the measurement.

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17 Calculations

Overview

The monitor performs physiological calculations using data acquired by the monitor and other devices. The monitor stores derived parameters and displays them on the Results (Calculations) screen, Drug Calculator, or Labs display. Available inputs and calculated parameters vary depending on whether you use standard or optional calculations software.

As a standard feature, the monitor automatically calculates a set of hemodynamic parameters called Hemo-Calcs whenever you measure cardiac output (see page 16-14 for detailed information). The monitor can also be configured to calculate drug-related parameters, including concentration, rate, total dose, and total volume.

In addition to these standard calculation features, two additional features are available with the PhysioCalcs software option:

- **Hemodynamics –** The monitor calculates hemodynamic parameters based on cardiac output, invasive blood pressure and patient data (for example, height and weight).
- **Hemo/Oxy/Vent Calculations** – This locked option provides oxygenation, and ventilation parameters in addition to hemodynamic parameters (for a complete list of hem/oxy/vent parameters, see page 17-5). When the monitor is connected to WinView or a device using the Medical Information Bus (MIB) interface protocol, you can also obtain laboratory data through the Hemo/OxyVent menu.

Physiological Calculations (Hemo/Oxy/Vent Calculations)

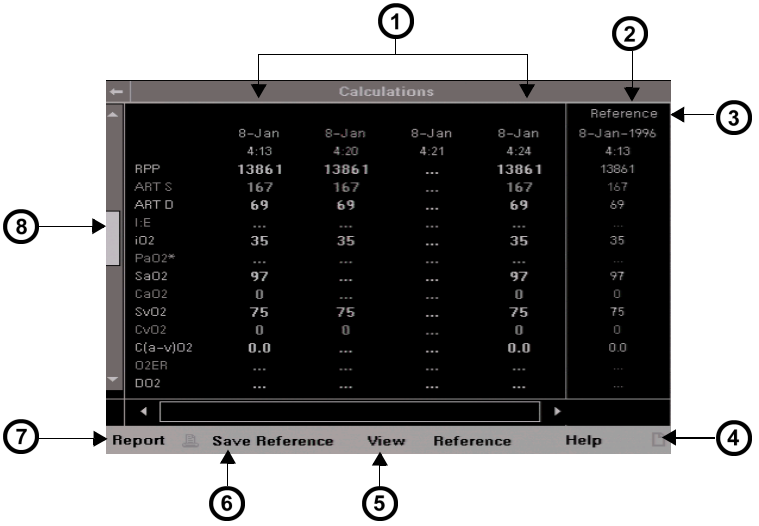
You can calculate and store hemodynamic, oxygenation and ventilation parameters for display on the Calculations screen and print them on a laser printer.

NOTE: Before initiating a physiological calculation, you must measure pulmonary wedge pressure (see page 15-20) and cardiac output (see page 16-7).

To obtain physiological calculations

1. Press the **Menu** fixed key to open the Main menu.
2. Click on **Calculations**.
3. Click on **Hemo** or **Hemo/Oxy/Vent** to display the associated calculations menu.
4. Click on **Capture Values** to save the date and time of the capture and display the current values of input parameters. You can use captured values immediately or hold them for later calculations.
5. Click on **Results**. The Calculations screen appears (see the following page).

NOTE: The Calculations screen does not display results for a derived parameter unless all relevant information has been entered.



1	Date and time stamps	**5**	Click and scroll to determine type of data displayed in View column: Reference – values stored via Save Reference key Normal Range – standard ranges for parameter values Units – units of measure for parameter values
2	View column	**6**	Save latest set of calculated data for display in View column
3	View category	**7**	Send report request to laser printer at central station
4	Display labels, definitions and ranges	**8**	Click and drag to scroll through list of parameters

To access the Hemo/Oxy/Vent calculations menu quickly

1. Click on the **Fast Access** fixed key.
2. Click on **Calculations** to display the **Hemo/Oxy/Vent** calculations menu.

If a value is missing or suspect (for example, artifact), you can enter or modify its values as follows:

1. Highlight the parameter in question and click. A data entry keypad appears:
2. Click on the digits of the new value.
3. Click on **Accept** when you are done. The modified value immediately appears on the Calculations screen, marked with a pound sign (**#**). Modified values are not written to Main Screen parameter boxes and waveforms, nor are they trended.

Hemodynamic Parameters

The monitor calculates the hemodynamic values using these parameters:

Label	Parameter Value Description	Derivation	Units
ART S	Systolic Arterial Pressure	Monitored input	mmHg kPa
ART M	Mean Arterial Pressure	Monitored input	mmHg kPa
ART D	Diastolic Arterial Pressure	Monitored input	mmHg kPa
CO, CCO, ICO.	Cardiac Output (continuous, intermittent)	Monitored input	L/min
p-CO	Thermodilution Cardiac Output via the PiCCO pod	Monitored input	L/min
PCCO	Pulse Contour Cardiac Output via the PiCCO pod	Monitored input	L/min
CVP	Central Venous Pressure	Monitored input	mmHg kPa
HR	Heart Rate	Monitored input	bpm
HT	Patient's height (length)	Manual entry	cm / in
PA M	Mean Pulmonary Artery Pressure	Monitored input	mmHg kPa
PWP	Pulmonary Capillary Wedge Pressure	Monitored input	mmHg kPa
WT	Patient's current weight	Manual entry	kg / lb

The monitor automatically calculates the following hemodynamic parameters:

Label	Parameter Description	Derivation	Units
BSA	Body Surface Area	Boyd or DuBois equation **NOTE:** Boyd equation: for patients whose weight is less than15 kg and whose height is less than 80 cm: $BSA = WT^{(0.7285 - 0.0188 \times (\log 10 WT)} \times HT^{0.3} \times 0.0003207$ DuBois equation: for all other patients: $BSA = WT^{0.425} \times HT^{0.725} \times 0.007184$ Body weight in grams; height in centimeters	m^2
CI, CCI, ICI	Cardiac Index (continuous, intermittent)	CO / BSA	$L/min/m^2$
p-CI	Thermodilution Cardiac Index via the PiCCO pod	p-CO / BSA	$L/min/m^2$
PCCI	Pulse Contour Cardiac Index via the PiCCO pod	PCCO / BSA	$L/min/m^2$
LHCPP	Left Heart Coronary Perfusion Pressure	ART D - PWP	mmHg
LVSW	Left Ventricular Stroke Work	0.0136 x (ART M- PWP) x SV	g x m/beat
LVSWI	Left Ventricular Stroke Work Index	0.0136 x (ART M - PWP) x SVI	$g \times m/m^2/beat$
PVR	Pulmonary Vascular Resistance	80 x ((P AM-PWP) /CO)	$dynes \times sec \times cm^{-5}$
PVRI	Pulmonary Vascular Resistance Index	80 x ((P AM-PWP) / CI)	$dynes \times sec \times cm^{-5} \times m^2$
RPP	Rate Pressure Product	ART S x HR	mmHg/min
RVSW	Right Ventricular Stroke Work	0.0136 x (PA M - CVP) x SV	g x m/beat
RVSWI	Right Ventricular Stroke Work Index	0.0136 x (PA M - CVP) x SVI	$g \times m/m^2/beat$
SV	Stroke Volume	CO x 1000 / HR	ml
SVI	Stroke Volume Index	SV / BSA	ml/m^2
SVR	Systemic Vascular Resistance	80 x (ART M - CVP) / CO	$dynes \times sec \times cm^{-5}$
SVRI	Systemic Vascular Resistance Index	80 x (ART M - CVP) / C.I.	$dynes \times sec \times cm^{-5} \times m^2$

Label	Parameter Description	Derivation	Units
TPR	Total Pulmonary Resistance	80 x PA M / CO	dynes x sec/cm^5
TVR	Total Vascular Resistance	80 x ART M / CO	dynes x sec/cm^5

Oxygenation and Ventilation Parameters

The monitor calculates the oxygenation and ventilation values using these parameters.

Label	Parameter Description	Derivation	Units
Hgb	Hemoglobin concentration	Monitored input	g/dl
iO2	Inspired Oxygen	Monitored input	%
PaCO2	Arterial CO2 Pressure	Input data	mmHg
PaO2	Arterial Oxygen Pressure	Input data	mmHg
PAUSE	Pause/Plateau Pressure	Monitored input	cmH2O
Pb	Barometric pressure	Monitored input	mmHg
PeCO2	Mixed Expired CO2 Pressure	Monitored input	mmHg
PEEP	Peak End Expiratory Pressure	Monitored input	cmH2O
PIP	Peak inspiratory Pressure	Monitored input	cmH2O
RRc, RRc*, RRv	Respiratory Rate	Monitored input	L/m
SaO2, SaO2*	Arterial Oxygen Saturation	Input data	%
SvO2	Venous Oxygen saturation	Monitored input	%
TVe	Expired Tidal Volume	Monitored input	ml/breath

The monitor automatically calculates the following oxygenation and ventilation parameters:

Label	Parameter Description	Equations	Units
C(a-v)O_2	Arteriovenous Oxygen Difference	CaO_2 - CvO_2	ml/dl
CaO_2	Arterial Oxygen Content	.0134 x HGB x SaO2	ml/dl
C_{DYN}	Dynamic Compliance	C_{DYN} =TVe/ (PIP - PEEP)	ml/cmH2O
Cs	Static Compliance	TVe/(Pause-PEEP)	ml/cmH2O
CvO_2	Venous Oxygen Content	.0134 x HGB x SvO2	ml/dl
DO_2	Oxygen Availability, Delivery, or Transport	CaO_2 x CO x 10	mL/min.
DO_2I	Oxygen Availability (or Delivery) Index	DO2 / BSA	mL/min/m^2
MV alv	Alveolar Minute Volume	(TVe- Vd aw) x RR	mL/min

Label	Parameter Description	Equations	Units
MVe	Expired Minute Volume	(TVe x RR) / 1000	L/min
MV/CO	Ventilation Cardiac Output ratio	MV alv / CO	None
O_2ER	Oxygen Extraction Ratio	(CaO2 - CvO2)/ CaO2	None
$P(A\text{-}a)DO_2$	Alveolar-arterial Oxygen Difference	iO2 x (PB -47) - PaCO2 - PaO2	mmHg
Qs/ Qt	Intrapulmonary Right-left Shunt (Percentage shunt)	1/(1 + C(a-v)O2 / P(A-a)O2 x .003	%
TVd phys	Tidal Volume deadspace (physiological)	TVe x (1-PeCO2/PaCO2	ml
TVd/ TV phys	Ratio of Tidal Volume deadspace to Tidal Volume deadspace (physiological)	Vd / TVe	not applicable
VO_2	Oxygen Consumption	$avDO_2$ x CO x 10	mL/min
VO_2I	Oxygen Consumption Index	VO_2 / BSA	$mL/min/m^2$

Lab Data

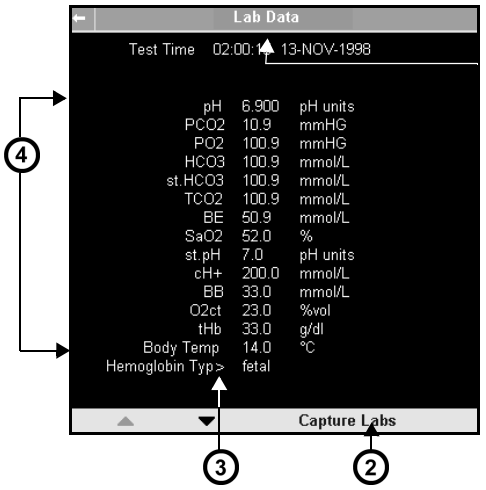
Lab Data Screen

You can factor lab data into the calculation of derived parameters. The monitor imports laboratory data automatically, through an MIB interface, or after a manual request through the network.

To display the Lab Data screen

1. Press the **Fast Access** fixed key.
2. Click on **Lab Data** to display most recently captured values.
3. Click on **Capture Labs** to display current values.

NOTE: The displayed parameters vary according to the type of blood analysis device is connected to the monitor.



1	Time/date stamp indicating the time the monitor receives data. Labeled according to the following criteria: test time – the time and date are generated by blood analysis device and sent with the lab results. Arrival time – the time and date are generated by the monitor; no test time is sent with the lab results.
2	Displays current values (appears ghosted until requested data is available)
3	A 'greater than' symbol (>) indicates that the number of characters or digits exceeds the available display space.
4	Parameter labels, values and units of measure.

Lab Data on Calculations Screen

To display laboratory data on the Hemo/Oxy/Vent Calculations screen, proceed as follows:

1. Sample and analyze the patient's blood.
2. Press the **Fast Access** fixed key on the monitor's front panel.
3. Click on **Calculations** to display the Hemo/Oxy/Vent Calculations menu. Lab data input parameters appear on the right.
4. Click on **Capture Values**. A message at the top of the main screen indicates when new lab data is available.
5. Click on **Capture Labs** to capture blood gas values.
6. Click on **Calculate or Results**. The Calculations screen appears with updated derived parameters.

Hemodynamic Calculations (Hemo-Calcs)

Hemodynamic calculations (Hemo-calcs) are a standard feature with your monitor. Whenever you measure cardiac output, the monitor automatically calculates a set of related hemodynamic parameters, marks them with a time-stamp and stores them in a special database. You can later view these derived parameters on the Calculation Results screen and print them on an Infinity network laser printer. Hemodynamic calculations are not trended.

NOTE: The Hemo-Calcs function is a reduced version of the Physiological Calculations locked option.

For accurate calculations:

- Be sure the patient's current height and weight are entered in the Patient Admit screen. Incorrect or missing height and weight data result in incorrect or blank output values.
- For a complete set of calculations, perform both a pulmonary wedge (PWP) measurement and a C.O. measurement. Blank values on the Calculations Results screen result from failure to perform both measurements.

Hemo-Calcs

To access Hemo-Calc results without locked options

1. Click on the **Menu** fixed key.
2. Click on **Review**.
3. Click on **Calc. Results** to display the **Hemo-Calcs calculations** menu.

Hemodynamic Parameters

NOTE: For a more detailed list of input and derived parameters, including units of measure and derivation, see page 17-5.

WARNING: Verify that you enter the patient's current weight (not his or her 'admit' weight). Failure to enter an accurate weight value can result in inaccurate calculations and put the patient at risk.

The monitor calculates the hemodynamic (Hemo) values using these parameters:

- HR – Current Heart Rate
- ART M – Current Mean Arterial Pressure
- PA M – Current Mean Pulmonary Artery Pressure
- PWP – Most recent Pulmonary Capillary Wedge Pressure
- CVP – Current Central Venous Pressure
- C.O. – Most recent Cardiac Output
- ART S – Current Systolic Arterial Pressure
- ART D – Current Diastolic Arterial Pressure
- HT – Patient's height (length) as entered
- WT – Patient's weight as entered
- p-CO – Thermodilution Cardiac Output via the PiCCO pod
- PCCO – Pulse Contour Cardiac Output via the PiCCO pod

The monitor automatically calculates the following hemodynamic parameters. Each parameter's unit of measure is indicated in parentheses:

- SV – Stroke Volume (ml)
- SVR – Systemic Vascular Resistance (dynes x sec x cm-5)
- ICI/CI – Intermittent Cardiac Index (liters/min/m2)
- SVI – Stroke Volume Index (ml/m2)
- SVRI – Systemic Vascular Resistance Index (dynes x sec x cm-5 x m2)
- BSA – Body Surface Area (m2)
- CCI – Continuous Cardiac Index (liters/min/m2)
- p-CI – Thermodilution Cardiac Index (liters/min/m2) via the PiCCO pod
- PCCI – Pulse Contour Cardiac Index (liters/min/m2) via the PiCCO pod

Drug Calculations

The monitor calculates the infusion rates of up to 44 drugs and displays the results in titration tables. You can assign and calculate up to four drugs per patient or monitoring session. Information pertaining to patient-specific drugs is automatically deleted when you discharge the patient from the monitor.

To meet the demands of a larger patient group, it is also possible to configure up to 40 default drugs. These drugs can be assigned only by the unit manager, or by others who have access to the password-protected Unit Manager menu. Nurses can, however, edit and recalculate default drugs from the unrestricted Drug Dosage menu. Data pertaining to default drugs is not deleted when a patient is discharged from the monitor.

Titration Tables

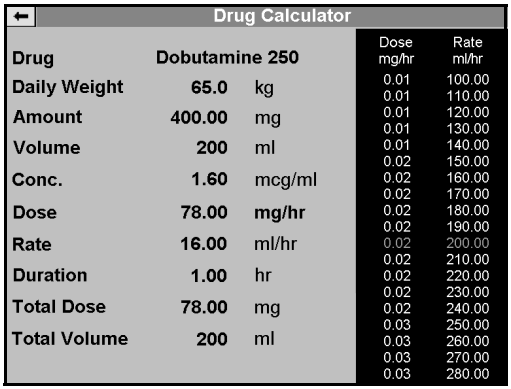
After you have entered the appropriate information, the monitor displays a titration table showing the units of measure you have specified on the Drug Calculator or Drug List Setup menu. Rates are displayed in green in the right column. Whenever you change an entry on the Drug Calculator menu, the monitor automatically updates titrated values.

To display a titration table, follow the instructions for calculating drugs on page 17-14. If you click on a new drug, you will display the drug calculator menu.

1. Click on the drug whose titration table you wish to display.
2. Click on information category (for example, **Daily Weight**).
3. Enter data as described on page 17-14.

The dose and rate are titrated if you have entered the appropriate input data for the calculation.The table is titrated again when you change any of the settings on the Drug Calculator menu.

An example of a calculated titration table is shown below.



Numbered labels (**Untitled 1 - 4**) on the Drug Dosage setup menu are reserved for drugs specific to the current patient or monitoring session, while default drugs are listed simply as **Untitled**. After you have assigned a drug on the Drug Dosage menu, you can enter its infusion parameters, perform calculations, and view a titration table using the Drug Calculator menu. When you assign a drug to the Drug Dosage menu, its name automatically appears on the Drug Calculator menu, where you can quickly calculate a new infusion rate (see page 17-14).

Drug Calculator Setup

The following table summarizes tasks you can perform using the Drug Calculations function.

Drug Calculation		
Task	**Menu**	**Initial Step**
Patient-specific drugs (Slots 1-4)		
Calculate a drug	Drug Dosage	New Drug
Default drugs (unnumbered slots 5-40)		
Assign a default drug	Unit Manager	Drug List Setup
Enter amount, volume and dose units for default drug	Unit Manager	Drug List Setup

Assigning Drugs

After you assign a drug, its name appears on both the Drug Dosage menu and the Drug Calculator menu.

To assign a drug

1. Press the **Fast Access** fixed key. The Fast Access menu appears.
2. Click on **Drug Dosage**.
3. Click on **New Drug** to display drug or drug fields.
4. Click on one of the first four display fields on the list (**Untitled 1 - Untitled 4**) to assign drugs to a particular patient.

NOTE: While clicking on a default drug accesses the Drug Calculator menu, the default drugs can only be named or renamed from within the Unit Manager menu (see page 17-16).

5. Click on **Drug**.
6. Click on **Name Drug** to display the text entry screen.
7. Enter the name of the drug you wish to assign by clicking on the letters under the text entry window. Edit your entry using the control buttons at the bottom of the screen.
8. Click on **Accept** to confirm.

Calculating a Drug

Use the following procedures to enter information on the Drug Calculator menu.

1. Press the **Fast Access** fixed key. The Fast Access menu appears.
2. Click on **Drug Dosage**.
3. Click on **New Drug** (see page 17-14).
4. Click on the new drug of your choice to display the Drug Calculator menu.
5. Scroll to a category and click to display the data entry box.

If you select **Conc.** (for Concentration), **Dose**, and **Total Dose**, the data entry box displays a field, where you can change the units of measure for these categories as follows:

1. Click on **Change Units**.
2. Use the rotary knob to select a unit of measure.
3. Click to confirm.

To enter a value for any of the Drug Calculator categories

1. Click successively on single digits to enter a value for the selected category.
2. Click on **Accept** to confirm your choices and return to the Drug Calculator menu.

NOTE: To access dose units based on patient weight, you must enter the patient's **Daily Weight** on the Drug Calculator menu. The monitor recalculates saved drugs automatically whenever you modify the adult or pediatric daily weight entry. You must enter a daily weight whenever you calculate a drug for a neonate.

The following table lists available ranges for each category on the Drug Calculator menu.

Drug Calculator Menu	
Menu Item	**Range and Units**
Drug (name)	Not applicable
Weight (of patient)	0-255.0 kg (adult, pediatric) 0-30,000 g (neonate)
Amount (of drug)	0-100,000,000,000 micrograms (mcg), m units, mEg, mmol 0-100,000,000 milligrams (mg), units, mol 0-100,000 grams (g), k units
Volume	0-10,000 ml
Concentration	0-100,000,000,000 mcg/ml, m units/ml, mEg/ml,mmol/ml 0-100,000,000 mg/ml, units/ml, mol/ml 0-100,000 g/ml, k units/ml 0-100 m units/ml
Dose per hour	0-100,000,000,000 mcg/hr, mEg/hr, m units/hr, mmol/hr 0-100,000,000 mg/hr, units/hr, mol/hr 0-10,000 g/hr, k units/hr
Dose per minute	0-1,666,666,666.66 mcg/min, mEg/min, m units/min, mmol/min 0-1,666,666.66 mg/min, units/min, mol/min 1-1,666.66 g/min, k units/min
Dose/weight per hour	0-100,000,000,000/wt, mcg/kg/hr, mEg/kg/hr, m units /kg/hr,mmol/kg/hr 0-100,000,000/wt mg/kg/hr, units/kg/hr, mol/kg/hr 0-0.100,000/wt g/kg/hr, k units/kg/hr

Drug Calculator Menu	
Menu Item	**Range and Units**
Dose/weight per minute	0-1,666,666,666.66/wt mcg/wt/min, mEg/wt/min, units/wt/min, mmol/wt/min 0-1,666,666.66/wt mg/wt/min, units/wt/min 0-1,666.66 g/wt/min, units/wt/min
Rate	0-10,000 ml/hr
Duration	0-10,000 hr
Total Dose	0-100,000,000,000 mcg, mEg, mmol 0-100,000,000 mg, units, mol 0-100,000 g, k units 1-100 m units
Total Volume	0-10,000 ml

Default Drug Setup (Unit Manager)

The unit manager can assign up to 40 default setups for the most commonly used drugs.

To assign default drugs

1. Press the **Menu** fixed key.
2. Click on **Monitor Setup**.
3. Click on **Unit Manager**. A data entry box appears.
4. Enter the Unit Manager password. If you make a mistake, click on **Backspace** and try again.
5. Click on **Accept** to open the Unit Manager menu.
6. Scroll to **Drug List Setup** and click. The cursor highlights the first in a list of drugs on the right of the screen.
7. Click on **Untitled** or on the name of a drug you wish to change. The Drug List Setup menu appears (figure at right).
8. Click on **Name Drug** to display a text entry box.
9. Enter the name of the drug you wish to assign by clicking on the letters under the text entry window. Edit your entry using the control buttons at the bottom of the screen.
10. Click on **Accept** when you are done.

To calculate an assigned drug

1. Open the Drug List Setup menu (see page 17-16).
2. Click on the data category. A text entry box appears.
3. Click successively on single digits to enter the desired value.
4. Click on **Change Units** to modify units of measure.
5. Scroll through available units of measure and click to select.
6. Click on **Dose Units**.
7. Scroll through available dose units and click to confirm.
8. Click on **Accept** to confirm your choices.

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18 Pulse Oximetry (SpO_2)

Overview

Dräger offers three algorithms for SpO_2 monitoring:

- Masimo SET®
- Nellcor Oximax®
- Dräger OxiSure®

NOTE: If installing VF9 software on monitors that do not have a Masimo SET logo (see page 18-4) or a Nellcor OxiMax logo (see page 18-5), Dräger OxiSure (with connection via the MultiMed cables) is available.

These technologies enhance the quality of SpO_2 monitoring, allowing you to measure the percentage of functional hemoglobin saturated with oxygen (% SpO_2) in the patient's arterial blood. An SpO_2 sensor measures the absorption levels of red and infrared light. The monitor uses the difference between the two measurements to calculate the percentage of saturated hemoglobin. Because light absorption varies with blood volume and blood volume varies with pulse rate, the monitor can also derive a pulse rate (PLS).

The SpO_2 sensor, available for adult, pediatric, and neonatal patients is connected to the monitor via the various MultiMed and NeoMed cables, or the Infinity®Masimo SET SpO_2 SmartPod®, or the Infinity® Nellcor Oximax® SpO_2 SmartPod® pod.

NOTE: For a complete list of Dräger provided SpO_2 accessories available with this product, see page C-13.

NOTE: Information about wavelength range may be useful during photodynamic therapy. For details, see the chapter entitled "Technical data" for SpO_2.

Precautions

Refer to the "Safety Considerations" section starting on page 8, at the beginning of these Instructions for Use, for general precautions regarding safe device operation.

SpO_2 measurements are particularly sensitive to the pulsations in the artery and the arteriole. Measurements may not be accurate if the patient is experiencing shock, hypothermia, anemia or has received certain medications that reduce the blood flow in the arteries.

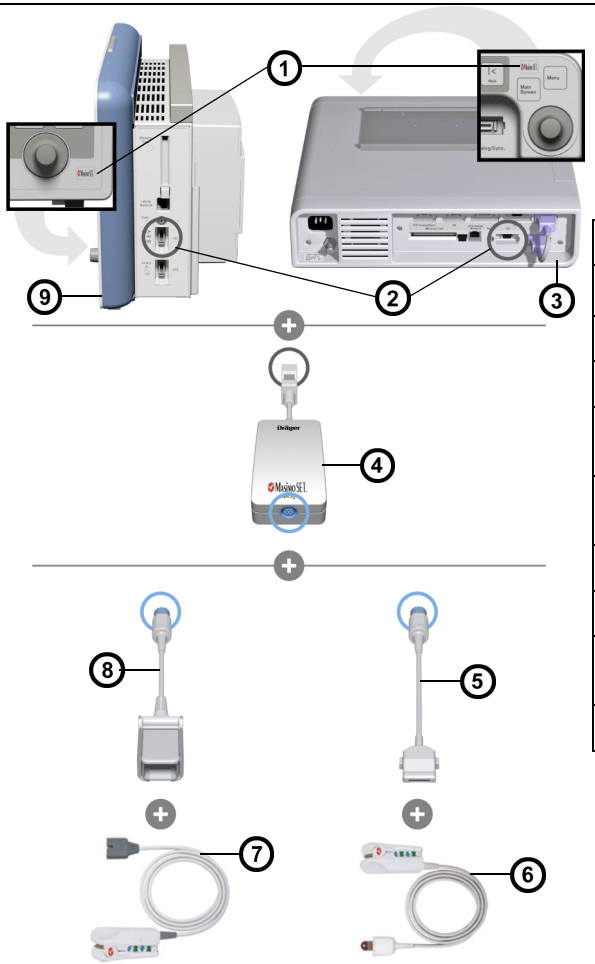
WARNING:

- **A pulse oximeter should not be used as an apnea monitor.**
- **High oxygen levels may predispose a premature infant to retrolental fibroplasia. If this is a consideration do NOT set the high alarm limit to 100%, which is equivalent to switching the alarm off. Transcutaneous pO_2 monitoring is recommended for premature infants receiving supplemental oxygen.**
- **Inspect the application site every two to three hours to check the skin quality and correct optical alignment. If the skin quality changes, move the sensor to another site. Change the application site at least every four hours.**
- **Use only Dräger-specified sensors. Other sensors may not provide adequate protection against defibrillation and may put the patient at risk.**

WARNING: Disposable accessories (such as disposable electrodes, transducers, etc.) are for single use only. Do not reuse disposable accessories.

Hardware Setup

Monitor with Masimo Logo - Hardware Setup



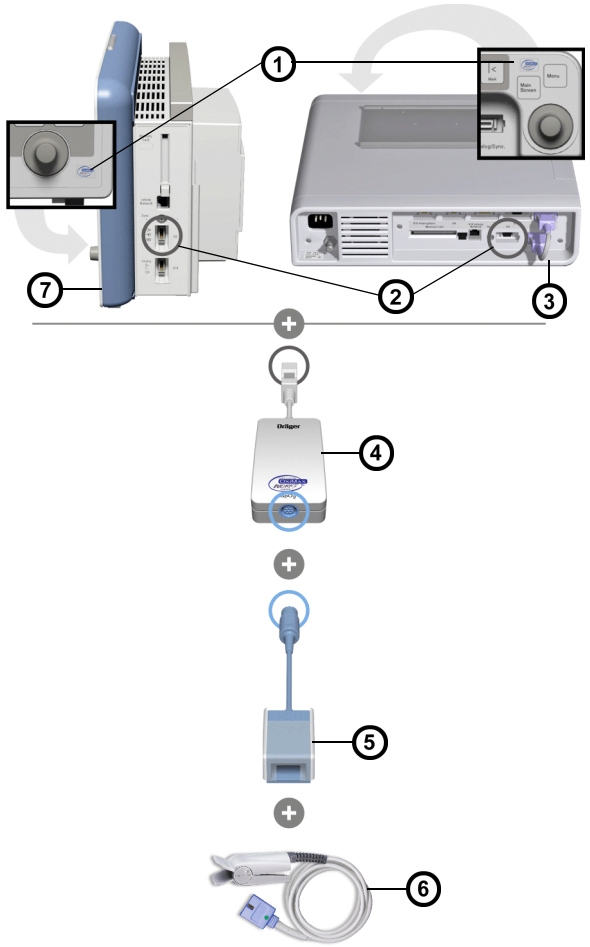
1	Masimo SET logo means Masimo SET compatibility is enabled
2	X8 connector
3	Infinity Kappa
4	Masimo SET pod with X8 connection cable to monitor
5	Masimo LNOP intermediate cable
6	Masimo LNOP SpO2 sensor
7	Masimo LNCS SpO2 sensor
8	Masimo LNCS intermediate cable
9	Infinity Delta/Delta XL

WARNING: Only Masimo sensors and intermediate cables can be used with the Masimo SET pod.

NOTE:

- The Masimo SET logo indicates that the monitor is configured with Masimo SET functionality only. Connection of SpO_2 via a MultiMed cable, MultiMed 12, or a MicrO2+ Pulse Oximeter is not supported.
- Possession or purchase of the Masimo SET® pod 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.

Monitor with Nellcor Logo - Hardware Setup



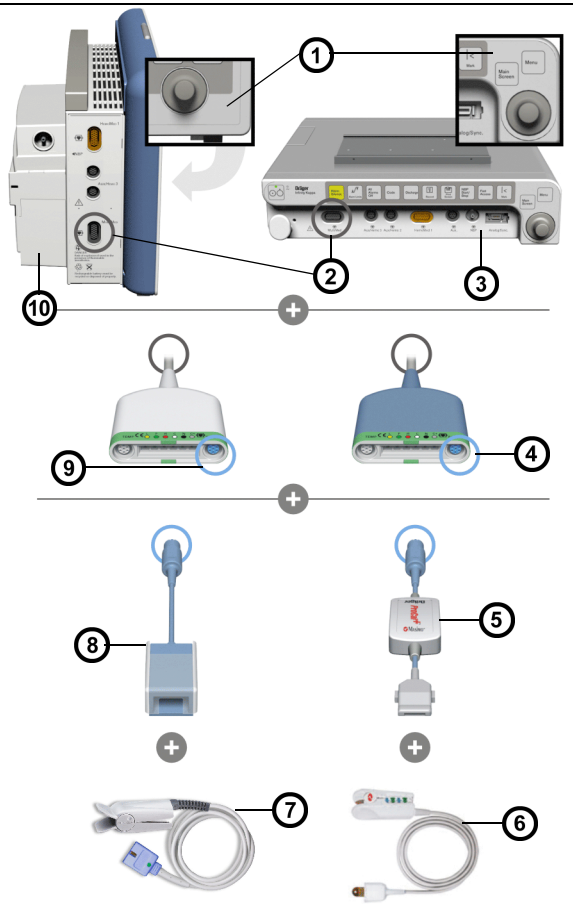
1	Nellcor Oximax logo means Nellcor Oximax compatibility is enabled
2	X8 connector
3	Infinity Kappa
4	Nellcor Oximax pod with X8 connection cable to monitor
5	Nellcor intermediate cable
6	Nellcor SpO2 cable
7	Infinity Delta/Delta XL

WARNING: Only use Nellcor intermediate cables and sensors recommended by Dräger.

NOTE:

- The Nellcor Oximax logo indicates that the monitor is configured with Nellcor Oximax functionality only. Connection of SpO_2 via a MultiMed cable, MultiMed 12, or a MicrO2+ Pulse Oximeter is not supported.
- Purchase of this instrument confers no express or implied license under any Nellcor patent to use this instrument with any oximetry sensor that is not manufactured or licensed by Nellcor.

Monitor Without Masimo or Nellcor Logo - Hardware Setup



1	Monitor without Masimo or Nellcor logo (see compatibility in note below)
2	MultiMed connector
3	Infinity Kappa
4	SpO2 connector on MultiMed
5	Masimo Procal+ Intermediate LNOP cable
6	Masimo LNOP SpO2 sensor
7	Dräger/Nellcor SpO2 sensor
8	Dräger/Nellcor Intermediate cable
9	SpO2 connector on MultiMed Plus cable
10	Infinity Delta/Delta XL

WARNING: Only use Dräger SpO_2 intermediate cables and SpO_2 sensors. Do not use other manufacturer's cables or sensors.

NOTE: A monitor that does not have a Masimo SET or Nellcor Oximax logo in the area near the rotary knob is compatible with:

- OxiSure via SpO_2 connector on various MultiMed cables (see above graphic).
- Masimo SET pod via Masimo intermediate cable (see page 18-4).
- Nellcor Oximax pod via Nellcor intermediate cable (see page 18-5).

Patient Preparation

The accuracy of SpO_2 monitoring depends largely on the strength and quality of the SpO_2 signal.

If a finger is used as a monitoring site, remove any nail polish. Trim the patient's finger nails, if necessary, for better sensor placement. Use only Dräger provided sensors and apply them per the sensor manufacturer's recommendation (see page C-13).

Ambient light can interfere with pulse oximetry measurements if the sensor is not properly attached, causing erratic measurement or missing values. Observe proper sensor placement and cover the sensor with opaque material if interference due to ambient light is suspected.

NOTE: Read the instructions provided with the sensor for optimal application techniques and for safety information. Never use damaged sensors.

1. Select the sensor type and size best suited for your patient.
2. If the sensor is reusable, clean it before and after each patient use.
3. Position the sensor correctly and attach it to your patient.
4. Connect the sensor to the patient cable. For the appropriate patient cable for your specific SpO_2 device, see page C-15.
5. Inspect the sensor application site frequently. A sensor that is too tight may damage the tissue by impeding blood flow or overheating the skin. Do not use a damaged sensor.

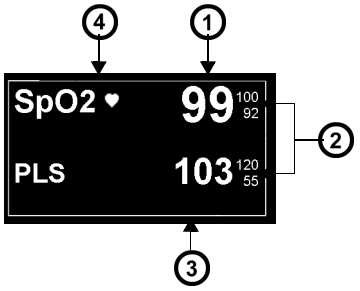
NOTE: After connection of the sensor observe monitor for any messages if the sensor does not light up. If sensor-LED does not light up, replace sensor.

Display Features

The monitor can display numerical readings in the SpO_2 parameter box and a pulse plethysmogram waveform in the adjacent channel.

NOTE: The SpO_2 pulse plethysmogram waveform is normalized and is NOT directly proportional to the pulse amplitude. The monitor automatically tries to maximize the size of this waveform, so the size only decreases when the signal quality is marginal. The waveform size can be manually increased for better visibility by using the waveform size menu selections.

The parameter box displays both the SpO_2 value and the pulse rate, as shown below:



1	SpO_2 value
2	Alarm limits (crossed bell if alarm is disabled)
3	SpO_2-source pulse rate
4	Heart symbol blinks with each pulse (symbol is only displayed if SpO_2 is selected as the pulse tone source).

SpO_2 Setup

To access the SpO_2 menu

- Click on the SpO parameter box

or

1. Press the **Menu** fixed key.
2. Click on **Patient Setup**.
3. Click on **Parameters** to display a list of available parameters.
4. Click on **SpO2**.

Quick Reference Table – SpO_2 Setup

Click on the following items to execute SpO_2 setup functions.

Menu Item	Description	Settings
Pulse Tone Source	Selects source for the pulse tone and displays a blinking heart (♥) in the corresponding parameter box. The higher the pitch, the higher the heart rate (HR) or SpO_2 saturation percentage. **NOTE**: You can also set the pulse tone source from the ECG setup menu.	• **ECG** – Monitor uses the ECG signal as the pulse tone source • **SpO2**– Monitor uses the SpO_2 signal as the pulse tone source
Pulse Tone Volume	Sets the volume of the pulse tone. **NOTE**: You can also set the pulse tone volume from the ECG menu.	**OFF, 5, 10, 20, 30, 40, 50, 60, 70, 80, 90, or 100**
Waveform Size	Determines the size of the pulse plethysmogram waveform **NOTE**: If the waveform height exceeds the display channel's size, the waveform is clipped. SpO_2 signal processing is not affected.	**10 - 100 %** (increments of 10)
Averaging (MultiMed cable and Nellcor Oximax pod only)	Determines the averaging of SpO_2 values. **NOTE**: The setting **Normal** is less sensitive to artifact, but slower to trigger an alarm. The setting **Fast** is quicker to alarm, but more sensitive to artifact. **NOTE:** The menu selection **Averaging** does not appear when a Masimo SET pod is connected.	MultiMed • **Normal** — Reflects 90 % of an SpO_2 change within 30 seconds • **Fast** — Reflects 90 % of an SpO_2 change within 15 seconds Nellcor Oximax • **Normal** — four to six seconds averaging under interference-free conditions • **Fast** — less than four seconds averaging under interference-free conditions
Averaging Time (Masimo SET pod only)	Determines the averaging of SpO_2 values. **NOTE:** The menu selection **Averaging Time** does not appear when a Nellcor Oximax pod or a MultiMed cable is connected.	**2 – 4, 4 – 6, 8** (default), **10, 12, 14, 16 s**

Menu Item	Description	Settings
Sensor OFF Alarm (default) **NOTE:** This menu will not be available when backwards compatibility is enabled.	Sets the alarm grade for the SpO2 sensor off condition (when sensor is off the patient).	• **Low Persistent** (Default, persistent alarm including message persistent) • **Low Non Persistent** (i.e. One Shot alarm but message persistent) • **MED** (i.e. always Persistent) • **HIGH** (i.e. always Persistent)
SpO2 Desat Limit	This feature disables the SpO_2 desaturation alarm or sets a threshold at which point a desaturation alarm of high priority is triggered. For example, if the lower alarm limit for SpO_2 is set at 95% and the desaturation limit is set at –5, the desaturation alarm will be triggered when the patient's SpO_2 value goes below 90%. **NOTE**: This selection is available for all patient categories and is protected by a clinical password.	• **–5**, **–10** (default), **–15**, **–20** • **OFF**
SpO2 Alarm	Accesses SpO_2 alarms on the Alarm Limits table (see page 5-8).	Not applicable

Status Messages

Monitor with Masimo Logo - Status Messages

Message	Possible Cause	Suggested Action
SpO_2 > # *SpO_2 < #*	The patient's SpO_2 falls outside the current upper or lower alarm limits.	Observe the patient and treat, if necessary.
PLS > # *PLS < #*	The patient's pulse rate falls outside the current upper or lower alarm limits.	
SpO2 < Low limit value - 20%	The patient's SpO_2 falls below the current lower alarm limit by 20% or more.	
PLS Out of Range (Low/High)	The pulse rate is outside the measuring range of the monitor	

Message	Possible Cause	Suggested Action
SpO_2 Sensor Off	Too much light is reaching the sensor's light detector because because the sensor is either disconnected or too much ambient light is present.	• Make sure the sensor is properly attached to the patient's finger. • Remove the light source. • Cover the sensor with opaque material. • Make sure no ambient light can reach the detector. • Contact DrägerService.
SpO_2 Unrecognized Sensor	The monitor does not recognize the sensor connected as valid.	• Check for a defective or an unapproved sensor. • Replace the sensor. • Contact the hospital's technical personnel or DrägerService.
SpO_2 Artifact	A persistent artifact is detected.	• Make sure the SpO_2 sensor is properly attached to the patient, patient is not moving, and all cables are properly connected. • Contact DrägerService.
SpO_2 Weak signal	The pulse amplitude is too low due to one of the following conditions: • Poor perfusion (shock). • Low body temperature.	• Check the patient and treat, if necessary. • Make sure the SpO_2 sensor is properly attached to the patient and all cables are properly connected. • Relocate the sensor to another extremity. • Contact DrägerService.
SpO_2 No Measurement	The monitor has not been able to compute a valid measurement within the last 30 seconds because of unstable measurement conditions.	• Make sure the SpO_2 sensor is properly attached to the patient at a site free of patient motion and all cables are properly connected. • Contact DrägerService.
SpO_2 Regulation Error	• Inconsistent light level detected by sensor. • Excess ambient light detected.	• Attache the SpO_2 sensor properly to the patient. • Remove or shade any external sources of light entering the sensor. • Contact DrägerService.
SpO_2 Unplugged	The sensor cable is not connected to the MultiMed pod.	• Make sure that the cables are securely connected. • Check for defective sensor.
SpO_2: Connection Not Supported	A Nellcor Oximax pod is connected.	• Disconnect the Nellcor Oximax pod and connect the Masimo SET pod.

Monitor with Nellcor Logo - Status Messages

Message	Possible Cause	Suggested Action
SpO_2 > # *SpO_2 < #*	The patient's SpO_2 falls outside the current upper or lower alarm limits.	Check the patient and treat, if necessary.
PLS > # *PLS < #*	The patient's pulse rate falls outside the current upper or lower alarm limits.	
SpO_2 < Low limit value - 20%	The patient's SpO_2 falls below the current lower alarm limit by 20% or more.	
PLS Out of Range (Low/High)	The pulse rate is outside the measuring range of the monitor	
SpO_2 Unrecognized Sensor	The monitor does not recognize the connected sensor as valid.	• Check for defective or unapproved sensor. • Replace the sensor. • Disconnect/reconnect the pod and replace with a good sensor. • Contact the hospital's technical personnel or DrägerService.
SpO_2 Artifact/ Sensor/Site?	• A persistent artifact • Wrong sensor and/or site used • High pulse amplitude • Sensor not properly placed • Electrical/optical interference • Light is blocked	• Make sure the SpO_2 sensor is the correct type and is properly attached to the patient. • Make sure the patient is not moving, and all cables are properly connected. • Make sure no electrical or optical interference is present. • Check the sensor for blocked light. (May be due to nail polish) • Change the site/location periodically. (for example finger vs. forehead, etc.) • Contact DrägerService.
SpO_2 Weak signal/ Sensor?	• The pulse amplitude is too low. • Weak signal/weak pulse. • Physiological: - Poor perfusion - Low body temperature - Sensor off the patient	• Check the patient and treat, if necessary. • Make sure the SpO_2 sensor is properly attached to the patient and all cables are properly connected. • Relocate the sensor to another extremity. • Contact DrägerService.

Message	Possible Cause	Suggested Action
SpO_2 Searching	The monitor has not been able to compute a valid measurement and is searching for a pulse.	• Make sure the SpO_2 sensor is properly attached to the patient at a site free of patient motion and all cables are properly connected. • Make sure the correct sensor type and/or site is used. • Contact Dräger DrägerService.
SpO_2 Unplugged	The sensor cable is not connected to the MultiMed pod.	• Make sure the cables are securely connected. • Check for a defective sensor.
SpO_2: Pod Failure	Pod hardware or software failure	• Disconnect/reconnect the pod, if the problem persists. • Disconnect/reconnect the pod and/or replace it with a good sensor. • Contact the hospital's technical personnel (SpO2 compatibility is a locked option).
SpO_2: Check/ replace Sensor	Defective/faulty sensor	• Replace with a Nellcor-compatible sensor. • Contact the hospital's technical personnel (SpO2 compatibility is a locked option).
SpO_2: Connection Not Supported	The Masimo SET pod is connected.	Disconnect the Masimo SET pod and connect a Nellcor Oximax pod.

Monitor Without Masimo or Nellcor Logo - Status Messages

Dräger OxiSure (via the MultiMed cables)

Message	Possible Cause	Suggested Action
SpO_2 > # *SpO_2 < #*	The patient's SpO_2 falls outside the current upper or lower alarm limits.	Check the patient and treat, if necessary.
PLS > # *PLS < #*	The patient's pulse rate falls outside the current upper or lower alarm limits.	
SpO_2 < Low limit value - 20%	The patient's SpO_2 falls below the current lower alarm limit by 20% or more.	
PLS Out of Range (Low/High)	The pulse rate is outside the measuring range of the monitor	
SpO_2 Sensor Off	Too much light is reaching the sensor's light detector. This condition usually occurs because the sensor is off the finger or because too much ambient light is detected.	• Make sure the sensor is properly attached to the patient's finger. • Remove the light source. • Cover the sensor with opaque material. • Make sure no ambient light can reach the detector. • Contact DrägerService.
SpO_2 Unrecognized Sensor	The monitor does not recognize the sensor connected as valid.	• Check for a defective or an unapproved sensor. • Replace the sensor. • Contact the hospital's technical personnel or DrägerService.
SpO_2 Light Blocked	Insufficient light is reaching the sensor's light detector. **NOTE:** With detached or partially detached disposable sensors, the light emitters and detectors may have become misaligned.	• Make sure the sensor is properly attached to the patient's finger, and the finger is free of blocking substances. • Check for a defective sensor and replace it, if necessary.
SpO_2 Artifact	Persistent artifact	• Make sure the SpO_2 sensor is properly attached to the patient, the patient is not moving, and all cables are properly connected. • Contact DrägerService.

Message	Possible Cause	Suggested Action
SpO_2 Weak signal	The pulse amplitude is too low due to of the following conditions: • Poor perfusion (shock). • Low body temperature.	• Check the patient and treat, if necessary. • Make sure the SpO_2 sensor is properly attached to the patient and all cables are properly connected. • Relocate the sensor to another extremity. • Contact DrägerService.
SpO_2 No Measurement	The monitor has not been able to compute a valid measurement within the last 30 seconds because of unstable measurement conditions.	• Make sure the SpO_2 sensor is properly attached to the patient at a site free of patient motion and all cables are properly connected. • Contact DrägerService.
SpO_2 Regulation Error	• Inconsistent light level • Excess ambient light	• Make sure the SpO_2 sensor is properly attached to the patient. • Remove or shade any external sources of light entering the sensor. • Contact DrägerService.
SpO_2 Unplugged	The sensor cable is not connected to the MultiMed pod.	• Make sure the cables are securely connected. • Check for a defective sensor.
SpO_2: non-Masimo compatible sensor	A non-Masimo compatible sensor or SpO_2 pod is connected to a monitor that is configured for Masimo.	• Replace with a Masimo-compatible sensor. • Contact the hospital's technical personnel (SpO_2 compatibility is a locked option).
SpO_2: non-Nellcor compatible sensor	A non-Nellcor compatible sensor or SpO_2 pod is connected to a monitor that is configured for Nellcor.	• Replace with a Nellcor-compatible sensor. • Contact the hospital's technical personnel (SpO_2 compatibility is a locked option).
Incompatible SpO_2 Cable (does not apply to 12-lead pod)	The SpO_2 cable part # 33 78 614 is no longer supported.	Replace with compatible SpO_2 cable (For a complete list of Dräger provided SpO_2 accessories available with this product, see page C-13).
Duplicate Device Connected	The MultiMed pod (with SpO_2 sensor) and Infinity Masimo SET pod or Infinity Nellcor Oximax pod are connected simultaneously.	Disconnect the duplicate device.

Masimo SET pod

Message	Possible Cause	Suggested Action
SpO_2 > # *SpO_2 < #*	The patient's SpO_2 is outside the current upper or lower alarm limits.	Check the patient and treat, if necessary.
PLS > # *PLS < #*	The patient's pulse rate is outside the current upper or lower alarm limits.	
SpO_2 < Low limit value - 20% **(Neonatal patient category only)**	The patient's SpO_2 is below the current lower alarm limit by 20% or more.	
PLS Out of Range (Low/High)	The pulse rate is outside the measuring range of the monitor	
SpO_2 Sensor Off	Too much light is reaching the sensor's light detector. This condition usually occurs because the sensor is off the finger or because too much ambient light is detected.	• Make sure that the sensor is properly attached to the patient's finger. • Remove the light source. • Cover the sensor with opaque material. • Make sure that no ambient light can reach the detector. • Contact DrägerService.
SpO_2 Unrecognized Sensor	The monitor does not recognize the sensor connected as valid.	• Check for a defective or unapproved sensor. • Replace the sensor. • Contact the hospital's technical personnel or DrägerService.
SpO_2 Artifact	A persistent artifact is detected.	• Make sure the SpO_2 sensor is properly attached to the patient, patient is not moving, and all cables are properly connected. • Contact DrägerService.
SpO_2 Weak signal	Pulse amplitude is too low due to one of the following conditions: • Poor perfusion (shock). • Low body temperature.	• Check the patient and treat, if necessary. • Make sure the SpO_2 sensor is properly attached to the patient and all cables are properly connected. • Relocate the sensor to another extremity. • Contact DrägerService.
SpO_2 No Measurement	The monitor has not been able to compute a valid measurement within the last 30 seconds because of unstable measurement conditions.	• Make sure the SpO_2 sensor is properly attached to the patient at a site free of patient motion and all cables are properly connected. • Contact DrägerService.

Message	Possible Cause	Suggested Action
SpO_2 Regulation Error	• Inconsistent light level • Excess ambient light	• Make sure the SpO_2 sensor is properly attached to the patient. • Remove or cover any external sources of light entering the sensor. • Contact DrägerService.
SpO_2 Unplugged	The sensor cable is not connected to the MultiMed pod.	• Make sure the cables are securely connected. • Check for a defective sensor.
SpO_2: non-Masimo compatible sensor	A non-Masimo compatible sensor or SpO_2 pod is connected to a monitor that is configured for Masimo.	• Replace with a Masimo-compatible sensor. • Contact the biomedical personnel (SpO_2 compatibility is a locked option).
Duplicate Device Connected	A MultiMed pod (with SpO_2 sensor) and an Infinity Masimo SET pod are connected simultaneously.	Disconnect the duplicate device.

Nellcor OxiMax pod

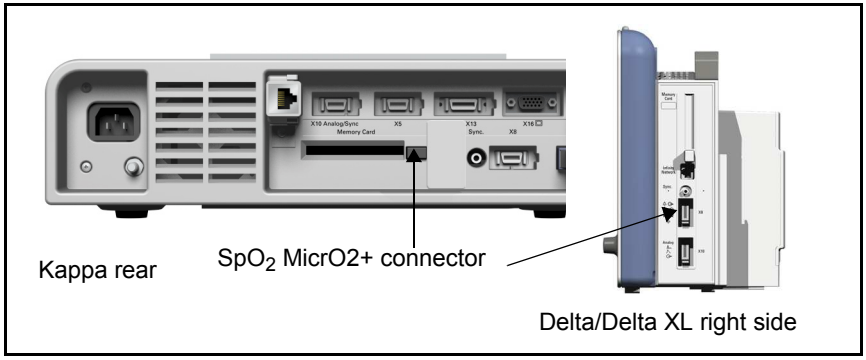
Message	Possible Cause	Suggested Action
SpO_2 > # *SpO_2 < #*	The patient's SpO_2 is outside the current upper or lower alarm limits.	Check the patient and treat, if necessary.
PLS > # *PLS < #*	The patient's pulse rate is outside the current upper or lower alarm limits.	
SpO_2 < Low limit value - 20% **(Neonatal patient category only)**	The patient's SpO_2 is below the current lower alarm limit by 20% or more.	
PLS Out of Range (Low/High)	The pulse rate is outside the measuring range of the monitor.	
SpO_2 Unrecognized Sensor	The monitor does not recognize the sensor connected as valid.	• Check for a defective or unapproved sensor. • Replace the sensor. • Disconnect/reconnect the pod and replace with a good sensor. • Contact the hospital's technical personnel or DrägerService.
SpO_2 Artifact/ Sensor/Site?	• Persistent artifact • Wrong sensor and/or site was used. • High pulse amplitude detected • Sensor improperly placed. • Electrical/optical interference • Light is blocked	• Make sure the SpO_2 sensor is of a correct type and is properly attached to the patient and that the patient is not moving, and all cables are properly connected. • Make sure no electrical or optical interference is present. • Check the sensor for blocked light (may be due to nail polish). • Change the site/location periodically (for example finger vs. forehead, etc.). • Contact DrägerService.
SpO_2 Weak signal/ Sensor ~~Off~~?	• Pulse amplitude is too low. • Weak signal/weak pulse due to one of the following conditions. - Poor perfusion. - Low body temperature. - Sensor off the patient.	• Check the patient. • Make sure the SpO_2 sensor is properly attached to the patient and all cables are properly connected. • Relocate the sensor to another extremity. • Contact DrägerService.

Message	Possible Cause	Suggested Action
SpO_2 Searching	The monitor has not been able to compute a valid measurement and is searching for a pulse.	• Make sure the SpO_2 sensor is properly attached to the patient at a site free of patient motion and all cables are properly connected. • Make sure the correct sensor type and/or site is used. • Contact DrägerService.
SpO_2 Unplugged	The sensor cable not connected to the MultiMed pod.	• Make sure the cables are securely connected. • Check for a defective sensor.
SpO_2: Pod Failure	Pod hardware or software failure.	• Disconnect/reconnect the pod if problem persists. • Disconnect/reconnect the pod and/or replace with a good sensor. • Contact the hospital's technical personnel (SpO_2 compatibility is a locked option).
SpO_2: Check/ replace Sensor	Defective/faulty sensor	• Replace with a Nellcor-compatible sensor. • Contact the hospital's technical personnel (SpO_2 compatibility is a locked option).
SPO_2: non-Nellcor compatible sensor	A non-Nellcor compatible sensor or SpO_2 pod is connected to a monitor that is configured for Nellcor.	• Replace with a Nellcor-compatible sensor. • Contact the hospital's technical personnel (SpO_2 compatibility is a locked option).
Duplicate Device Connected	A MultiMed pod (with SpO_2 sensor) and an Infinity Nellcor Oximax pod are connected simultaneously.	Disconnect the duplicate device.

MicrO2+® Standalone Pulse Oximeter

Overview

The MicrO2+ can be used as a second source of SpO_2 monitoring with monitors that are compatible with Dräger Oxisure via MultiMed. It is a small, battery operated pulse oximeter that connects to the monitor's X8 connector via an RS232 cable.



When monitoring SpO_2 via the MicrO2+ the parameter box is labeled SpO2*. SpO_2*alarms are set from the Alarm Limits menu (see chapter 5). SpO_2* does not display a waveform and is not supported for OCRG.

NOTE:

- You cannot use the remote keypad and/or the Masimo SET or Nellcor Oximax pods with the MicrO2+ simultaneously.
- MicrO2+ pulse oximeter is not supported on monitors with Masimo or Nellcor logo (see pages 18-4 and 18-5).

Parameters

Parameter	Label	Units	Range
SpO_2	SpO_2*	%	1 to 100
PLS	PLS*	b/min	30 to 250
Delta SpO_2	ΔSpO_2%	%	0 to 99

NOTE:

- ΔSpO_2% is the absolute value of (SpO_2 - SpO_2*).
- Both SpO_2 and SpO_2* must be connected to get a ΔSpO_2% value.
- If PLS and PLS* are not within +/- 6 bpm, the SpO_2% parameter field will be blank.

SpO_2 MicrO2+ Setup

To access the SpO_2 MicrO2+ menu

- Click on the SpO_2* parameter box

or

1. Press the **Menu** fixed key.
2. Click on **Patient Setup**.
3. Click on **Parameters** to display a list of available parameters.
4. Click on **SpO2***.

Click on **SpO2* Label** to set the label in the parameter box. Choices are **None, Pre-ductal,** and **Post-ductal**. If you choose **None**, the **SpO2*** parameter box will have no label.

Click on **SpO2* Alarm** to go to the **SpO2*** entry in the Alarm Limits menu.

SpO_2 MicrO2+ Trends

The **SpO2*, PLS*,** and **SpO2%** trends can be seen in the trend/graph table (see chapter 6).

If both SpO_2 and SpO_2 are connected:*

1. SpO_2 and SpO_2* are displayed on the same trend/graph, with both parameter labels. The SpO_2 trend is white and SpO_2* trend is blue.
2. PLS and PLS* are displayed on the same trend graph, with both parameter labels. The PLS trend is white and PLS* trend is blue.
3. Click on the Cursor to see the SpO_2, SpO_2*, and SpO2% values.

NOTE: SpO2% does not appear if there is no delta for that data point.

4. The Trend Setup menu has combined selections for the channel in Manual Display mode for SpO_2/SpO_2* and also for PLS/PLS*.

If only SpO_2 or SpO_2 (Not both) are connected:*

1. SpO_2 and SpO_2* are displayed on their own trend/graphs.
2. PLS and PLS* are displayed on their own trend/graphs.
3. The Trend Setup menu has separate selections for each channel in manual display mode for SpO_2, SpO_2*, PLS, and PLS*.

MicrO2+® SpO_2 Status Messages

Message	Possible Cause	Suggested Action
SpO_2 > #* *SpO_2* < #*	The patient's SpO_2* is outside the current upper or lower alarm limits.	Check the patient and treat, if necessary.
PLS > #* *PLS* < #*	The patient's pulse rate is outside the current upper or lower alarm limits.	
PLS Out of Range (High)*	The pulse rate is outside the measuring range of the monitor	
SpO_2% > UL	The SpO_2% is greater than the upper limit.	
SpO_2 Transparent*	Too much light is reaching the sensor's light detector. This condition usually occurs because the sensor is off the finger or because too much ambient light is detected.	• Make sure the sensor is properly attached to the patient's finger. • Remove the light source. • Cover the sensor with opaque material. • Make sure no ambient light can reach the detector. • Contact DrägerService.
SpO_2 Unrecognized Sensor*	An invalid value was detected for the sensor calibration resistor.	• Check for a defective or unapproved sensor. • Replace the sensor. • Contact the hospital's technical personnel or DrägerService.
SpO_2 Light Blocked*	Insufficient light is reaching the sensor's light detector. **NOTE:** With detached or partially detached disposable sensors, the light emitters and detectors may have become misaligned.	• Make sure the light sensor is properly attached to the patient's finger, and that the finger is free of blocking substances. • Check for a defective sensor and replace, if necessary.
SpO_2 Artifact*	Persistent artifact	• Make sure the SpO_2 sensor is properly attached to the patient, the monitoring site is free of patient motion, and all cables are properly connected. • Contact DrägerService.
SpO_2 Weak signal*	The pulse amplitude is too low due to one of the following conditions: - Poor perfusion (shock). - Low body temperature.	• Check the patient. • Make sure the SpO_2 sensor is properly attached to the patient and all cables are properly connected. • Relocate the sensor to another extremity. • Contact DrägerService.

Message	Possible Cause	Suggested Action
SpO_2 No Measurement*	The monitor has not been able to compute a valid measurement within the last 30 seconds because of unstable measurement conditions.	• Make sure the SpO_2 sensor is properly attached to the patient at a site free of patient motion and all cables are properly connected. • Contact DrägerService.
SpO_2 Searching*	Searching for valid pulses from which to compute measurements.	Make sure the SpO_2 sensor is properly attached to the patient.
SpO_2 Regulation Error*	• Inconsistent light level • Excess ambient light	• Make sure the SpO_2 sensor is properly attached to the patient. • Remove or shade any external sources of light entering the sensor. • Contact DrägerService.
SpO_2 Unplugged*	The sensor or sensor cable is not connected to the MultiMed pod.	• Make sure that the cables and the sensor are securely connected. • Check for defective sensor.
SpO_2 Incompatible*	The MicrO2+ software version does not match, or the MicrO2+ pulse oximeter is connected to a Masimo-only or Nellcor-only Monitor.	Contact DrägerService.
SpO_2 Disconnected*	The MicrO2+ is disconnected.	Reconnect the MicrO2+
SpO_2 H/W Failure*	Front-end hardware circuit failure.	Contact DrägerService.

19 Transcutaneous Blood Gas Monitoring

Overview

With transcutaneous blood gas monitoring, you can perform continuous non-invasive measurements of the body's ability to deliver oxygen to tissue and remove carbon dioxide via the cardiopulmonary system. The ability to obtain pre-ductal and postductal tpO_2 values for neonates may indicate right to left shunting. Transcutaneous monitoring is useful in trending the patient's oxygenation status and can reduce the number of blood gas samples needed. However, it is not intended to replace invasive blood gas monitoring via a blood gas device. Blood gas values do not match transcutaneous gas readings.

NOTE:

- Transcutaneous blood gas measurements are contraindicated for an infant patient under gas anesthesia. Anesthetic agents, such as halothane, can cause incorrect or drifting readings.
- Noninvasive trending of transcutaneous carbon dioxide partial pressure is intended for any patient population.
- Transcutaneous blood gas values may not be clinically useful for patients with reduced cardiac output.

Precautions

WARNING:

- **You must either remove the transducer before defibrillating, or remembrane and calibrate the transducer after defibrillating. To avoid transducer damage, remove it from the patient during surgical procedures.**
- **Sensor temperatures of 43 °C (109 °F) and above for long periods may damage the skin and could result in severe burns. Change the monitoring site at least every four hours and whenever the site timer expires. Check the patient frequently if you are not using the site timer.**

CAUTION:

- *Verify the Auto Heater Shutdown setting with your unit manager before you configure the site timer. If the Auto Heater Shutdown function has been enabled in the Monitor Setups menu, the sensor heater shuts down as soon as the tpO_2/CO_2 site timer expires. If the Auto Heater Shutdown function has been disabled, the heater does not shut down and could burn the patient's skin.*
- *Clean tpO_2/CO_2 sensors with the pad included in the membrane kit. Do not clean the sensor surface with alcohols.*
  After applying hand lotion, dry your hands thoroughly before handling the sensor and cable because lotions containing isopropanol/propylalcohol and alcohol can damage the sensor cable.
- *For accurate measurement values always use the Severinghaus correction factor. The $tpCO_2$ label is used for the transcutaneous carbon dioxide measurement values, whether this correction factor was applied or not.*
- *Always store the sensor with the cap on to avoid drying out the membrane. If the sensor has been in storage or if you are using a new sensor, soak the membranes for 24 hours before use.*

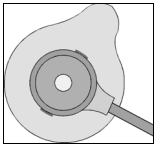
NOTE: tpO_2/CO_2 may be monitored through an MIB connection to the Radiometer MicroGas 7650 monitor.

Patient Preparation

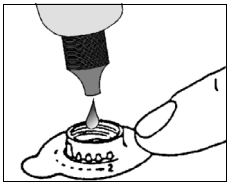
For reliable tpO_2/CO_2 measurements place the sensor membrane directly over the capillaries in the patient's skin. For a monitoring site select a flat or outward-curving (convex) surface with no bony protuberances, one that has good blood circulation, minimal fat deposits, and a thin outer layer of the epidermis. Avoid hairy parts, skin areas with a cavity, and visible veins. On neonates, the abdominal and chest regions and the inner surface of the upper thighs tend to be ideal monitoring sites. To obtain pre-ductal tpO_2 values, place the sensor on the patient's upper chest, right arm or head. Place the sensor on the lower abdomen or legs to obtain post-ductal values.

Applying the Sensor

1. Place an adhesive fixation ring on the patient's skin.
2. Apply the sensor to the fixation ring. Applying more than one fixation ring allows you to move the sensor around quickly to obtain tpO_2/CO_2 values from multiple monitoring sites. Doing so will help you avoid burning or irritating the patient's sign. If the skin becomes irritated, simply move the sensor to a different fixation ring and allow the hyperaemia (red spot) to fade before reusing the earlier monitoring site. If you intend to reuse a monitoring site, remove excess fluid from the fixation ring after you remove the sensor.
3. Degrease the patient's skin and remove loose skin flakes.
4. Remove the paper cover from an adhesive fixation ring.
5. Position the ring above the monitoring site so that the sensor cable points in the desired direction, at right angles to the marks on the sides of the fixation ring. Attach the fixation ring to the monitoring site: press down on the threaded part, then rub around the flexible foil surface.



6. Place 4-5 drops of contact liquid on the skin inside the ring.
7. Place the sensor in the fixation ring, aligning the arrow on the sensor with one of the marks on the ring. Turn the sensor clockwise for ¼ of a turn to secure it. The cable should be at right angles to the two side marks.



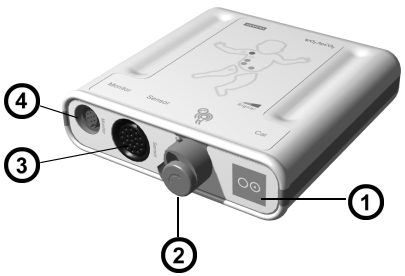
8. Secure the sensor cable with a cable clip to prevent pull on the adhesive ring and the skin and to prevent the sensor from tilting.

Hardware

WARNING: If the monitor reports a hardware failure, remove the sensor immediately and do not reapply the sensor until the problem has been corrected.

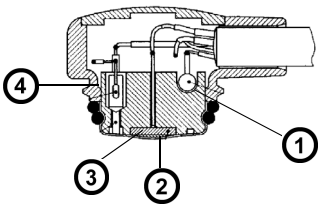
The transcutaneous monitoring system consists of a tpO_2/CO_2 pod, a solid-state sensor, and a calibration unit. The sensor contains two temperature sensors, a heating element, and a combined O_2 and CO_2 sensing element. The sensor heats the patient's skin, increasing local blood perfusion. Oxygen and carbon dioxide diffuse through the heated skin and the sensor measures their values on the skin's surface. In neonates, episodes of hypoxia and hyperoxia can therefore be quickly detected and avoided.

tpO_2/CO_2 pod



1	Calibration fixed key
2	Calibration chamber
3	Connection to tpO_2/CO_2 electrode
4	Connection to monitor

tpO_2/CO_2 sensor



1	Heating element
2	Solid-state ceramic Severinghaus-type CO_2 electrode
3	Platinum Clark-type O_2 electrode
4	Temperature sensors (2)

Sensor Warm-Up

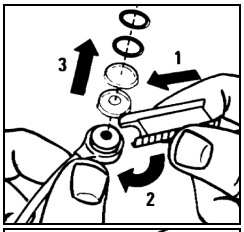
The sensor's heating element must warm the underlying tissue before obtaining accurate tpO_2/CO_2 values. The length of the warm-up period varies; it generally takes 10 to 15 minutes. Values displayed in the tpO_22/CO_2 parameter box during calibration and the initial warm-up phase are not clinically useful because the reading is only stable after the measurement site is warm and local hyperemization is complete.

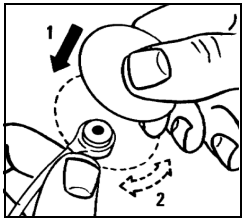
tpO_2/CO_2 alarms are disabled during warm-up. The start and end of the warm-up period are marked on the trend display with a vertical line on the trend graph and an event marker on the trend table.

Replacing Sensor Membranes

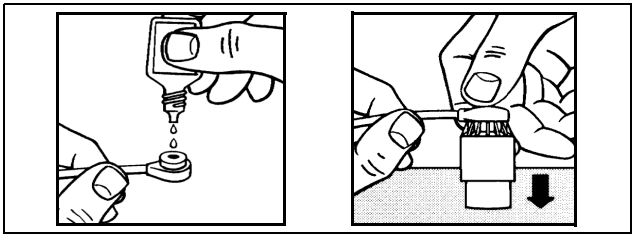
Replace the sensor's membranes once a week for reliable measurements. Sensors last about one year, whether used or stored (see page C-24 for a information about the sensor, membrane kits and other accessories).

To replace the membranes



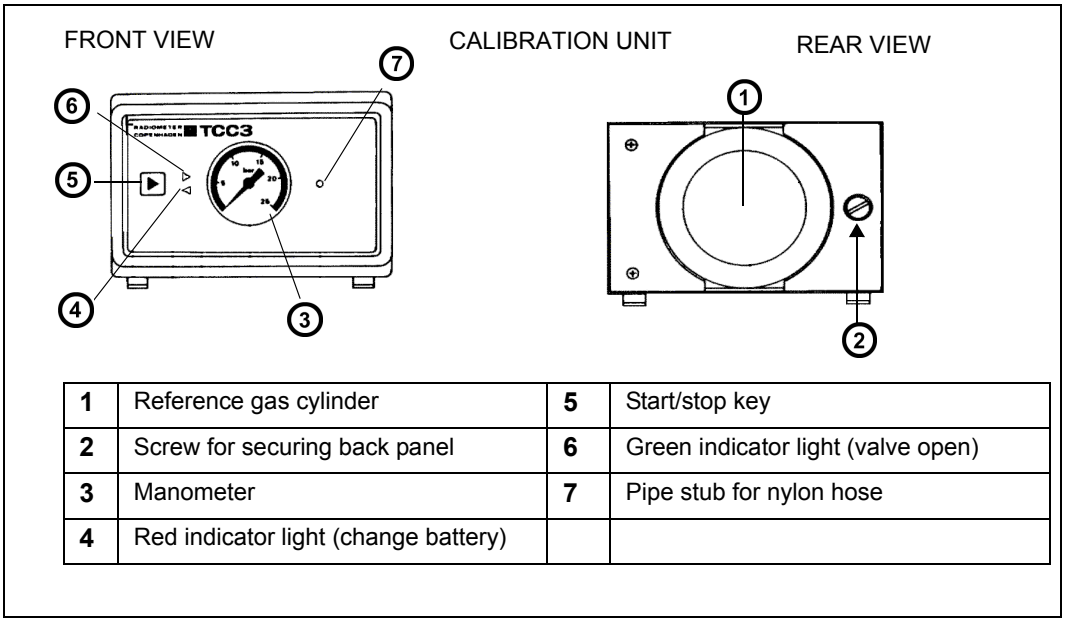


1. Slide the O-ring remover under the O-rings, just above the arrow on the sensor housing. Turn clockwise to release both O-rings.
2. Peel off the two membranes.
3. Absorb the old electrolyte solution with the cleaning paper. Rub the tip of the sensor two or three times to remove the thin layer of silver that may be on the tpO_2 part of the sensor.
4. Place two drops of electrolyte solution on the sensor surface (below left). Check that the solution covers the entire surface and there are no bubbles.
5. Turn the sensor over as shown (below right). Insert the sensor head into the top of the membrane unit. Press the sensor into the membrane unit. Remove the sensor from the membrane unit and wipe off any surplus electrolyte with a soft tissue. The sensor is now ready for calibration.



Calibration Unit

A reference gas cylinder inside the calibration unit is used to calibrate the sensor. Use the Start/Stop key (▶) on the unit's front panel to start or stop the flow of reference gas. The gauge on the front panel shows the actual pressure in the gas cylinder. Replace the cylinder when the pointer indicates LOW.



1	Reference gas cylinder	**5**	Start/stop key
2	Screw for securing back panel	**6**	Green indicator light (valve open)
3	Manometer	**7**	Pipe stub for nylon hose
4	Red indicator light (change battery)		

WARNING:

- **Gas cylinder contents are under pressure. Do not puncture. Do not store or use near heat or an open flame.**
- **Never discard the container into fire or an incinerator. Exposure to temperatures above 54°C (154°F) may cause the contents to vent or the container to burst.**
- **Remove the safety valve before discarding an empty gas cylinder.**

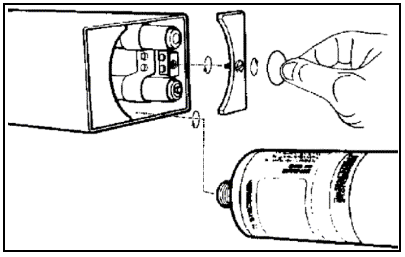
To install the reference gas cylinder

1. Remove the protective valve cap on the cylinder.
2. Screw the cylinder clockwise as far as possible into the socket on the back panel of the calibration unit.

To replace the batteries of the calibration unit

CAUTION: *To prevent leakage, always use two batteries of the same type and expiration date to power the calibration unit.*

1. Remove the reference gas cylinder.
2. Loosen the screw on the back panel of the Calibration Unit.
3. Remove the panel.
4. Replace the batteries with the polarity orientation shown inside the unit.
5. Replace the back panel and tighten the screw.



Calibrating the tpO_2/CO_2 Sensor

The sensitivity of the tpO_2/CO_2 sensing elements can vary. Calibrate with a known reference gas before each monitoring session and every few hours when in use (recommendation is within two hours).

To calibrate the sensor

1. Attach the reference gas cylinder to the calibration unit.
2. Connect one end of the nylon hose to the pipe stub on the calibration unit and the other end to the pipe stub on the pod's calibration chamber.

NOTE: Always use the recommended gas tubing. Using different tubing will cause inaccurate measurements.

3. Connect the sensor cable to the pod.
4. Remove the sensor cap and insert the membraned sensor into the pod's calibration chamber.
5. Swing the chamber cover down to secure the sensor.

6. Press the Start/Stop key (▶) on the calibration unit to start the flow of gas, checking the gauge reading on the front of the unit to verify an adequate gas supply.

NOTE: The calibration unit automatically cuts off the flow of reference gas after 20 minutes, but the gas flow can be stopped before that by pressing the **Start/Stop** key.

7. Access the tpO_2/CO_2 setup menu.
8. Click on **Start Calibration**.

or

— Press and hold the calibration key on the front of the tpO_2/CO_2 pod for two seconds.

— Calibration information appears on the right side of the menu. The monitor sounds a tone when calibration is complete.

9. Remove the sensor from the calibration chamber, holding it away from sources of CO_2. The monitor performs a final response test of the CO_2 sensor.

If the calibration is successful, the date and time of the calibration are displayed on the tpO_2/CO_2 menu, and the site timer, once it is enabled, starts counting down the timed monitoring session.

NOTE: If you do not remove the sensor within 30 minutes after the start of calibration, the sensor heater switches off and a new calibration is required.

Calibration typically takes 3 to 5 minutes. The monitor performs the following functional checks:

— Temperature Test — Turns on the sensor heater and verifies the sensor heats to the set temperature (±0.05 °C) within 3 minutes

— Range Test — Verifies the sensor produces voltages within acceptable ranges when exposed to the reference gas

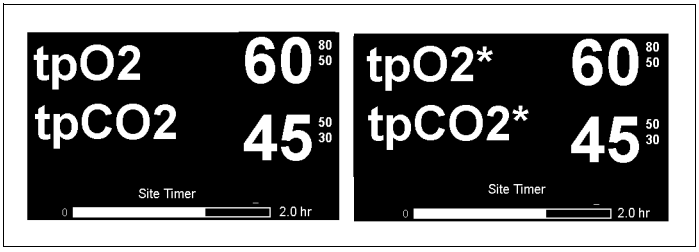
— Stability Test — Verifies the sensor produces stable voltages for at least 1 minute after exposure to the reference gas

Display Features

The monitor displays tpO_2/CO_2 values and trends as follows:

- In the tpO_2/CO_2 parameter box on the Main screen
- In the trend display (see chapter 6, Trends)
- On the oxycardiorespirogram (see page 12-9)

When two tpO_2/CO_2 pods are connected, each displays a parameter box on the main screen. The labels of the second pod are marked by an asterisk (*), as shown below:



tpO_2/CO_2 Setup

High sensor temperatures on the skin's surface offer the greatest degree of accuracy and can quickly detect a change in the patient's condition. However, the heat from the sensor may cause severe burns, especially in neonates. On the tpO_2/CO_2setup menu, you can restrict the application time of the sensor and establish a temperature set point (the target temperature for heating the sensor during calibration).

The tpO_2/CO_2 pod's settings for altitude and barometric pressure influence the measurement. The tpO_2/CO_2 pod contains an internal pressure sensor that measures current barometric pressure, which changes with altitude and weather conditions. The monitor allows you either to rely on the barometric pressure values generated automatically by the pod or manually enter pressure values obtained with an external barometer. Readings are displayed on the tpO_2/CO_2 setup menu.

See "Precautions" on page 19-3 for other important safety information.

To access the tpO_2/CO_2 setup menu:

- Click on the tpO_2/CO_2 parameter box (if displayed)

or

1. Press the **Menu** fixed key.
2. Click on **Patient Setup.**
3. Click on **Parameters.**
4. Scroll to **TP** or **TP*** and click.

NOTE:

- Some tpO_2/CO_2 setup functions are also available on the password-protected Unit Manager menu (see page 2-16). This allows the unit manager, head nurse, or physician to configure certain critical tpO_2/CO_2 functions according to the hospital's policies and safety considerations.
- The tpO_2/CO_2 and tpO_2/CO_2* setup menus do not time-out.

Quick Reference Table – tpO_2/CO_2 Setup

The tpO_2/CO_2 setup menu		
Menu Item	**Description**	**Settings/Procedures**
Site Timer	Limits tpO_2/CO_2sensor use to a specified period of time. When time has expired, an alarm sounds until the heater is shut down or until you place the sensor in the calibration chamber, and a message is displayed on all network devices. The timer starts to count down the monitoring session after sensor calibration. A bar graph in the tpO_2/CO_2 parameter box indicates time remaining.	• **0.5 - 8.0** hr in half-hour increments • **OFF** **NOTES:** The following Unit Manager menu items affect **Site Timer** setting in the tpO_2/CO_2 setup menu. See page 2-16 for detailed information. • If the **Site Timer Control** setting has been set to **Manager** in the Unit Manager menu, the **Site Timer** setting on the tpO_2/CO_2 setup menu is ghosted. • If the **Timer OFF Control** has been disabled in the Unit Manager menu, you cannot disable the site timer on the tpO_2/CO_2 setup menu.

The tpO_2/CO_2 setup menu		
Menu Item	**Description**	**Settings/Procedures**
Extend Site Timer	Clears the site timer alarm and extends the site timer by 30 minutes. This extension is only allowed once.	**NOTES**: • The selection is ghosted and not selectable until the TP/TP* site timer alarm sounds. • Once activated, the selection is ghosted again and is not selectable until the site has been changed and the timer has expired for that TP or TP* site. • If the **Site Timer Control** setting has been set to **Manager** in Unit Manager menu, the **Extend Site Timer** setting on the tpO_2/CO_2 setup menu is ghosted. • If the **Auto Heater Shutdown** setting is set to **ON** in the Unit Manager menu, the **Extend Site Timer** setting on the tpO_2/CO_2 setup menu is ghosted.
Set Temp	This function determines the temperature set point, or target temperature to heat the sensor during calibration **NOTE**: The ideal sensor temperature for tpO_2/CO_2 monitoring on neonates is 43 °C or above.	**99° - 113° F (37 - 45° C)**
Current Sensor Temp	Displays current temperature of sensor.	Display-only (visible only during calibration).
Last New Membrane	Sets the date and time of installation of a new membrane.	Format of date and time is 10:10 Dec 14.
Correction Factors	Selects the correction factor to use for $tpCO_2$ values (see page 2-17 for detailed information).	• **Severing** (default) • **OFF**
Atm. Pressure Mode	Determines automatic or manual setup for atmospheric pressure compensation **NOTE**: The atmospheric pressure compensation should be set by qualified personnel only. Consult your hospital's technical personnel or DrägerService before changing the Atm. Pressure Mode setting to **Manual**.	• **Manual** – the monitor does not update pressure readings. • **Auto** – the monitor updates the pressure reading continuously.

The tpO_2/CO_2 setup menu		
Menu Item	**Description**	**Settings/Procedures**
Auto Pressure	Displays the current atmospheric pressure. **NOTE**: If the pod's internal pressure sensor is not properly calibrated, you cannot calibrate the tpO_2/CO_2 sensor in Auto mode (Auto Pressure displays ***).	• Display-only • This function is ghosted if the **Atm. Pressure Mode** setting is set to **Auto**.
Manual Pressure	Allows you to enter barometric pressure manually **NOTE**: If **Auto Pressure** displays ***, enter the barometric pressure manually and have the pressure sensor calibrated by a qualified DrägerService technician.	1. Select **Atm. Pressure Mode** on tpO_2/CO_2 setup menu. 2. Click on **Manual**. 3. Select the desired setting.
tpO2 Alarm	Accesses tpO_2/CO_2 values in the Alarm Limits table (see page 5-8).	Not applicable
NOTE: Some tpO_2/CO_2 setup functions are also available on the Unit Manager menu, where the unit manager, head nurse, or physician can configure certain critical tpO_2/CO_2 functions according to the hospital's policies and safety considerations. See page 2-16 for information.		

Status Messages

Message	Possible Cause	Suggested Action
tpO_2 > # *tpO_2 < #*	tpO_2 or $tpCO_2$ values are outside the alarm limits, due to one of the following conditions: • Physiological • Inappropriate limit settings • Loose fixation ring	• Check the patient and treat, if necessary. • Change the alarm limits (see *Alarms* chapter). • Apply a new fixation ring at different monitoring site. • Check the sensor and pod; recalibrate the sensor; change the sensor membranes or replace the sensor, if necessary.
$tpCO_2$ > # *$tpCO_2$ < #*		
TP Out of Range (High)	tpO_2/CO_2 values are outside the measuring range, due to one of the following conditions: • Physiological • Equipment malfunction	• Check the patient and treat, if necessary. • Check the sensor and pod; recalibrate the sensor; apply new sensor membranes; replace the sensor, if necessary.
TP Warming Up -- Reduced Accuracy.	Warm-up phase in progress	Wait until the warm-up phase has ended before relying on the displayed tpO_2/CO_2 values for clinical evaluation.
TP Sensor Unplugged	The tpO_2/CO_2 sensor is unplugged.	• Check all connections. • Replace the sensor and recalibrate, if necessary.
TP Pod Unplugged	The tpO_2/CO_2 pod is not connected to the monitor.	• Check all connections. • Replace the pod or connecting cable, if necessary.
Check TP Sensor Site	The site timer will expire within 15 minutes.	Prepare to recalibrate and reposition the sensor.
TP Check/ Replace Sensor	The auto heater shutdown is in effect or the sensor didn't heat to the desired temperature setting.	• Recalibrate sensor and apply at new monitoring site to start the Site Timer. • Verify that the sensor is compatible with pod.
TP Change Sensor Site	The site timer has expired.	• Immediately remove the sensor from the patient. • Recalibrate the sensor and apply at new monitoring site.
Remove Probe from Chamber	The calibration of the sensor is complete.	Remove the sensor from the calibration chamber.
TP Chamber Timeout	The electrode remained in the calibration chamber > 30 min.	Recalibrate or cover the sensor with a protective cap for storage.

Message	Possible Cause	Suggested Action
TP Cal Required	The sensor must be calibrated before use and after the following: • Change in sensor temperature setting • Change in site timer setting • Change in manually entered barometric pressure value • Change in auto heater shutdown setting	Calibrate the sensor.
TP Cal Accepted	The sensor calibration was successful.	Apply the sensor and proceed with monitoring.
TP Cal Failed	The sensor calibration was unsuccessful.	Recalibrate the sensor.
TP Barometric Cal Failed	The pod's internal barometric pressure sensor needs calibration.	Contact DrägerService.
TP Comm Failure	Loss of communication between monitor and pod.	• Remove the sensor from the patient immediately. • Check the pod and the cable and connections. If necessary, replace the cable or pod.
TP Drift	The actual sensor temperature differs from the target temperature setting by > 0.3 °C.	• Make sure the sensor is securely placed in the fixation ring and ring is properly attached to the patient. • Replace the sensor if necessary.
TP Cartridge (pod) Incompatible	The tpO_2/CO_2 pod is incompatible with the monitor.	• Replace the pod. • Contact DrägerService.
TP Pods Only Supported on AUX1 or AUX2.	TP pod is connected to the wrong connector at the monitor.	Connect the TP pod to one of the bottom two pod connectors of the monitor (Hemo/Aux. or Aux.).
TP Pod H/W Failure	The tpO_2/CO_2 hardware failure.	• Remove the sensor immediately from the patient. • Check the sensor; the pod and the pod connections. Replace the sensor or the pod, if necessary. • Disconnect then reconnect the pod. • Recalibrate the sensor. • If problem persists, call DrägerService.

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20 $etCO_2$ (End-Tidal CO_2) monitoring

Overview

End-tidal CO_2, or $etCO_2$, is the level of carbon dioxide in the airway at the end of expiration. The monitor reports $etCO_2$ and its associated parameters iCO_2 (Inspired CO_2) and RRc (Respiration Rate) via an optional free-standing MultiGas module, an $etCO_2$ module or an $etCO_2$ pod. You can also monitor $etCO_2$ via an optional combined $etCO_2$/respiratory mechanics pod.

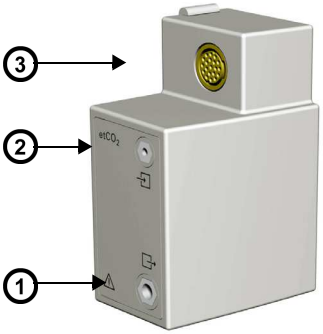
NOTE: To monitor $etCO_2$ and other airway gases via the MultiGas module, (see page 24-1). To monitor airway pressure, flow, volume and other respiratory mechanics variables together with or separately from $etCO_2$, see chapter 22, Respiratory Mechanics.

The $etCO_2$ module and pods acquire signals from a Capnostat® sensor. For mainstream monitoring, the sensor fits over a specially designed adapter in the intubated patient's airway or breathing circuit. For sidestream detection, a sampling pump delivers signals from the adapter to the module or pod.

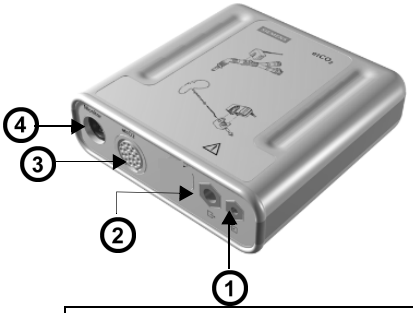
NOTE: $etCO_2$ readings assume body temperature of 37 °C and humidity of 100 %, otherwise $etCO_2$ readings may vary.

NOTE: Dräger pods and their accessories that come into contact with the patient are all free of latex.

Ports and outlets are clearly marked on the front of the $etCO_2$ module and pods. Use these labels as a guide when connecting the pod or module to the monitor and peripherals..



Slide into slot on rear of monitor until the module rests securely.	
1	Sidestream output port
2	Sidestream input port
3	Capnostat sensor cable



Plug one end of connector cable into PodCom connector on left side of monitor. Plug the other end into the pod.	
1	Sidestream input port
2	Sidestream output port
3	Capnostat sensor cable
4	PodComm connection (to monitor)

General $etCO_2$/Gas Analysis Precautions

Refer to the "Safety Considerations" section starting on page 8, at the beginning of these Instructions for Use, for general precautions regarding safe device operation.

WARNING:

- **The safety and effectiveness of the respiration measurement method in the detection of apnea, particularly the apnea of prematurity and apnea of infancy, has not been established.**
- **Patient monitors that measure CO_2, anesthetic agents, and/or respiratory mechanics are not intended to be used as an apnea monitor and/or recording device. While these products provide an apnea alarm, that alarm condition is initiated based on the elapsed time since the last breath was detected. Clinical diagnosis of a true apneic event, however, requires multiple physiological signals.**
- **CO_2 alarms do not activate until the first breath is detected after turning on the monitor or discharging a patient.**
- **The accuracy of CO_2 and respiration rate measurements may be affected by not applying the sensor properly, by certain patient conditions and by certain environmental conditions.**
- **Incorrect, loose or damaged tubing connections may compromise ventilation by allowing gas leaks which may compromise measurement accuracy. To avoid this, securely connect all components and check connections for leaks according to standard clinical procedures.**

WARNING:

- **Occupational safety: Used sampling tubing, T-connectors, and water traps could be contaminated and must be handled and disposed of with care. Infection hazard may be present. Dispose of these items in accordance with local regulations.**
- **Optimize response time by reducing dead space and by keeping sampling tubing as short as possible without stretching it. Long sampling lines may decrease accuracy and cause slower response times for side-stream measurement technologies.**
- **When using a sampling line for intubated patients with a closed suction system, do not place the airway adapter between the suction catheter and endotracheal tube. This is to make sure that the airway adapter does not interfere with the functioning of the suction catheter.**

CAUTION:

- *Leaks in the breathing circuit (for example, an uncuffed endotracheal tube or a damaged airway adapter) may significantly affect CO_2 and respiratory mechanics measurement values (for example, airway pressure, flow, dead space, and CO_2 production).*
- *Calibrate the Capnostat sensor when you switch sensor types (for example, from adult to neonatal).*
- *To prevent damage to Capnostat sensor windows, remove the airway adapter from the circuit whenever aerosolized medication is being delivered.*
- *To prevent leakage, make sure the airway adapter is firmly connected to the breathing circuit.*
- *Cutting or removing any part of the sample line could compromise measurement accuracy.*
- *In high-altitude environments, $etCO_2$ values may be lower than values observed at sea level, as described by Dalton's law of partial pressures. When using the monitor in high-altitude environments, it is advisable to adjust $etCO_2$ alarm settings accordingly.*
- *If too much moisture enters the sampling line, the message "$etCO_2$ Tubing Blocked" will appear in the message area. Replace the sampling line once the "$etCO_2$ Tubing Blocked" message appears.*

NOTE:

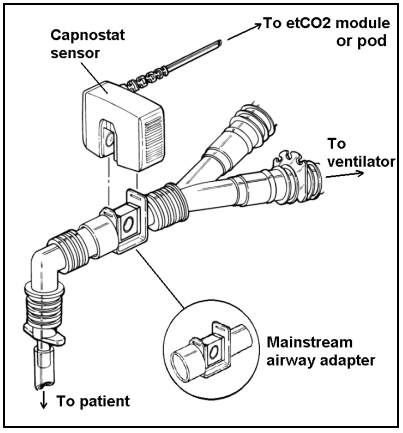
- During nebulization or suction for intubated patients, remove the sampling line luer connector from the monitor to avoid moisture buildup and sampling line occlusion.
- Replace the sampling line according to hospital protocol or when a blockage is indicated by the device. Excessive patient secretions or a build-up of liquids in the airway tubing may occlude the sampling line, requiring more frequent replacement.

Sampling Methods

Mainstream

For mainstream detection, the sensor is located within the patient's airway or breathing circuit, allowing you to monitor individual breathing cycles of the intubated patient. This method is appropriate for neonatal as well as adult and pediatric patients.

Mainstream Monitoring Setup

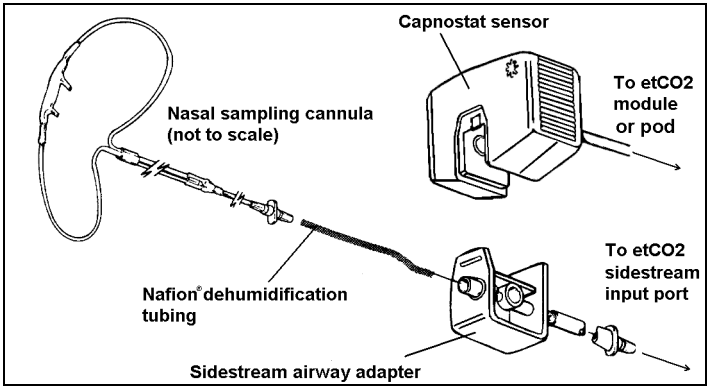


1. Click on $etCO_2$ parameter box to access $etCO_2$ setup menu.
2. Click on **Measurement Mode**.
3. Click on **Main**.
4. Select a mainstream airway adapter. Make sure the windows are clean and dry. Clean or replace the adapter if necessary.
5. Align the marks on bottom of the adapter with the sensor.
6. Snap firmly into place.
7. Insert the adapter in a vertical position between the elbow and ventilator circuit "Y.
8. Position sensor cable away from patient.
9. Confirm proper connection on the $etCO_2$ setup menu.

Sidestream (Adult and Pediatric Patients Only)

Sidestream monitoring is appropriate for non-intubated patients or for intubated patients who are breathing independently. Sidestream monitoring should not be used on neonates and is therefore disabled in Neonatal mode.

A pump in the $etCO_2$ device samples the patient's inspired and expired air as it passes a nasal sampling cannula. You cannot measure flow, volume or pressure via sidestream monitoring.



Sidestream Monitoring Setup

1. Click on the $etCO_2$ parameter box to access the setup menu.
2. Click on **Measurement Mode**.
3. Click on **Side**.
4. Make sure the sidestream pump in the $etCO_2$ device turns on, and that you feel suction at the input port.
5. Select a sidestream airway adapter. Make sure the windows are clean and dry. Clean or replace the adapter if necessary.
6. Use the sidestream sampling tubing to connect the airway adapter to the input connector on the face of the $etCO_2$ module or pod. (Dräger recommends the NAFION® dehumidification tubing set.

NOTE: For a complete list of $etCO_2$ accessories provided by Dräger for this product, see page C-24.

7. Connect a nasal sampling cannula to the dehumidification tubing set if one is used. Otherwise, connect the cannula directly to the sidestream airway adapter.

NOTE: Dehumidification and cannula tubing can affect the calibration of the airway adapter. Calibrate the *Capnostat* adapter if you change to different combinations or lengths of cannula and dehumidification tubing.

8. Align the marks on the bottom of the adapter and the bottom of the CAPNOSTAT sensor. Snap the airway adapter into the sensor until you hear a click.
9. You must calibrate the adapter when you switch adapter types (for example, from adult to neonatal) as described on page 19-11.
10. Attach the O_2 tubing to the ventilator and enter the O_2 setting to be used.
11. Access the $etCO_2$ menu and select **Gas Compensation** (when using the $etCO_2$ pod) or **O2 Compensation** (when using the $etCO_2$ module).
12. Dial in the O_2 setting you used in step and click to confirm your choice.
13. Insert the cannula tips into the patient's nostrils, pass the cannula tubing behind the ears, and slide the retaining sleeve up so that the tubing is snug under the chin.
14. Secure the CAPNOSTAT sensor to the bedding or to the patient's bedclothing.
15. Make sure the sensor cabling and nasal cannula tubing are secured and out of the patient's way.

WARNING: When performing sidestream CO_2 measurements on patients who are receiving or have recently received anesthetics, connect the outlet to a scavenging system to avoid exposing medical staff to anesthetics.

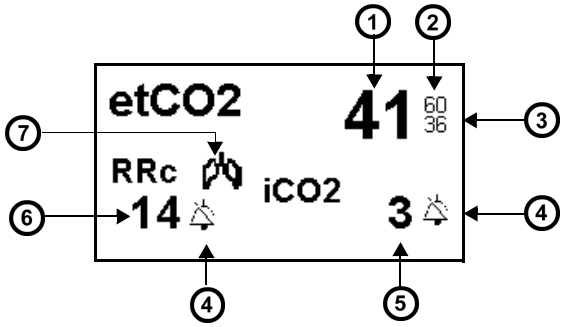
CAUTION: *Always position the Capnostat airway adapter vertically to prevent patient secretions from obscuring the adapter windows.*

Display Features

The monitor reports $etCO_2$ data as waveforms and parameter values. Current parameter values appear in the $etCO_2$ parameter box. For information on displaying trended $etCO_2$ values, see chapter 6, Trends.

Parameters

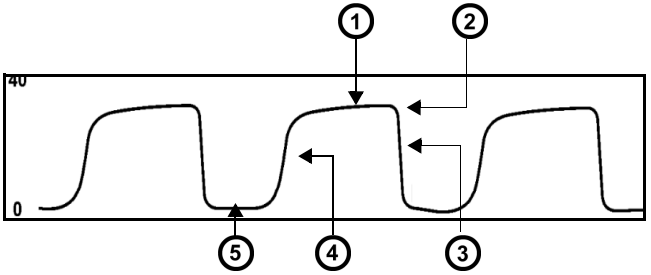
The $etCO_2$ parameter box displays the following parameters and their current values.



1	End-tidal CO2 value – highest average CO2 in the airway during expiratory period.	5	Inspired CO2 value – minimum average value of CO2 in the airway over the inspiratory period
2	Upper alarm limit	6	Respiration rate
3	Lower alarm limit	7	Respiration icon (blinks with each breath)
4	Disabled alarm icon		

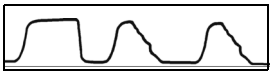
Capnograms

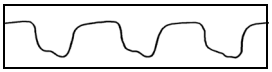
The monitor also displays an instantaneous CO_2 reading as a waveform or capnogram. A typical capnogram is shown below:



1	Expiratory plateau (level of CO2 in lungs ceases to increase significantly)
2	End-tidal concentration point (end of expiration phase, where etCO2 is measured)
3	Onset of inspiration phase
4	Expiration phase
5	Baseline during inspiration

You can use capnograms to troubleshoot problems with equipment or monitor configuration as well as to monitor a patient's clinical status. The following table shows some of the more common problems identifiable through capnogram analysis:

Capnogram	Description	Immediate and possible causes
	Alveolar plateau shows downward slope that merges with descending limb	Inadequate Seal Around Endotracheal Tube • Leaky or deflated endotracheal or tracheostomy cuff • Artificial airway that is too small for the patient
	Elevated waveform baseline with corresponding increase in $etCO_2$ level	Rebreathing • Insufficient expiratory time • Faulty expiratory valve • Inadequate inspiratory flow • Malfunction of a CO_2 absorber system • Partial rebreathing circuits

	Change in slope of ascending limb. Possible absence of an alveolar plateau	Obstruction in Apparatus • Partial obstruction in expiratory limb of breathing circuit • Foreign body in upper airway • Partially kinked or occluded artificial airway • Herniated endotracheal/tracheostomy tube cuff • Bronchospasm
	Elevated baseline, with pronounced slope on descending limb	Faulty Ventilator Circuit Valve • Rebreathing (see above)

$etCO_2$ Setup

The $etCO_2$ setup menus differ slightly depending on whether the monitor is connected to an $etCO_2$ module or an $etCO_2$ pod. The procedure for opening the setup menu, however, is the same for both devices.

Accessing Setup Menus

- Click on the main screen $etCO_2$ parameter box to open the $etCO_2$ setup menu

or

1. Press the **Menu** fixed key on the front of the monitor. The Main menu appears.
2. Click on **Patient Setup**. A list of available patient setup functions appears.
3. Click on **Parameters** in the second column. A list of available parameters appears.
4. Click on **etCO2**. The $etCO_2$ setup menu appears.

Quick Reference Table – $etCO_2$ Setup

The following table explains $etCO_2$ setup functions.

<table>
<tr><th>Function</th><th>Description</th><th>Settings</th></tr>
<tr><td colspan="3">Calibration</td></tr>
<tr><td>Sensor Cal.</td><td>Displays date and time of last Capnostat sensor calibration</td><td>Not applicable</td></tr>
<tr><td>Adapter Cal.</td><td>Initiates airway adapter calibration</td><td>Not applicable</td></tr>
<tr><td colspan="3">Gas Compensation
Gas compensation offsets inappropriate levels of anesthetic agents and gases by ensuring that gas percentages in each respiratory phase add up to 100: each gas in any gas mixture exerts a partial pressure of the total. Room air, for example, is made up of approximately 79% nitrogen and 21% oxygen. Gas concentration is usually expressed as a percentage, while partial pressure is measured in mmHg or kPa. These setup functions differ according to the device used to monitor $etCO_2$ (pod or module).</td></tr>
<tr><td>Agent Concentration (pod only)</td><td>Sets value of primary expired anesthetic agent to compensate for offsets</td><td>• 1 % - 20 %</td></tr>
<tr><td>Gas Compensation (pod only)</td><td>Determines gas percentages for inspiratory and expiratory breathing. The table below lists settings on the Gas Compensation menu in the first column and lists automatically calculated percentages in the right five columns
<table>
<tr><th rowspan="2">Setting</th><th colspan="5">Agent</th></tr>
<tr><th>CO2</th><th>O2</th><th>N2</th><th>N2O</th><th>He</th></tr>
<tr><td>Air</td><td>5</td><td>17</td><td>78</td><td>0</td><td>0</td></tr>
<tr><td>N2O/O2</td><td>5</td><td>35</td><td>0</td><td>60</td><td>0</td></tr>
<tr><td>>60% O2</td><td>5</td><td>75</td><td>20</td><td>0</td><td>0</td></tr>
<tr><td>Heliox</td><td>5</td><td>35</td><td>0</td><td>0</td><td>60</td></tr>
</table></td><td>• Air
• N2O/O2
• >60% O2
• Heliox</td></tr>
<tr><td>N2O Compensation (module only)</td><td>Compensates for presence of nitrous oxide, not normally present in room air but typically used in the operating room. Significant concentrations of nitrous oxide can cause the monitor to overestimate the level of $etCO_2$ by approximately 5 %.</td><td>• ON
• OFF</td></tr>
<tr><td>O2 Compensation (module only)</td><td>Compensates for patient’s supplemental oxygen. Failure to compensate for supplemental oxygen can also result in inaccurate measurements.</td><td>• 21 % - 100 %</td></tr>
<tr><td colspan="3">Other $etCO_2$ setup functions</td></tr>
<tr><td>Scale</td><td>Determines size of currently displayed waveform</td><td>• 40 mmHg
• 60 mmHg
• 80 mmHg
• 100 mmHg (pod only)</td></tr>
</table>

Function	Description	Settings
Respiratory Sweep Speed	Sets waveform sweep speed on screen display.	• **6.25 mm/s** • **12.5 mm/s** • **25 mm/s** • **50 mm/s**
Averaging	Sets interval for CO_2 measurements **NOTE:** The monitor reports the maximum value of $etCO_2$ during the specified sampling interval.	• **Breath** (end-expiration point) • **10 s** • **20 s** • **Instantaneous** (pod only setting) – Represents the highest CO_2 value per one-second interval
Atm. Pressure Mode	Determines automatic or manual setup for atmospheric pressure compensation **NOTE**: Atmospheric pressure compensation should be set by qualified personnel only. Consult with your hospital's technical personnel/ DrägerService before changing the Atm. Pressure Mode setting to **Manual**.	• **Auto** • **Manual**
Atm. Pressure	This is the current atmospheric pressure. This function is ghosted if you have selected **Auto** under Atm. Pressure Mode.	• **540** to **800 mmHg** (in increments of 5)
Measurement Mode	Configures the monitor for mainstream or sidestream monitoring	• **Main** • **Side**
Respiration Filter (module only)	Filters signal artifact caused by cardiogenic oscillations or Baines rebreathing bumps, which could cause the monitor to display an erroneously high respiration rate (RRc)	• **Normal** – Disables the filter • **Special** – Enables this filtering at the expense of a certain degree of monitor responsiveness
Apnea Alarm	Displays the Apnea Alarm menu.	• **RRc Apnea Time** • **Apnea Archive**
etCO2 Alarm	Accesses the Alarm Limits table, where you can set upper and lower alarm thresholds.See chapter 5, Alarms, for information about setting and displaying alarm limits.	Not applicable

Quick Reference Table--Apnea Alarm submenu

The following table explains apnea alarm submenu functions.

Function	Description	Settings
RRc Apnea Time	Specifies time monitor waits before reporting a cessation of breathing as an apnea event.	• **OFF, 10, 15, 20, 25,** and **30 s**
Apnea Archive	Allows you to store and/or record automatically an alarm event for apnea. You can later review stored alarms on the Event Recall screen.	• **OFF**, **Record, Store** (default), **Str./Rec.**

Cleaning, Calibration and Verification

Cleaning

For information on cleaning ventilation tubing, sensors and adapters, see Chapter 30.

Adapter Calibration

Calibrate the adapter every time you switch adapter types — for example, when you switch from a mainstream to a sidestream adapter, or from an adult to a neonatal adapter. You do not normally have to calibrate an adapter if you are replacing it with another of the same type.

To calibrate an airway adapter:

1. Click on the $etCO_2$ parameter box to access the setup menu.
2. Click on **Adapter Cal.** A popup message *etCO2 Place Adapter in Room Air* appears:
   Connect the CO_2 sensor onto the airway adapter and hold them away from any source of CO_2 (including the patient's mouth and your own).
3. Click on **Continue**. The calibration takes approximately 15 seconds, during which the message *etCO2 Calibrating Adapter* appears.
4. When calibration is successful, the monitor displays the message *etCO2 Adapter Cal. Accepted.* If calibration fails, the monitor displays a status message (see "Status Messages" on page 20-16).

Sensor Calibration and Verification

For accurate readings, calibrate the Capnostat every time you connect it to a different $etCO_2$ module or pod. Calibration is unnecessary if you disconnect the sensor and later reconnect it to the same device. You can display the date and time of the last Capnostat sensor calibration by clicking on **Sensor Cal.** in the $etCO_2$ menu. Verify the sensor calibration periodically to check that it is functioning correctly, or when you suspect changes or inaccurate readings.

To calibrate and verify the Capnostat sensor

1. Make sure the monitor is turned on and properly connected to the module or pod.
2. The monitor displays a message informing you that the sensor is warming up (~2 minutes at room temperature).
3. When the sensor reaches a stable temperature, the monitor instructs you to place the sensor on the zero cell.
4. Locate the zero and reference cells on the sensor cable.
5. Place the sensor on the zero cell. The calibration process begins automatically and takes about 20 seconds.
6. When calibration is complete, the monitor instructs you to place the sensor on the reference cell.
7. Place the sensor on the Reference cell. The monitor displays the message *etCO2 Verifying Sensor Cal.*
8. When the verification is complete, the monitor displays the message *etCO2 Sensor Cal. Verified.* You can now use the sensor.

If verification fails, the monitor again displays the message e*tCO2 Place Sensor on Zero Cell*. In this case, repeat the process from step 5. A status message appears if calibration fails again (see table at the end of this chapter).

Status Messages

Message	Condition	Suggested Action
$etCO_2$ < # *$etCO_2$ > #*	The upper or lower alarm limits exceeded by value #.	• Check the patient and treat, if necessary. • Change the alarm limits. • Check the equipment and replace it, if necessary.
iCO_2 < # *iCO_2 > #*		
RRc < # *RRc > #*		Check the ventilator for: • Inspiratory flow • Expiratory time • Faulty expiratory valve
RRc Apnea	No breath is detected for a period exceeding the RRc apnea time set by the user.	Check the patient and treat, if necessary.
$etCO_2$ H/W Failure	Hardware malfunction	Disconnect then reconnect the $etCO_2$ module/pod. If the message persists, return the device to the hospital's technical personnel and try a new one.
$etCO_2$ Atm. Press. Sensor Failure	Hardware malfunction ($etCO_2$ pod).	Shift to manual mode and dial in the pressure. If an automatic pressure required, contact the hospital's technical personnel.
$etCO_2$ Calibrate Atm. Press.	Corrupt EEPROM	Shift to manual mode and dial in pressure. If automatic pressure required, contact the hospital's technical personnel.
$etCO_2$ Sensor Unplugged	The $etCO_2$ sensor has been disconnected.	Disconnect then reconnect the $etCO_2$ sensor. If the message persists, try another sensor.
$etCO_2$ Sensor Warming Up	The CAPNOSTAT has not yet reached a stable temperature.	Wait for the sensor to warm up (up to three minutes at room temperature). If the message fails to clear, contact the hospital's technical personnel.
$etCO_2$ Sensor Failure	The CAPNOSTAT source current is out of range or sensor did not warm up within 8 minutes.	Try the sensor again. If the message persists, try a new sensor.
$etCO_2$ Sensor Too warm	The external heat source is warming the sensor.	• Replace the sensor. • Remove the heat source. • If the problem persists, disconnect and reconnect the sensor.
$etCO_2$ Place Sensor on Zero Cell	The last sensor calibration failed or sensor is not the last sensor calibrated on this device.	Place the sensor on the zero cell and wait for zeroing to complete.
$etCO_2$ Sensor Temp Not Stable	The sensor temperature is unstable following warm-up.	Wait at least three minutes for the message to disappear. If the message persists, replace the sensor.

Message	Condition	Suggested Action
$etCO_2$ Out of Range (High)	The CO_2 value is out of range (high).	• Check the patient and treat,if necessary. • Recalibrate sensor.
$etCO_2$ Check Airway Adapter/Cal	The airway adapter is dirty, not fully seated, or out or calibration.	• Make sure the adapter is properly seated. • Clean and calibrate the airway adapter.
$etCO_2$ Calibrating Sensor	Calibrating on the zero cell in progress.	Informational message; no action required
$etCO_2$ Cannot Cal. Sensor	The calibration on the zero cell could not be completed because of CAPNOSTAT temperature instability.	• Check for any heat sources warming the sensor and remove them. • Wait at least three minutes for the temperature to stabilize.
$etCO_2$Adapter Failure	The airway adapter is dirty, not fully seated, or out or calibration.	Make sure the airway adapter is properly seated. Clean and calibrate the airway adapter if needed.
$etCO_2$ Place Sensor On Ref Cell	The calibration on the zero cell completed successfully.	Place sensor on the reference cell and wait for calibration to complete.
$etCO_2$ Sensor Cal. Failed	The calibration on the zero cell failed.	Recalibrate. If the message persists, try a new sensor.
$etCO_2$ Verifying Sensor Cal	Calibrating on reference cell in progress.	Informational message; no action required
$etCO_2$ Sensor Cal. Verified	Verification completed successfully.	Informational message; no action required
$etCO_2$ Calibrating Adapter	The airway adapter calibration (zeroing in room air) is in progress.	Informational message; no action required
$etCO_2$ Cal. Failed, Breaths?	Breaths were detected during the 20 second period following the activation of the adapter cal. key.	Make sure the sensor is not connected to the patient's ventilator breathing circuit or close to a CO_2 source. Recalibrate.
$etCO_2$ Cannot Cal. Adapter	The airway adapter calibration (zeroing in room air) could not be completed because of CAPNOSTAT temperature instability, or because the CAPNOSTAT was on the zero cell.	• Recalibrate holding the sensor in room air (not on zero cell). • Wait at least eight minutes for temperature to stabilize and recalibrate. • Remove any heat source warming the sensor and recalibrate. • Remove sensor from Zero cell, place on the adapter, and recalibrate.
$etCO_2$Adapter Cal. Accepted	The airway adapter calibration (zeroing in room air) is completed.	Informational message; no action required

Message	Condition	Suggested Action
$etCO_2$ Adapter Cal. Failed	The airway adapter calibration (zeroing in room air) failed.	Make sure the adapter is properly attached to the sensor and that its windows are clean. If the problem persists, try another adapter.
etCO2 Adapter Cal. Required	The sidestream measurement mode was initiated, requiring air way adapter cal. (zeroing in room air) to calibrate pump.	Calibrate the new adapter.
$etCO_2$ Tubing Blocked	Sidestream tubing obstructed, or the filter is clogged.	• Clear blockage in the tubing. • Replace the module/pod.
$etCO_2$ Tubing Leak	The sidestream tubing has a leak.	Change the tubing.
$etCO_2$ module Disconnected	The $etCO_2$ module is not connected to the monitor.	Check cable and connection. Replace cable if necessary.
$etCO_2$ module Incompatible	Corrupt EEPROM. Wrong software or hardware version	• Try a new module. • Consult the hospital's technical personnel.
NOTE: If the $etCO_2$ pod is disconnected, the $etCO_2$ parameter box disappears.		

21 Microstream® $etCO_2$ Monitoring

Overview

The Infinity® $etCO_2$ Microstream® SmartPod®, when connected to a monitor, allows the monitor to measure and display sidestream $etCO_2$ (end-tidal CO_2), iCO_2 (inspired CO_2) and RRc (Respiration Rate). The Microstream pod cannot be used simultaneously with either an $etCO_2$ pod or an $etCO_2$ /respiratory mechanics pod.

The Microstream pod is intended for use with adult, pediatric, and neonatal patients with appropriate accessories (see page C-25). The pod uses a fixed sample flow rate of 50 mL/min. and requires a proprietary sample line (accessory) and connects to the monitor via PodCom.

Precautions

Refer to the general precautions section for $etCO_2$ on page 20-2.

WARNING: The use of accessories, transducers, sensors and cables other than those specified may result in increased emission and/or decreased immunity of the equipment and/or system.

WARNING: When performing sidestream CO_2 measurements on patients who are receiving or have recently received anesthetics, connect the outlet to a scavenging system to avoid exposing medical staff to anesthetics.

WARNING: Loose or damaged connections may compromise ventilation or cause an inaccurate measurement of respiratory gases. Securely connect all components and check connections for leaks according to standard clinical procedures.

CAUTION:

- *To avoid blocking the sampling tube, do not attempt to sterilize the Microstream pod by immersing it in liquids.*
- *Do not obstruct the exhaust port on the Microstream pod because it prevents air flow.*
- *CO_2 readings and respiratory rate can be affected by sensor application errors, certain ambient environmental conditions, and certain patient conditions.*
- *Before use, carefully read the Microstream® $etCO_2$ sampling lines Directions for Use.*

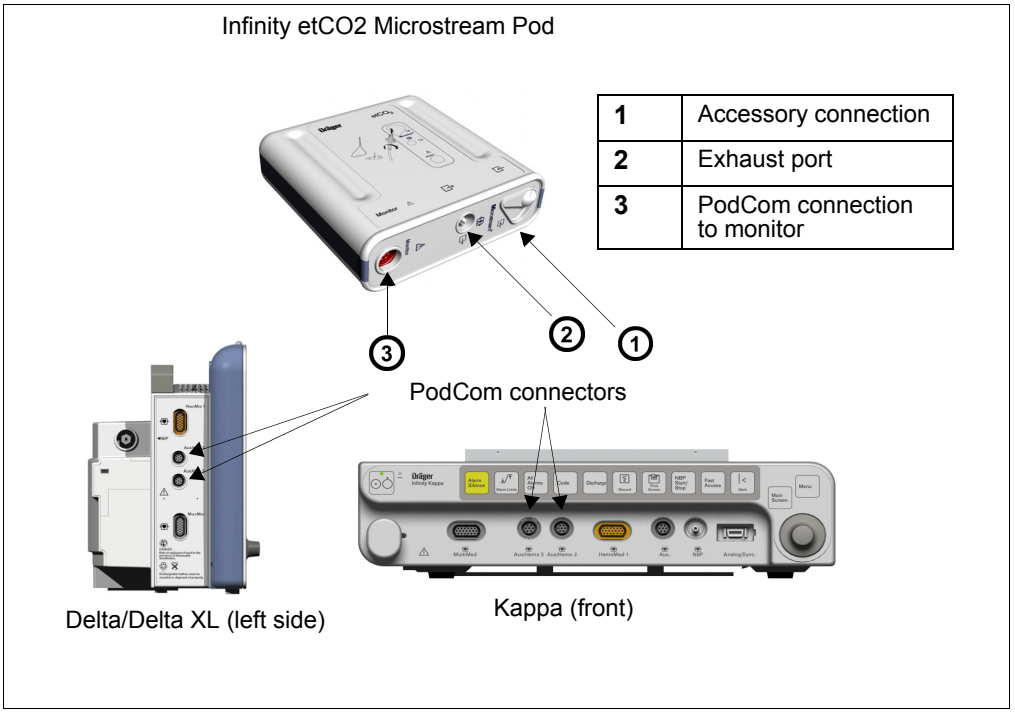
NOTE:

- The pod and associated accessories that have patient contact are free of latex.
- The pod automatically compensates for atmospheric pressure within the defined operating ranges listed in appendix B.
- The Infinity etCO_2 Microstream SmartPod meets its accuracy specifications within 1.1 minutes after the monitor is powered on.
- During nebulization or suction for Intubated patients, in order to avoid moisture buildup and sampling line occlusion, remove the sampling line luer connector from the monitor.
- When connecting a sampling line to the monitor, screw the sampling line connecter clockwise into the monitor CO_2 port until it can no longer be turned, to ensure that it is connected securely to the monitor. This will assure that there is no leak of gases during measurement at the connection point and that measurement accuracy is not compromised.

Connection

Ports and outlets are clearly marked on the front of the Microstream pod. Use these labels as a guide when connecting the pod to the monitor and accessories.

Monitor - Pod Connection



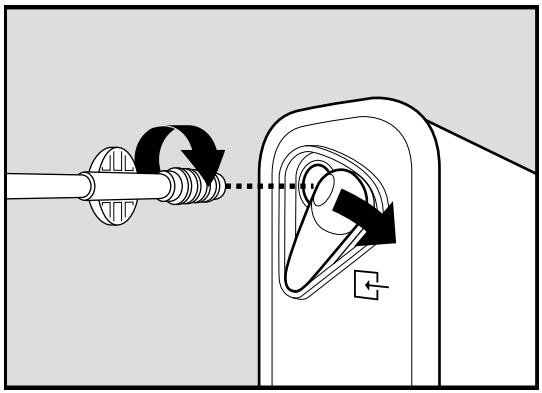
1. Plug one end of the connecting cable into either of the two PodCom connectors on the monitor (the second PodCom connector is optional on the Delta).
2. Plug the other end of the cable into the Microstream pod.

Accessory connection

Select the appropriate sample line according to your monitoring needs.

NOTE: For a complete list of Microstream accessories provided by Dräger for this product, see page C-25.

CAUTION: *When connecting a sampling line to the monitor, move the cover of the CO_2 port to the side; insert the sampling line connector into the CO_2 port, then turn the connector clockwise to secure it in place. This ensures that gas does not leak from the connection point and helps to ensure that measurement accuracy is not compromised.*



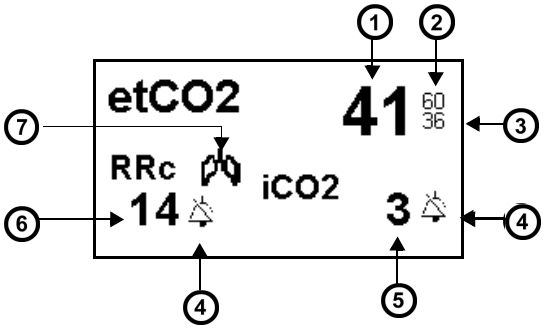
NOTE: After connecting the CO_2 sampling line, check that CO_2 related information appears on the monitor display.

$etCO_2$ Display Features

The monitor reports $etCO_2$ data as waveforms and parameter values. Current parameter values appear in the $etCO_2$ parameter box. For information on displaying trended $etCO_2$ values, see chapter 6, Trends.

Parameters

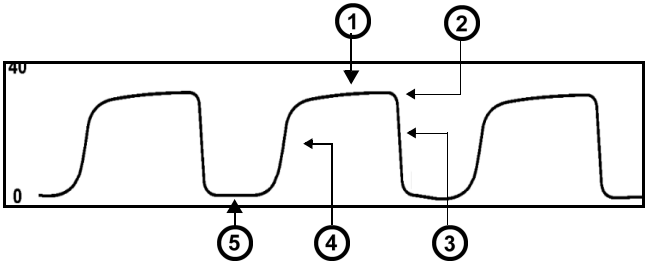
The $etCO_2$ parameter box displays the following parameters and their current values.



1	End-tidal CO_2 value – highest CO_2 in the airway during expiratory period	**5**	Inspired CO_2 value – minimum value of CO_2 in the airway over the inspiratory period
2	Upper alarm limit	**6**	Respiration rate
3	Lower alarm limit	**7**	Respiration icon (blinks with each breath)
4	Disabled alarm icon		

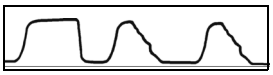
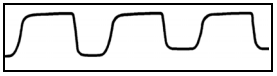
Capnograms

The monitor also displays an instantaneous CO_2 reading as a waveform or capnogram. A typical capnogram is shown below:



1	Expiratory plateau (level of CO_2 in lungs ceases to increase significantly)
2	End-tidal concentration point (end of expiration phase, where $etCO_2$ is measured)
3	Onset of inspiration phase
4	Expiration phase
5	Baseline during inspiration

You can use capnograms to troubleshoot problems with equipment or monitor configuration as well as to monitor a patient's clinical status. The following table shows some of the more common problems identifiable through capnogram analysis:

Capnogram	Description	Immediate and possible causes
	Alveolar plateau shows downward slope that merges with descending limb	Inadequate seal around endotracheal tube • Leaky or deflated endotracheal or tracheostomy cuff • Artificial airway that is too small for the patient
	Elevated waveform baseline with corresponding increase in $etCO_2$ level	Rebreathing • Insufficient expiratory time • Faulty expiratory valve • Inadequate inspiratory flow • Malfunction of a CO_2 absorber system • Partial rebreathing circuits

	Change in slope of ascending limb. Possible absence of an alveolar plateau	Obstruction in apparatus • Partial obstruction in expiratory limb of breathing circuit • Foreign body in upper airway • Partially kinked or occluded artificial airway • Herniated endotracheal/tracheostomy tube cuff • Bronchospasm
	Elevated baseline, with pronounced slope on descending limb	• Faulty ventilator circuit valve • Rebreathing (see above)

$etCO_2$ Setup

Accessing Setup Menus

- Click on the main screen $etCO_2$ parameter box to open the $etCO_2$ setup menu

or

1. Press the **Menu** fixed key on the front of the monitor. The Main menu appears.
2. Click on **Patient Setup**. A list of available patient setup functions appears.
3. Click on **Parameters** in the second column. A list of available parameters appears.
4. Click on **$etCO_2$**. The $etCO_2$ setup menu appears.

Quick Reference Table – etCO2 Setup

The following table explains Microstream pod $etCO_2$ setup functions.

Function	Description	Settings
Scale	Determines size of currently displayed waveform.	• **40 mmHg** • **60 mmHg** • **80 mmHg** • **100 mmHg**
Respiratory Sweep Speed	Sets waveform sweep speed on screen display.	• **6.25 mm/s** • **12.5 mm/s** • **25 mm/s** • **50 mm/s**
Averaging	Sets interval for CO_2 measurements. **NOTE:** The monitor reports the maximum value of $etCO_2$ during the specified sampling interval.	• **Breath-Breath** • **10 s** • **20 s (default)** • **30s**
etCO2 Alarm	Accesses Alarm Limits table, where you can set upper and lower alarm thresholds.See chapter 5, Alarms, for information about setting and displaying alarm limits.	Not applicable
BTPS (body temperature, pressure, saturation)	User selectable correction factor.	• **On** (default) • **Off**
Last Cal	Displays the last calibration date of the pod (read only).	Not applicable

Calibration

Calibration should be performed when the monitor displays the advisory message *Calibration Required*. An initial calibration is requested after the first 1,200 operating hours. Afterwards, calibration is required annually or at 4,000 operating hours, whichever is first.

Calibration is a Biomed function and is password protected. Consult your hospital's technical personnel for further information.

Status Messages

Message	Condition	Suggested Action
$etCO_2$ <LL *$etCO_2$ > UL*	Values are outside the current alarm limits.	• Check the patient and treat, if necessary. • Change alarm limits. • Check accessory and replace, if necessary.
iCO_2 < LL *iCO_2 > UL*		
RRc < LL *RRc > UL*		
etCO2 Out of Range (High)	The CO_2 value is out of range (high).	Check the patient and treat, if necessary.
RRc Out of Range (High)	The RRc value is out of range (high).	
$etCO_2$ Tubing Disconnected	The FilterLine™ is unplugged.	Check sample line and reconnect.
$etCO_2$ Tubing Leak	The sidestream tubing has a leak. **NOTE:** Occurs only during power up or during an auto zero.	Replacethe tubing.
$etCO_2$ Tubing Blocked	The FilterLine™ is obstructed.	• Disconnect and reconnect the FilterLine™. • Disconnect and replace with new FilterLine™.
$etCO_2$ Zeroing	Autozero in progress	Informational message; no action required.
$etCO_2$ Zero Failed	Autozero unsuccessful.	• Retry to autozero. • Return the pod to the hospital's technical personnel.
$etCO_2$ Zero Accepted	Autozero completed successfully.	Informational message; no action required
Calibrate $etCO_2$ pod	An initial calibration is requested after the first 1,200 operating hours. Afterwards, calibration is required annually or at 4,000 operating hours, whichever is first.	• Recalibrate pod. • Return the pod to the hospital's technical personnel.
$etCO_2$ Calibrating	Calibration in progress.	Informational message; no action required
$etCO_2$ Cal. Accepted	Calibration process completed successfully.	
$etCO_2$ Cal. Canceled	Calibration cancelled.	

Message	Condition	Suggested Action
$etCO_2$ Cal. Failed	Calibration failed.	• Retry calibration. • Return the pod to hospital's technical personnel.
$etCO_2$ pod Disconnected	The sidestream pod is unplugged from the monitor.	• Check cable and connection. • Replace the cable, if necessary.
$etCO_2$ pod Incompatible	Corrupt EEPROM. The wrong software or hardware version.	• Try a new pod. • Consult the hospital's technical personnel.
Disconnect Duplicate $etCO_2$ pods	Multiple pods are connected.	Disconnect unwanted duplicate pod.
Service $etCO_2$ pod	Pod must be serviced if pump hrs. >= 20,000 hrs.	Contact DrägerService or replace pod.
CO2: H/W Problem	Microstream pod hardware malfunction.	Disconnect the Microstream pod, then reconnect it. If the message persists return the pod to the hospital's technical personnel.

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22 Respiratory Mechanics

Overview

When connected to an optional $etCO_2$/Respiratory Mechanics pod, the monitor can calculate and display CO_2, airway pressure, flow and volume waveforms. You can also configure the monitor to display numerical readings of $etCO_2$, and additional derived respiratory parameters.

Respiratory mechanics parameters are trended in graphical and tabular form. For more information about trend display, see 6, Trends.

The monitor collects information about airway pressure, flow, volume and associated variables via a specially designed airway adapter attached to the patient's endotracheal tube. Depending on the adapter in use, the pod obtains readings for the following:

- End-tidal CO_2 ($etCO_2$)
- Respiratory mechanics
- Both $etCO_2$ and respiratory mechanics

NOTE:

- This chapter deals exclusively with respiratory mechanics monitoring. For information about monitoring $etCO_2$, see chapter 20.
- You cannot conduct sidestream measurements of $etCO_2$ using the $etCO_2$/ Respiratory Mechanics pod.

Precautions

Refer to the general precautions section for $etCO_2$ (see page 19-3).

WARNING: The internal transducer is connected by the sampling tube to the breathing circuit. The breathing circuit can not be completely disinfected between uses of successive patients because the internal transducer cannot be completely disinfected. Compliance with certain recommendations of the American Thoracic Society regarding hygiene and infection control during spirometry may not be practical using the $etCO_2$/Respiratory Mechanics pod.

CAUTION:

- *Do not use the airway adapter or sensor if the monitor displays the message "Flow: Invalid Sensor."*
- *Verify the mechanical/spontaneous threshold on the airway pressure (Paw) setup menu. Improper settings of this function will cause incorrect calculations of some respiratory mechanics parameters (for example, mechanical versus spontaneous parameters). In pressure support ventilation modes, you may need to adjust the threshold.*
- *Periodically check the flow sensor and tubing for excessive moisture or secretion build-up. Although the pod automatically attempts to clear the tubing if necessary, moisture or secretions may remain and affect measurements.*
- *When monitor settings for CO_2 compensation and respiratory mechanics gas composition differ from actual gas composition in the breathing circuit, small effects in monitored respiratory mechanics parameters may result.*
- *Fluid that accumulates in the etCO_2/Flow and Flow airway adapter sensors or sensor tubing may cause the reported tidal and minute volumes to be higher than set volumes. If reported values are significantly different than expected, manually purge the sensor tubing. If purging does not clear the fluid, replace the airway adapter sensor.*
- *To avoid accidental disconnections, do not apply excessive tension to any sensor cable or tubing.*
- *To prevent damage to sensor windows, remove the airway adapter from the circuit whenever aerosolized medication is being delivered.*
- *Always position the airway adapter windows vertically to prevent patient secretions from obscuring the adapter windows.*
- *If you are switching adapter types (for example, adult to neonatal) for etCO_2/ Respiratory Mechanics monitoring, recalibrate the adapter as described in chapter 19. Sensor changes do not require recalibration.*
- *The etCO_2 / Respiratory Mechanics Pod should be kept at or above the level of the patient breathing circuit to prevent ingress of fluids into the pod by gravity.*

NOTE:

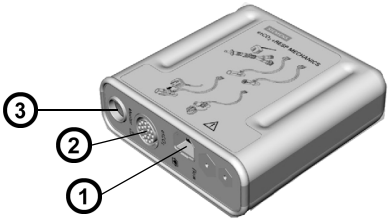
- The pod and associated accessories that have patient contact are free of latex.
- The pod measures ventilation parameters at the patient's endotracheal tube. For this reason, the monitor may display some parameter values which differ from those displayed on an associated ventilator. This discrepancy should not be taken as a sign of inaccuracy in either device, as the actual quantities being measured at the endotracheal tube and the ventilator may indeed differ. Discrepancies can be attributed to a number of factors, including compliancy of the tubing, airway resistance, and heat and humidity of patient expiration. Because some ventilators try to compensate for the difference, readings may be nearly identical. Measurements at the endotracheal tube, however, are likely to give a more accurate assessment of ventilation parameters.
- The calculations of derived respiratory mechanics parameters are based on the direct measurements of airway pressure, flow and CO_2. An error in one of the direct measurements can affect some or all of the derived parameters.

Hardware Setup

Monitor-Pod Connection

NOTE: Disconnect an $etCO_2$ module or pod or an MIB connection to a ventilator before using the $etCO_2$/Respiratory Mechanics pod.

1. Plug one end of the connecting cable into either of the two PodCom connectors on the left side of the monitor (the second PodCom connector is optional on the Delta).
2. Plug the other end of the cable into the pod.
3. Follow the instructions on page 22-6 to connect the Capnostat sensor ($etCO_2$) and flow sensor (respiratory mechanics) to the ventilated patient.

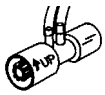
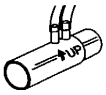
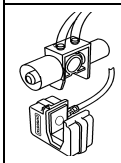
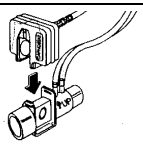
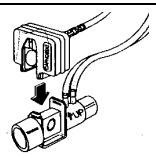


1	Flow sensor connection
2	Capnostat sensor connection
3	PodCom (connection to monitor)

$etCO_2$/Respiratory Mechanics Pod

Selecting a Sensor

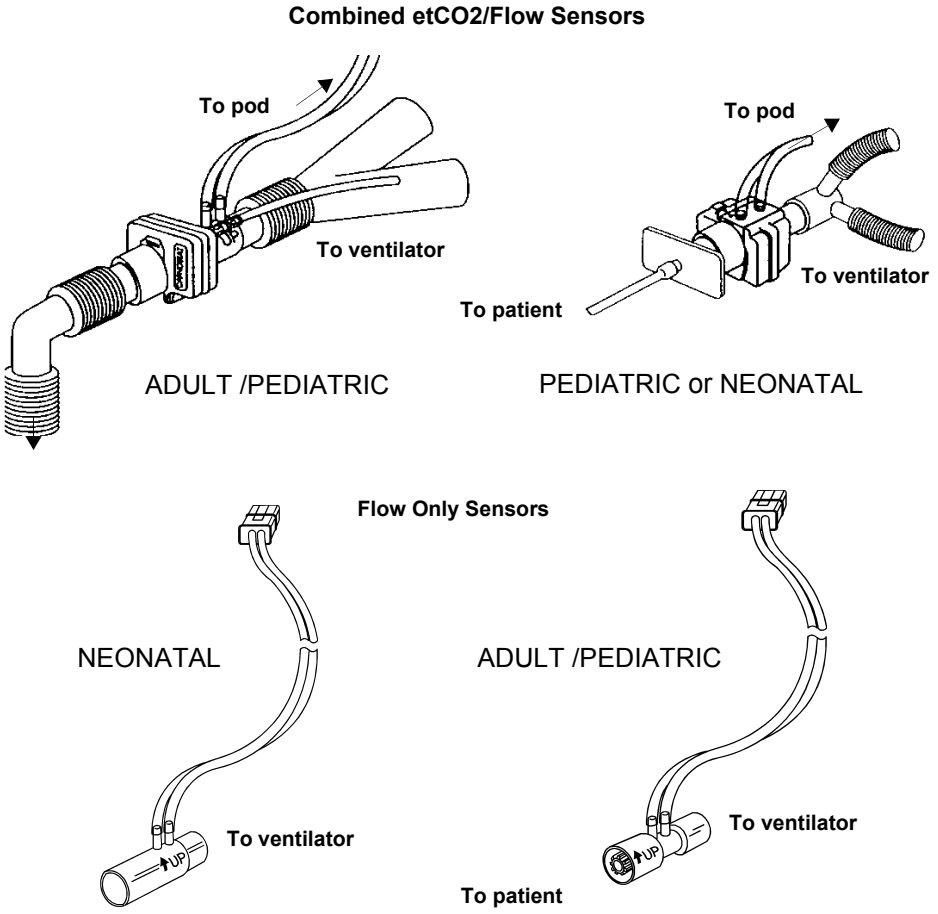
Select a sensor according to your monitoring needs and the size of your patient's endotracheal tube. To monitor respiratory mechanics only, use a Flow sensor. For both respiratory mechanics and etCO_2 parameters, use a combined CO2/Flow sensor.

Sensor Type	ETT Size	Tidal Volume	Patient Age
 Flow (Neonatal)	< 4 mm	1 - 100 ml	Not specified
 Flow (Adult/Pediatric)	> 4 mm	200 - 3000 ml	Not specified
 Combined CO2/Flow (Neonatal)	2.5 - 4 mm	1 - 100 ml	< 4 years
 Combined CO2/Flow (Pediatric)	3.5 - 6 mm	30 - 400 ml	2 - 18 years
 Combined CO2/Flow (Adult/ Pediatric)	5.5 mm	200 - 3000 ml	> 12 years

To monitor respiratory mechanics only

1. Select an appropriate flow sensor.
2. Plug the sensor tubing into the etCO_2/Respiratory Mechanics pod.
3. Connect the flow sensor to the breathing circuit as shown in the following illustration. A message at the top left of the screen confirms the size of the sensor and its correct connection.

etCO2/Flow Breathing Circuit Setup



To monitor both $etCO_2$ and respiratory mechanics

1. Select an appropriate $etCO_2$/Flow sensor.
2. Plug the sensor into the $etCO_2$/Respiratory mechanics pod.
3. Snap a Capnostat sensor onto the $etCO_2$/Flow sensor.
4. Connect the $etCO_2$/Flow sensor to the patient breathing apparatus as shown in "etCO2/Flow Breathing Circuit Setup" on page 22-6. A message at the top of the screen confirms the sensor size and its proper connection.
5. Follow procedures for $etCO_2$ mainstream setup (page 20-6).

Purge Sensor Function

The $etCO_2$/Respiratory Mechanics pod accommodates automatic or manual purging of the flow sensor tubing. While the pod automatically purges the breathing circuit periodically; manual purges are sometimes necessary.

NOTE: Pressure and flow parameters are frozen and waveforms are not drawn during purging.

Automatic Purging

The following table describes automatic purge characteristics.

Mode	Ventilator Circuit Pressure	Interval
Adult	0 - 40 cmH2O	10 minutes
Adult/Pediatric	41 - 60 cmH2O	5 minutes
	> 60 cmH2O	2 minutes
Pediatric	Not applicable	5 minutes [1]
Neonatal	Not applicable	3 minutes [1]
[1]**NOTE:** Sensor tubing lines are purged at required interval regardless of circuit pressure.		

Manual Purging

The **Paw** and **Vent** menu and **Purge Sensor** function allows manual purging between the automatic purge cycles. See “Quick Reference Table: Paw and Vent Setup” on page 22-8.

Paw and Vent Setup Menus

On the Airway Pressure (**Paw**) and Flow/Volume (**Vent**) setup menus you can configure the monitor to display respiratory mechanics parameters.

To access respiratory mechanics parameters setup menus:

- Click on the parameter box labeled **Paw** on the main screen to open the Airway Pressure setup menu or **Vent** to open the Flow/Volume setup menu.

Each of these setup menus has a second “page” that is displayed by clicking on the **more** arrow at the bottom of the screen.

Quick Reference Table: Paw and Vent Setup

Click on the following menu items to execute setup functions.

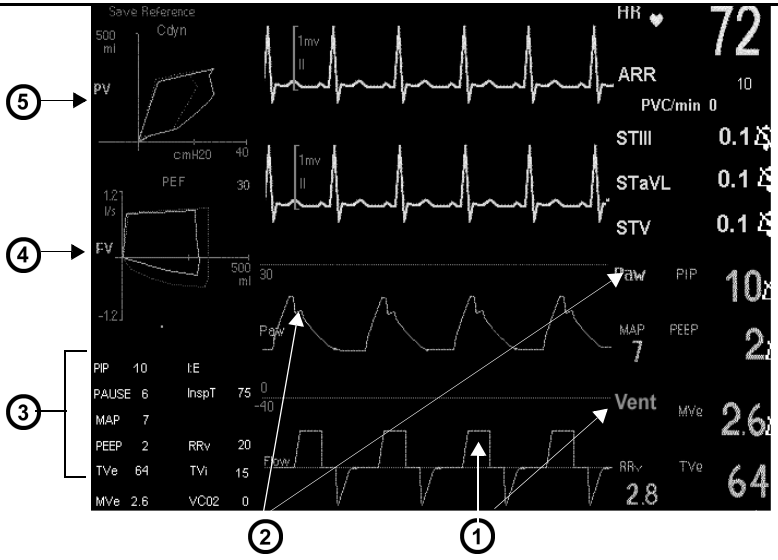
Function	Description	Settings
PAW Setup Menu		
Respiratory Mechanics	Displays a list of continuously updated ventilator parameters.	See page 22-16 for complete list of associated parameters.
PV Loop	Displays the pressure/volume loop.	Not applicable
Paw Scale	Sets or changes the size of the currently displayed pressure (Paw) waveform.	**10, 15, 20, 25, 30, 40, 50, 60, 80, 100,** and **120 cmH20** (upper values) The monitor automatically sets the lower waveform value to zero.
Purge Sensor	Purges the sensor tubing of water condensation and patient secretions (see page 21-8). **NOTES**: Pressure and flow parameters are frozen and no waveforms are drawn during purging.	Not applicable
PIP Alarm	Opens the Alarm Limits table beginning at the PIP setting.	Not applicable
Mech/Spon Threshold	Sets the pressure level used to distinguish spontaneous breathing from mechanical breathing.	**0 - 50 cmH2O**
NOTE: The Mech/Spon threshold item may require adjustment based on the patient's PIP value for pressure support ventilator modes. If adjustment is not made, all breaths will be considered mechanical. The appropriate level for the threshold depends on the ventilator.		
Gas Compensation	Informs the monitor of ventilation gas being used. See page 20-12 for more information on gas compensation.	**Air, N2O/O2, >60 %, Heliox** **NOTE:** N_2O/O_2 available in **OR** mode only.
• Parameter 1 • Parameter 2 • Parameter 3	Selects up to 3 parameters for display in the airway pressure parameter box.	**PIP, PEEP, MAP, Pause,** or **None**
Clear Reference	Clears the reference loop from main screen.	Not applicable
Loop Draw	Sets the number of displayed loops.	**1, 4**
Split Screen	Configures the main screen to display ventilator or trend data as well as standard waveforms and parameters.	**OFF, 60 Min Trends, 10 Min Trends, Ventilation**

Function	Description	Settings
VENT Setup Menu		
Respiratory Mechanics	Displays a list of continuously updated ventilator parameters.	See page 22-16 for complete list of associated parameters.
FV Loop	Displays a flow/volume loop	Not applicable
Flow Scale	Sets the size of the flow waveform.	**5, 10, 15, 20, 35, 50, 100, 150, or 200 L min.** The monitor automatically adjusts lower scale to negative value
Vol Scale	Sets the size of the volume waveform.	**5, 10, 25, 50, 75, 100, 250, 500, 750, 1000,** and **1500 ml** Monitor automatically adjusts lower scale to 0
Purge Sensor	Purges the tubing of water condensation and patient secretions. **NOTE**: Though the system periodically purges the breathing circuit automatically, it may sometimes be necessary to purge manually.	Not applicable **NOTES**: • Pressure and flow parameters are frozen during purging. • Waveforms are not drawn.
MVe Alarm	Opens the Alarm Limits table beginning at MVe setting.	Not applicable
Gas Compensation	Informs the monitor of ventilation gas in current use. See page 20-12 for more information on gas compensation.	**Air, N2O/O2, >60%, Heliox** **NOTE:** N_2O/O_2 is available in OR mode only.
Agent Concentration (available in OR mode only)	Informs the monitor of the anesthetic agents in ventilation gas being used.	**0 - 20 %** (increment 1 %)
Waveform Display	Sets the type of the displayed waveform.	• Flow • Vol
• Parameter 1 • Parameter 2 • Parameter 3	Selects up to 3 parameters for display in the flow/volume parameter box.	**PIF, PEF, TVi, TVe, RRv, MVe, TV Ik, None**
Clear Reference	Clears the reference loop from the main screen.	Not applicable
Loop Draw	Configures the number of displayed loops.	**1, 4**
Vent Mini Trend	Selects which parameter is displayed in the Mini Trend when the split screen is set to 10 or 60 min trends.	**TVi s/m, TVe s/m, TVd aw, MVe s/m, MVe, RRs/m, RRv, Cdyn, C20/Cdyn, Raw e, PEF, TValv, MValv s/m, VCO2**

Function	Description	Settings
VENT Setup Menu		
Split Screen	Configures the main screen to display ventilator or trend data and standard waveforms and parameters.	**OFF, 60 Min Trends, 10 Min Trends, Ventilation**

Display Features

You can configure the monitor to display waveforms, ventilation loops, and numerical values calculated by the etCO_2/Respiratory Mechanics pod. The following illustration shows a typical main screen layout when the etCO_2/Respiratory Mechanics pod is connected. The number and screen position of the parameter boxes depends on your configuration of the Main Screen menu. See page 2-5 for instructions on configuring the main screen.



1	Flow/volume (Vent) waveform and parameter box
2	Airway pressure (Paw) waveform and parameter box
3	Ventilation parameters
4	Flow/volume loop
5	Pressure/volume loop

Display Parameters (Main Screen)

Certain respiratory mechanics parameters are available for continuous display in parameter boxes. Others can be displayed only on a special Respiratory Mechanics screen.

Parameter boxes show the parameter label, its current numerical value, and its alarm limits (if available and set for that parameter). You can display up to three parameters at a time. To display a parameter box, you must change its display priority in the Parameter Priority option. See page 2-6 for more information on prioritizing and displaying parameter boxes.

To select the parameters you wish to display in the main screen parameter box, open the appropriate setup menu as follows:

- Click on the parameter box labeled **Paw** (airway pressure) or **Vent** (Flow/Volume),

or

1. Press the **Menu** fixed key on the front of the monitor.
2. Click on **Patient Setup**.
3. Click on **Parameters**. A list of available parameters appears.
4. Click on **Paw** or **Vent**.

To set up respiratory mechanics parameter values

1. Open the Paw or Vent menu as described above.
2. Click on **More** at the bottom of the menu to get to the second page.
3. Click on **Parameter 1** to display available choices.
4. Scroll through parameters listed in the right column.
5. Click on a desired parameter, or click on **None** to leave this space in the parameter box empty.
6. Repeat steps 3 through 5 for **Parameter 2** and **Parameter 3**.

You can display values for any three of the following parameters in the respiratory mechanics parameter boxes:

Paw Parameter Box (Airway Pressure Parameters)		**Vent Parameter Box (Airway Flow and Volume Parameters)**	
PIP	Peak Inspiratory Pressure	PIF	Peak Inspiratory Flow
PEEP	Positive End-Expiratory Pressure	PEF	Peak Expiratory Flow
MAP	Mean Airway Pressure	TVi	Inspired Tidal Volume
Pause	Pause Pressure	TVe	Expired Tidal Volume
		MVe	Expired Minute Volume, Total
		RRv	Respiratory Rate, ventilator
		TV lk	ET tube leakage (neonatal only)

NOTES:
- For associated units of measure and derivations, see page 22-16.
- Respiratory Mechanics parameters are automatically added to the Alarm Limits table when you connect the $etCO_2$/Respiratory Mechanics pod.
- Only PIP, PEEP, and MVe are in the Alarm Limits table.

Additional Display Parameters

To display a list of derived respiratory mechanics parameters

1. Click on the parameter box labeled **Paw** or **Vent**,

or

Use the **Menu** fixed key to access the Paw or Vent setup menu (page 22-11).

2. Click on **Respiratory Mechanics**. A read-only list of parameters appears:

Selecting Additional Display Parameters

The Respiratory Mechanics menu parameters display varies according to the **View** control key setting and the sensor you use.

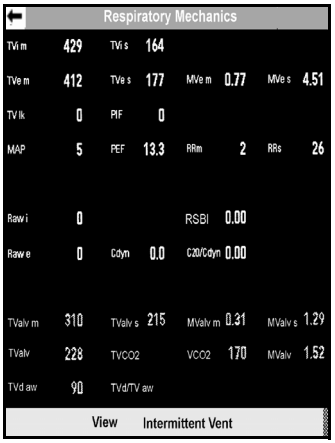
To configure the parameter display

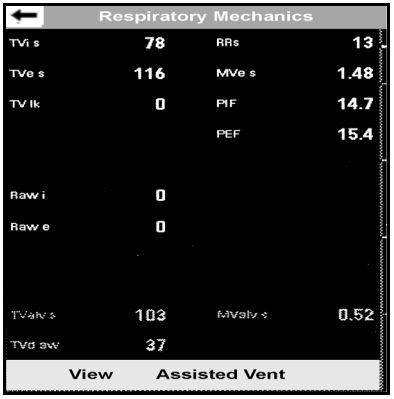
1. Click on the parameter box labeled **Paw** or **Vent**.
2. Click on **Respiratory Mechanics**.
3. Click on **View** at the bottom of the screen.
4. Scroll through the available settings (**Intermittent Vent, Controlled Vent, Assisted Vent**) and click to select a ventilation mode.

Screen Configurations – Neonatal

The following illustrations show the Respiratory Mechanics screen variously configured according to flow sensor type (neonatal, pediatric, or adult) and **View** setting (intermittent, controlled, or assisted). For parameter definitions, units of measure, and derivations, see the table on page 22-16.

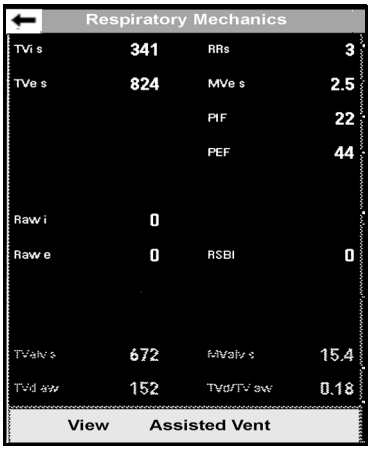
NEONATAL FLOW SENSOR

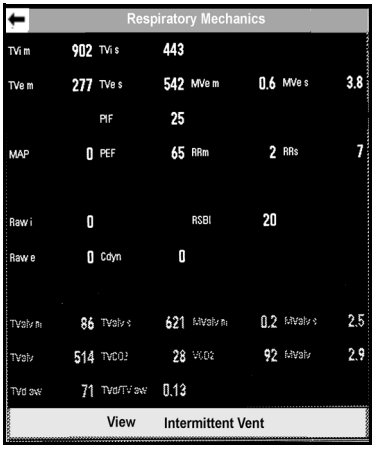


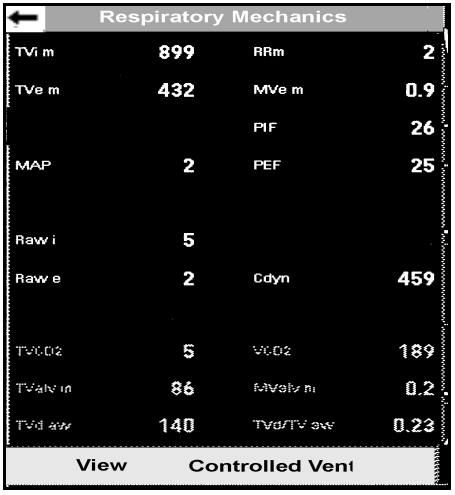


Screen Configurations – Adult and Pediatric

ADULT and PEDIATRIC FLOW SENSOR







Respiratory Mechanics Parameters

The following table lists respiratory mechanics parameters, derivations, and units of measure.

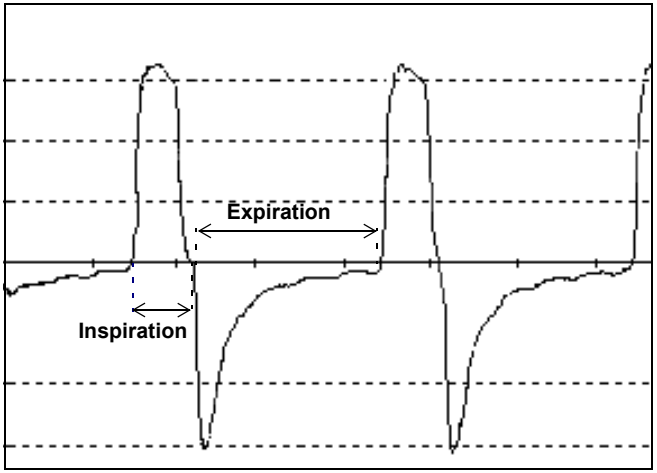
NOTE:

- Spontaneous (s) and mechanical (m) rates and volumes are calculated separately and are designated by the letters <s> or <m> after the parameter (for example, MVe s for expired Minute Volume, spontaneous ventilation; MVe m for expired Minute Volume, mechanical ventilation).
- Resistance and compliance are not calculated in spontaneously breathing patients. The resistance and compliance values displayed for spontaneous breaths are zero.
- For the purposes of compensation, the temperature of the breathing circuit is assumed to be 35 °C for inspired and expired gas; the humidity of the breathing circuit is assumed to be 50 % for inspired gas and 100 % for expired gas; and the default gas composition values are 21 % O_2 and 0 % CO_2 for inspiratory and 17 % and 5 % CO_2 for expiratory (only VCO2 and TVCO2 are referenced to STPD, or standard temperature pressure dry). Therefore, TVi will, in most cases, be equal to or greater than TVe.

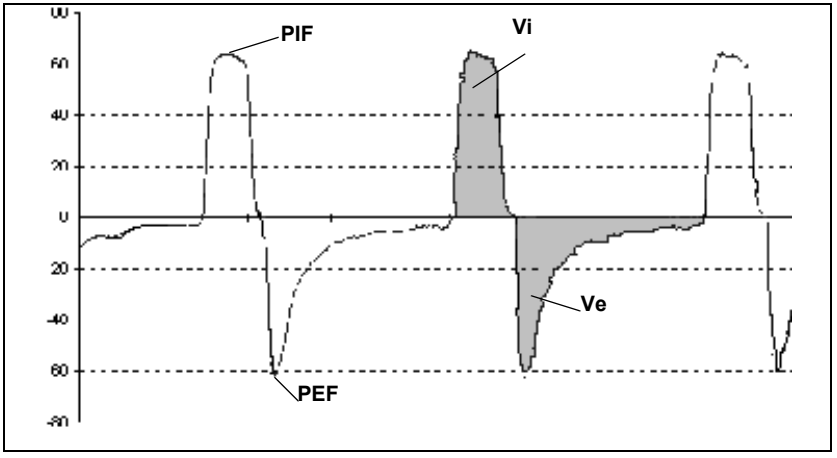
Label	Description	Derivation	Units
C20/ Cdyn	C_20 / Cdyn Ratio (mechanical)	Ratio of the compliance of the last 20 % of inspiration over dynamic lung compliance (available only when neonatal sensor is used)	
Cdyn	Lung Compliance, Dynamic (mechanical)	Ratio of change in volume over change in pressure during inspiration	mL/ cmH_2O
I:E	Ratio of Inspiratory to Expiratory Time	Ratio of inspiratory time to expiratory time, using all the breaths and updated on a breath by breath basis	
InspT %	Percent Inspired Time	Ratio of inspiratory time to total time of breath x 100 %	%
MAP	Mean Airway Pressure	Average airway pressure measured during entire breath cycle	cmH_2O
MValv	Alveolar Minute Volume	Average alveolar volume per minute of effective gas exchange	L
MVe	Expired Minute Volume	Average expired volume per minute, calculated using an eight breath moving average	L/min
Pause	Pause Pressure (mechanical)	Airway pressure held during an inspiratory pause; calculated only in mechanical breaths	cmH_2O
PeCO2	Mixed Expired CO2	Volume of CO_2 in a breath divided by the eight breath moving average of total expired volume	mmHg
PEEP	Positive End-Expiratory Pressure	Lowest positive airway pressure at end of expiratory period *or* average airway pressure during last 25 % of expired flow	cmH_2O

Label	Description	Derivation	Units
PEF	Peak Expiratory Flow	Highest airway flow measured during expiration	L/min
PIF	Peak Inspiratory Flow	Highest airway flow during inspiration	L/min
PIP	Peak Inspiratory Pressure	Highest airway pressure during inspiration	cmH_2O
Raw e	Expired Dynamic Airway Resistance (mechanical)	Amount of pressure required to move gas at a flow of one liter per second, derived from expiration (P[end exp] - Pause) /Flow [end exp]	cmH_2O / L / s
Raw i	Inspired Dynamic Airway Resistance (mechanical)	Represents the dynamic resistance to inspiratory airflow created by the breathing circuit, ET tube, and major airways of the lung (P[end insp] - Pause)/Flow [end insp]	cmH_2O / L / s
RRv	Respiratory Rate	Average frequency of last 8 breaths	1/min
RSBI	Rapid Shallow Breathing Index	Respiratory rate divided by tidal volume for spontaneous breaths, (RRs/TVs), for RRs < 57 bpm	bpm/L
T i	Inspiratory time	Duration of inspiration	sec
T e	Expiratory time	Duration of expiration	sec
TV lk	ET tube leakage (mechanical)	Difference between expired and inspired tidal volume expressed as a percent in mechanical breaths (100 x [TVi m - TV e m])/ TV i	%
TValv	Alveolar Tidal Volume	Average volume calculated from difference of expired volume and airway deadspace TVe - TVd aw	mL
TVCO2	CO2 Tidal Volume	Volume of CO_2 expired per breath, calculated from concentration of expired CO_2 less concentration of inspired CO2 and multiplied by total expired breath, compensated to STPD (Standard Temperature and Pressure Dry) TV alv X $PeCO_2$	mL
TVd aw	Airway (anatomic) Deadspace	Volume of breath not participating in gas exchange measured during expiration (ineffective tidal volume)	mL
TVd/ TV aw	Airway Dilution Ratio (Ratio of Tidal Volume to Airway Deadspace)	Tidal volume lost to airway deadspace divided by Expired Tidal Volume during a spontaneous or mechanical breath	
TVe	Expired Tidal Volume	Average expired volume of current breath	mL
TVi	Inspired Tidal Volume	Average inspired volume of current breath	mL
VCO2	CO2 Minute Elimination	Volume of CO_2 expired per minute, compensated to STPD (Standard Temperature and Pressure Dry) $TVCO_2$ x RRv	mL/min

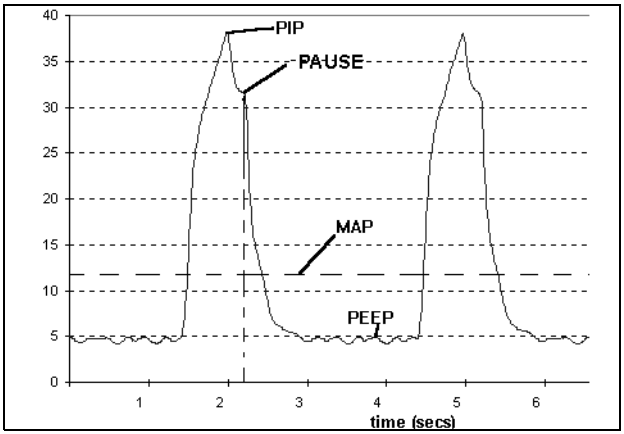
Key Concepts of Respiratory Mechanics



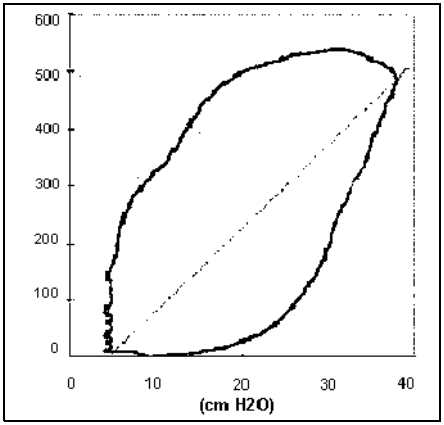
Flow waveform showing breath Intervals -- Inspiration and Expiration



Flow waveform showing peak inspiratory flow (PIF), peak expiratory flow (PEF), inspiratory volume (Vi) and expiratory volume (Ve)



Pressure waveform showing peak inspiratory pressure (PIP), pause pressure (PAUSE), mean airway pressure (MAP) and peak end-expiratory pressure (PEEP)



Dynamic Compliance

Waveforms

Pressure waveforms are displayed next to the Paw parameter box. You can choose to display either a flow waveform or a volume waveform next to the Vent parameter box and size the waveform.

To choose between flow or volume waveforms:

1. Click on the Vent parameter box

or

Use the **Menu** fixed key (see page 22-11) to get to the **Vent** menu.

2. Click on **Waveform Display**.
3. Select **Flow** or **Volume**, and click to confirm your choice.

To set or modify the size of the waveform:

1. Click on the parameter box labeled **Paw** or **Vent.**

or

Use the **Menu** fixed key (see page 22-11) to get to the **Paw** or **Vent** setup menu.

2. Click on **Paw Scale** (on Paw menu) or **Flow Scale**, **Vol Scale** (on Vent menu). Available settings vary according to the type of waveform you wish to configure. See page 22-8 for more information about these settings.
3. Scroll to the desired size and click to confirm your choice.

Loops

Loops are graphical representations of waveform data collected by the ventilator. Pressure/Volume loops and Flow/Volume loops offer valuable information about the patient's response to mechanical ventilation.

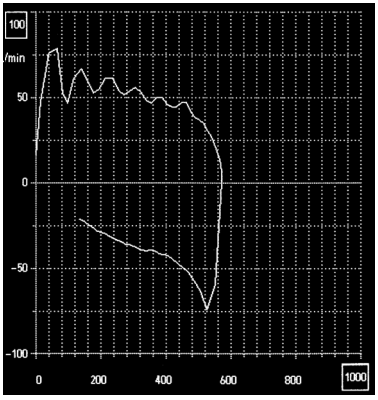
The monitor automatically erases older loops and replaces them with newer ones. The last loop drawn is the brightest.You can save and display a Reference Loop, which serves as a useful point of analysis and comparison.

Pressure/Volume Loops

Pressure/Volume loops illustrate changes in compliance, resistance and work of breathing. A mechanical breath plots counter-clockwise, while a spontaneous breath plots clockwise. Inspiration starts at a point defined by baseline pressure and the volume level at the beginning of inspiration; loops show corresponding Dynamic Compliance (Cdyn) values (see page 22-16).

Flow/Volume Loops

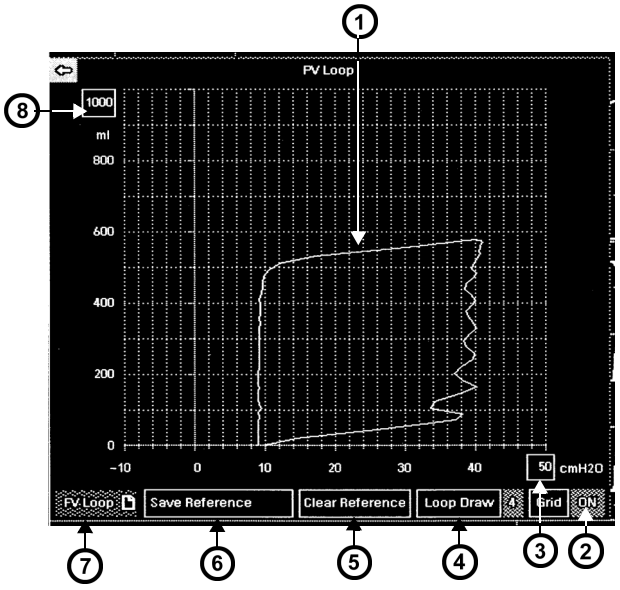
Flow/Volume loops report mechanical and spontaneous breaths the same way. Inspiration begins at the origin and moves upward and left to right (clockwise). Expiration plots below the horizontal axis and progresses right to left in a return to the origin. The Flow/Volume loop display shows the corresponding PEF value (see illustration on page 22-16).



Displaying Loops

1. Open the Paw or Vent setup menu (see page 22-11).
2. Click on **PV Loop** (on **PAW** menu) to display pressure/volume loop.
3. Click on **FV Loop** (on **Vent** menu) to display flow/volume loop.

The following illustration shows a pressure/volume loop. Click on the control keys at the bottom of the screen to change loop settings.



1	Pressure/Volume waveform
2	Display or hide grid
3	Pressure scale
4	Set number of loops displayed
5	Clear reference loop from screen
6	Save last completed loop and time stamp
7	Display Flow/Volume loop
8	Set volume

Setting Number of Loops

You can display either a single loop or four consecutive loops.

To set the number of display loops

1. Open the Paw or Vent setup menu (see page 22-7).
2. Scroll to the bottom of the menu and click on the **More** arrow to get to the second page.
3. Click on **Loop Draw**.
4. Select **1** or **4** to set the number of display loops.

or

Use the **Loop Draw** control key at the bottom of the loop display (“Displaying Loops” on page 22-21) to set the number of loops.

Reference Loops

Reference loops allow you to monitor a patient's status prior to and following a specific therapy or ventilator change. Save or clear a reference loop and its time and date stamp by clicking on the appropriate control key at the bottom of the loop screen.

Continuous Loop Display

You can monitor the patient's response to ventilation while you access other functions on the main screen.

To display small loops in the upper corner of the main screen

1. Open the Paw or Vent setup menu (see page 22-7).
2. Click on **More** at the bottom of the menu to get to the second menu page.
3. Highlight **Split Screen** and click**.**
4. Click on **Ventilation.**
5. Press the main screen fixed key, and the small loop display appears in the upper left corner.

To learn more about Paw or Vent menu selections, see the "Quick Reference Table: Paw and Vent Setup" on page 22-8.

Alarms

The following alarms annunciate (if they are enabled) when the etCO_2/Respiratory Mechanics pod detects a violation of alarm limits:

- PIP (high-priority alarm) – user sets upper alarm limit.
- PEEP (medium-priority alarm) – user sets upper and lower alarm limits.
- MVe (medium-priority alarm) – user sets lower alarm limit

Cleaning and Calibration

For general information on cleaning pods and accessories, see chapter 30. It is not necessary to clean flow sensors, as they are intended for single use only. You do not have to calibrate the flow sensor.

For instructions on calibrating and verifying the airway adapter and the Capnostat sensor, see page 20-14.

Status Messages

Message	Condition	Suggested action
PIP > #	The PIP value is above the alarm limits. **NOTE**: A PIP alarm can only occur if a valid sensor is connected and the PIP alarm has been enabled.	Check the patient and the ventilator settings.
PEEP > # *PEEP < #*	The PEEP value is above or below the alarm limits. **NOTE**: The PEEP and MVe alarms are not available until a sensor is connected and a valid Respiratory Rate (RRv) becomes available.	Check the patient and the ventilator settings.
MVe < #	The MVe value is below the alarm limit. **NOTE**: PEEP and MVe alarms are not available until a sensor is connected and a valid Respiratory Rate (RRv) becomes available.	Check the patient and the ventilator settings.
RRv: APN	An apnea based on flow measurements	Check the patient and the airway circuit.
Flow: • Adult/Pediatric Sensor • Pediatric Sensor • Neonatal Sensor	Indicated Flow or CO2/Flow sensor connected.	Verify that the flow or the $etCO_2$/flow sensor type matches the patient category.
Flow: Invalid Sensor	An unknown sensor is connected.	Replace the sensor.
Flow: Purge in Progress	Purging flow sensors and tubing.	None
Flow: Unable to Zero; Purge Sensor	Flow or pressure sensor zero failed.	• Check the tubing. • Initiate manual purge.
Flow: Sensor Disconnected	Flow sensor is disconnected.	• Connect the sensor. • Check the airway circuit.
Flow: H/W Problem	Hardware failure.	• Contact DrägerService representative.
Flow: Purge Timeout	Purge time has exceeded standard limits.	• Check the tubing. • Initiate a manual purge.
CO2/Flow Pod Disconnected	The $etCO_2$/Respiratory Mechanics pod is disconnected.	Connect the pod.
Duplicate Device Connected	A device that duplicates the pod's monitoring capabilities is connected.	Disconnect the duplicate device.

Message	Condition	Suggested action
Disconnect Duplicate $etCO_2$ Pods	An $etCO_2$ pod, $etCO_2$ module, and/or $etCO_2$/ respiratory mechanics pod are connected at the same time.	Disconnect the redundant source of $etCO_2$.
NOTE: Messages are valid only when an $etCO_2$/Respiratory Mechanics pod is connected (with the exception of *Flow: Sensor Disconnected)*.		

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23 FiO_2 (Fractional Inspired O_2) monitoring

Overview

The monitor measures fractional inspired oxygen concentration (FiO_2), in neonatal mode only, via the NeoMed pod and an FiO_2 sensor. The FiO_2 sensor is typically placed in the incubator or under the oxygen hood and near the infant's head. As varying concentrations of oxygen diffuse into the sensor, two electrodes generate a current proportional to the partial pressure of oxygen in the air of the hood or incubator. The monitor measures this electrical current and converts it to a percentage, which it then displays on the monitor.

Because the sensor responds to partial pressure of oxygen (and not percentage), changes in barometric pressure can affect the reading even if the percent of oxygen being monitored stays the same. Changes in humidity change the percentage of oxygen in the air (but not the partial pressure). As a result, the reading does not change and may not accurately reflect the concentration of oxygen. For example, if 100% oxygen is displayed as saturated with 100 % humidity, the actual concentration of oxygen is 97 %.

The FiO_2 sensor, which has a minimal response to gases other than oxygen, is sensitive to changes in barometric pressure and humidity. Do not handle the sensor unnecessarily, as your body heat can temporarily cause it to produce error.

FiO_2 sensors contain lead. Dispose of sensors properly and in accordance with local regulations.

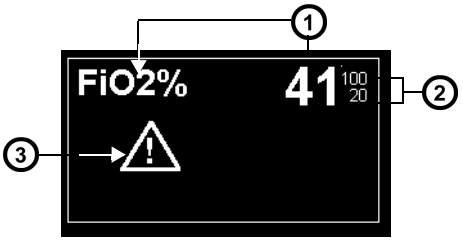
Precautions

WARNING: Setting alarm limits below 21 % may expose patients to low oxygen levels, compromising primary organ function.

CAUTION: *Dispose of a leaking sensor according to local regulations. Because the sensor contains caustic materials, avoid contact with eyes, skin or clothing.*

Display Features

FiO_2 values are displayed in a parameter box as shown below.



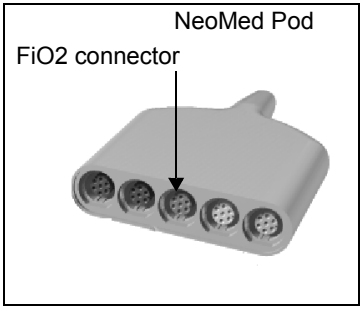
1	FiO_2 value and label
2	Alarm limits (crossed bell icon if alarm is disabled)
3	Attention icon (appears when the alarm value falls below 21 %)

FiO_2 Setup

The monitor acquires FiO2 signals from the sensor via the NeoMed pod.

To connect the pod to the sensor

1. Set the patient category on the monitor to **Neonatal**.
2. Plug an FiO_2 sensor cable into the FiO_2 connector on the NeoMed pod.
3. Plug the NeoMed pod into the MultiMed connector on the monitor.
4. Attach a sensor into the FiO_2 sensor cable. Push the sensor firmly into cable receptacle until you hear it click.
5. Place the sensor in the incubator or under the oxygen hood.



Menu Access

The FiO_2 menu displays the date and time of 1-point and 2-point calibrations (see below). The menu item **Last O2 Cal** is informational only. It displays the date and time of the last successful calibration, either 1-point or 2-point.

To open the FiO_2 menu

- Click on the *FiO_2* parameter box on the Main screen

or

1. Press the **Menu** fixed key.
2. Click on **Patient Setup**.
3. Click on **Parameters**.
4. Click on **FiO2**.

Calibration

Every time a sensor is connected to the NeoMed pod, you must calibrate the monitor to the sensor. The monitor does not display FiO_2 values until it is calibrated.

There are two types of calibration. 1-point calibration measures the oxygen in room air, typically 21 %, and calibrates the monitor to that measurement. A 2-point calibration uses two measurements, room air and 100 % oxygen, to calibrate the monitor. A 2-point calibration provides more accurate FiO_2 monitoring because the monitor is calibrated to two different measurements.

1-point calibration should be performed daily. A 2-point calibration should be performed weekly. You should also calibrate the monitor under the following circumstances:

- Periodically, to verify the correct functioning of the sensor
- Daily, if you are monitoring a patient's FiO_2 on a daily basis
- When you suspect that sensor characteristics have changed
- When the accuracy of the monitor is in question
- When there is a change in humidity or barometric pressure of the monitoring site

1 Point Calibration (Room Air)

A 1-point calibration of the sensor to room air (21 % oxygen) should be performed on a daily basis.

1. Make sure the monitor is turned on and that the NeoMed and the monitor are set up for FiO_2 monitoring (see page 23-3).
2. Expose the sensor to room air.
3. Open the FIO_2 menu (see page 23-4).
4. Click on **1 Point Cal.** The message *21 % Calibration in Progress -- Calibration may take from 1-10 minutes* appears.
5. Wait for the message *21 % Calibration Complete* to appear. (A message informs you of a failed calibration. Try calibrating again; if the message persists, try a new sensor.)
6. Return the sensor to the incubator or oxygen hood.

2 Point Calibration (Cal Gas)

NOTE: Contact your hospital's technical personnel for help with 2-point calibration.

A 2-point calibration of the system, to 100 % dry oxygen and room air (21 % oxygen), should be performed every week:

1. Make sure the monitor is turned on, that the NeoMed pod is properly connected, and set up for FiO_2 monitoring.
2. Set up the sensor for O_2 calibration following your hospital's guidelines.
3. Open the FiO_2 menu (see page 23-4).
4. Click on **2 Point Cal.**
5. Supply 100 % O_2 when instructed by the monitor.
6. Click on **Continue**. A message appears informing you that the calibration is in progress and requesting you to wait until calibration is complete before proceeding with room air calibration.
7. Wait for the system to calibrate. When calibration is finished, the message *100 % Calibration Complete* appears.
8. Follow the instructions on page 23-5 to calibrate the system to room air (1-point calibration).

9. Return the sensor to the incubator. A status message appears if calibration fails. Refer to the table at the end of this chapter for status messages.

Status Messages

Message	Condition	Suggested Action
FiO_2 < #	The O_2 value exceeds the upper alarm limits.	• Check the patient and treat, if necessary. • Recalibrate the system.
FiO_2 > #	The O_2 value fell below the lower alarm limits.	
FiO_2 Cal. Canceled	The calibration has been stopped.	Try to calibrate again.
FiO_2 Cal Failure	The monitor could not calibrate the FiO_2 sensor.	Recalibrate. If the message persists, try a new sensor.
FiO_2 Cal Accepted	The calibration was successful.	Informational message only.
FiO_2 21% Cal. in Progress	The monitor is performing a 21 % (1-point) calibration.	Wait.
FiO_2 100% Cal. in Progress	The monitor is performing a 100 % (2-point) calibration.	Wait.
FiO_2 Cal Required	The sensor needs to be calibrated.	Perform a calibration.
FiO_2 Cal Paused	The monitor is waiting for the sensor to be exposed to room air (during 2-point calibration).	Remove the sensor from the T-piece and expose it to room air.
FiO_2 H/W Failure	Hardware malfunction.	Disconnect the NeoMed pod, then reconnect it. If the message persists, return the pod to hospital's technical personnel and try a new one.
FiO_2 Pod Unplugged	The monitor cannot detect a NeoMed pod.	Check the connections and verify the pod is correctly plugged into the monitor.
FiO_2 Sensor Unplugged	The monitor is not detecting a sensor.	Check the sensor connections.
FiO_2 Sensor Failure	The sensor is not accurately measuring oxygen.	Try the sensor again. If the message persists, try a new sensor.

24 MultiGas Monitoring

Application

Intended Use

The Scio Four module samples gas from the breathing gas of pediatric patients and adults. It continuously measures the concentration of CO_2, N_2O, and anesthetic agents (Halothane, Isoflurane, Enflurane, Sevoflurane, and Desflurane) in the breathing gas as well as the O_2 concentration (optional). All measured values as well as derived values are communicated to a patient monitor.

NOTE: In this chapter, all Scio Four modules (Scio Four, Scio Four Oxi, Scio Four plus, and Scio Four Oxi plus) are referred to as "gas analyzer".

NOTE: In this chapter, all Infinity Delta Series patient monitors are referred to as "patient monitor".

Getting Started

Upon start-up, the gas analyzer passes through an initialization (status message *MultiGas Initialization* appears) and warm-up period (status message *MultiGas Warming Up* appears). During this time, concentrations for certain gases may not be available and the anesthetic agent may not be identified.

WARNING: Risk of inaccurate gas measurement values
During warm-up, reported values may not be accurate. Wait until the gas analyzer has completed initialization and warm-up. Refer to the Technical Data appendix in the gas analyzer supplement for further information regarding gas analyzer accuracy.

WARNING: Risk due to defective sensors
If the gas analyzer is not ready for operation, the patient will not be adequately monitored.Before using the medical device, ensure a suitable substitute monitoring.

WARNING: Risk of inaccurate gas measurement values
When the patient monitor is used with a gas analyzer, it meets the Class A limits of CISPR11. The system is not intended for connection to public mains due to possible line-conducted disturbances.

Operation

WARNING: Risk of patient safety
The multigas information displayed is intended to be used by trained and authorized health care professionals only.

WARNING: Risk of misinterpretation
Misdiagnosis or misinterpretation of the measured values or other parameters can endanger the patient.
Do not make therapeutic decisions based solely on individual measured values and monitoring parameters. Therapeutic decisions must be made solely by qualified users.

WARNING: Risk of inaccurate gas measurement waveforms
Under extreme monitoring conditions (and if network functionality is in use), intermittent spikes may be present on the gas analyzer waveform display. Parameter box data is not affected.

WARNING: Risk due to incorrect settings
For patient monitors within the same care area, different standard alarm limits or therapy settings might be configured. The user must observe the following:

– Ensure that the values set for new patients are appropriate.

– Ensure that the alarm system is neither rendered useless by setting extreme values for the alarm limits nor deactivated by switching off the alarms.

WARNING: Risk of inaccurate gas measurement
When using three anesthetic agents the oxygen measurement may be inaccurate. Only use one agent at a time.

Multigas Monitoring Setup

The gas analyzer parameters are displayed in the etCO_2*, O_2/N_2O (in some models only N_2O) and anesthetic agent parameter boxes. Each has its own setup menu, described in the following pages.

$etCO_2$* Monitoring

The $etCO_2$* waveform displays the instantaneous CO_2 concentration. The $etCO_2$* parameter box displays the following parameters:

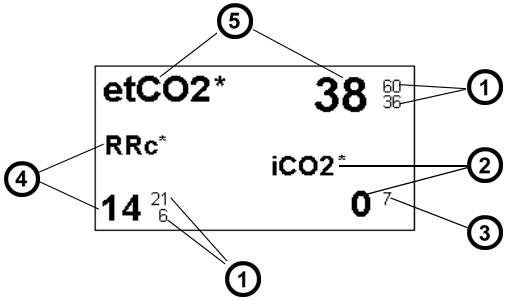
— Inspired CO_2 (iCO_2*) — The level of CO_2 in the airway during the inspiration phase.

— End-tidal CO_2 ($etCO_2$*) — The level of CO_2 in the airway at the end of expiration.

— Respiration Rate (RRc*) — The patient's respiration rate, derived from the $etCO_2$* signal by calculating an average rate over the two most recent breaths

NOTE: The parameter labels $etCO_2$, iCO_2 and RRc are marked by an asterisk (*) to distinguish them from parameters monitored by the $etCO_2$ pod or module.

Typical $etCO_2$ parameter box displays are shown below.



1	Alarm limits
2	iCO_2* (inspired CO_2) label and value
3	Alarm limit (upper limit only)
4	Respiration rate label and value
5	$etCO_2$* (end-tidal CO_2) label and value

NOTE: If alarms are disabled, crossed-out bell icons appear next to the corresponding parameter values.

NOTE: The patient monitor does not alarm for $etCO_2$* or inspiratory and expiratory agent limit violations until it has established a valid respiratory rate.

To access the Scio $etCO_2$ setup menu*

- Click on the $etCO_2$* parameter box

or

1. Press the **Menu** fixed key.
2. Click on **Patient Setup**.
3. Click on **Parameters** to display a list of available parameters.

Click on **etCO2***.

Quick Reference Table – etCO2 Setup*

Click on the following items to execute $etCO_2$* setup functions:

The $etCO_2$* Setup Menu		
Menu Item	**Description**	**Settings**
Scale	Sets the $etCO_2$* waveform scale.	• **40, 60, 80 mmHg**
Respiratory Sweep Speed	Sets waveform sweep speed on screen display.	• **6.25, 12.5, 25, 50 mm/s**
Agent Display	Displays a separate agent parameter box;. Ghosted if the monitor is displaying combined MultiGas parameter box.	• **ON** • **OFF**
Pressure Comp.	Sets the compensation for ambient atmospheric pressure.	• **Auto** • **760 mmHg**
RRc* Apnea Time	Sets the time that the monitor waits before reporting a cessation of breathing as an apnea event.	• **OFF, 10, 15, 20, 25, 30 s**
Apnea Archive	Allows you to store and/or record an alarm event automatically for apnea. You can later review stored alarms on the Event Recall screen.	• **OFF**, **Record**, **Store** (default), **Str./Rec.**
MultiGas Zero	Manually zeroes the Scio module (parameter values disappear during zeroing).	Not applicable
Auto Zero Delay	Delays automatic zeroing for 5 minutes for uninterrupted monitoring. **WARNING**: **Delaying the auto zero may impact accuracy.** **NOTE**: Gas sensors in the Scio module are automatically zeroed and calibrated against room air. Parameter values disappear during zeroing. One minute before automatic zeroing, the monitor sounds an attention tone and displays the message *Auto zero in <1 minute*.	Not applicable
etCO2* Alarms	Accesses $etCO_2$* alarms in Alarm Limits table (see chapter 5) **WARNING: $etCO_2$ alarms do not activate until the first breath is detected after turning on the monitor or discharging a patient.**	

O_2/N_2O or N_2O Monitoring

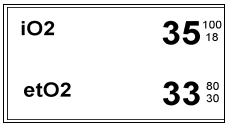
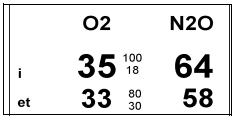
NOTE: The O_2 monitoring function is only available with Scio Four Oxi and Scio Four Oxi plus.

The O_2 waveform indicates the instantaneous O_2 concentrations. The O_2/N_2O or N_2O parameter box displays the following parameters:

- Inspired O_2 (iO_2) — The level of O_2 in the airway during the inspiration phase
- Expired O_2 (etO_2) — The level of O_2 in the airway during the expiration phase
- Inspired N_2O (iN_2O) — The level of N_2O in the airway during the inspiration phase
- Expired N_2O (etN_2O) — The level of N_2O in the airway during the expiration phase

The appearance of the O_2/N_2O or N_2O parameter box varies depending on whether the N_2O display is turned on in the O_2 menu or oxygen measurement is provided by gas analyzer.

Typical O_2/N_2O parameter box displays are shown below

Parameter Box	Description
	Scio module: N_2O display turned off. This module calculates both iO_2 and etO_2 values.
	Scio Module: N_2O display turned on. This module calculates both iO_2/iNO_2 and $etO_2/etNO_2$ values.
	**NOTES**: The symbol (shown left) in the parameter box indicates that the O_2 lower alarm limit has been set to a value less than 21% (the percentage of O_2 in room air). The O_2 parameter box does not show N_2O alarm limits because N_2O does not alarm.

NOTE: The patient monitor does not alarm for inspiratory and expiratory oxygen limit violations until it has established a valid respiratory rate.

To access the O_2/N_2O or N_2O setup menu

- Click on the O_2/N_2O or N_2O parameter box

or

1. Press the **Menu** fixed key.
2. Click on **Patient Setup**.
3. Click on **Parameters** to display a list of available parameters.

Click on **O_2 or N_20**.

Quick Reference Table -- O_2/N_2O or N_2O Setup

Click on the following items to execute O_2/N_2O or N_2O setup functions

The O_2 /N_2O or N_2O Setup Menu		
Menu Item	**Description**	**Settings**
MultiGas Parameter	Enables the combined MultiGas parameter box display.	• **ON**, **OFF**
O2 Scale	Sets O_2 waveform scale	• **50 %**, **100 %**
N2O Display	Displays N_2O values **NOTES:** Ghosted if the monitor is displaying a combined MultiGas parameter box. N_2O alarms are not supported, so N_2O alarm limits do not appear in the parameter box.	• **ON** • **OFF**
MultiGas Zero	Manually zeroes the Scio module. **NOTE**: During zeroing, the monitor temporarily blanks Scio parameter values.	Not applicable
Auto Zero Delay	Delays automatic zeroing for 5 minutes for uninterrupted monitoring (see page 24-6 for information)	Not applicable
O2 Calibration	See page 24-8 for further information on calibration functions.	• **1 Point Cal.** • **2 Point Cal.** • **Last O2 Cal.**
O2 Alarms	Accesses the Limits table (see chapter 5)	Not applicable

Quick Reference Table – N_2O Setup

Click on the following items to execute N_2O setup functions

N_2O Setup Menu		
Menu Item	**Description**	**Settings**
MultiGas Parameter	Enables combined MultiGas parameter box display	• **ON** • **OFF**
MultiGas Zero	Manually zeroes the Scio module (parameter values disappear during zeroing).	Not applicable
Auto Zero Delay	Delays automatic zeroing for 5 minutes for uninterrupted monitoring (see page 24-6 for information)	Not applicable

Anesthetic Agent Monitoring

The agent waveform indicates the instantaneous agent concentration. The agent parameter box displays the following parameters:

- Inspired agent (e.g. iSEV) — The level of anesthetic agent in the airway during the inspiration phase
- Expired agent (e.g. etSEV) — The level of anesthetic agent in the airway during the expiration phase

The agent waveforms and parameters can be identified by color as follows:

- Halothane = red;
- Desflurane = light blue;
- Enflurane = orange;
- Sevoflurane = yellow;
- Isoflurane = purple.

The appearance of the agent parameter box varies depending on the number of identified agents. Typical agent parameter box displays are shown below.

NOTE: If the combined multigas parameter box is enabled, no additional agent parameter box can be enabled.

NOTE: If two agents are detected, the one with the higher expired MAC value is regarded as the primary agent.

To access the Agent setup menu

- Click on any agent parameter box if displayed

  or

1. Press the **Menu** fixed key.
2. Click on **Patient Setup**.
3. Click on **Parameters** to display a list of available parameters.
4. Click on **AGENT** to display the Agent menu.

Quick Reference Table - Agent Setup

Click on the following items to execute Agent setup functions:

The Agent Setup Menu		
Menu Item	**Description**	**Settings**
Agent Scale	Sets the agent waveform scale.	• **1, 2, 3, 5, 10, or 20%**
Agent Display	Displays a separate agent parameter box. **NOTE:** Ghosted if the monitor is displaying a combined MultiGas parameter box .	• **ON** • **OFF**
Agent ID ***(Scio Four Oxi and Scio Four only)***	Configures the Scio Four Oxi or Scio Four module to measure the concentration levels of a user-specified anesthetic agent. **WARNING**: • **Use care when setting the agent ID manually. Measurements will be inaccurate if the wrong agent ID is selected.** • **Scio Four Oxi & Scio Four cannot recognize anesthetic gas mixtures. Measurements will be inaccurate if anesthetic gases are mixed.** **NOTE**: If the user has not selected an anesthetic agent yet, *AA?* is displayed in the parameter box.	• **HAL** • **ISO** • **SEV** • **ENF** • **DES**
MultiGas Zero	Manually zeroes the Scio module (parameter values disappear during zeroing).	Not applicable
Auto Zero Delay	Delays automatic zeroing for 5 minutes.	Not applicable
Agent Alarms	Accesses Agent alarms in Alarm Limits table (see chapter 5)	

Manual Agent ID

NOTE: The manual agent ID setup is only relevant for gas analyzers without automatic agent recognition – Scio Four and Scio Four Oxi.

If no anesthetic agent has been selected, the message *AA*? is displayed in the parameter box.

To set the Agent ID

- Click on any agent parameter box if displayed

  or

1. Press the **Menu** fixed key.
2. Click on **Patient Setup**.
3. Click on **Parameters** to display a list of available parameters.
4. Click on **Agent**.
5. Click on Agent ID and choose teh desired agent.

WARNING: Risk due to inaccurate gas measurement values. Use care when setting agent ID manually. Measurements will be inaccurate if the wrong agent ID is selected.

WARNING: Risk due to inaccurate gas measurement values. Measurements using a gas analyzer without automatic agent recognition will be inaccurate if anesthetic gases are mixed.

NOTE: The agent ID resets to blank upon a power cycle or patient discharge.

NOTE: The patient monitor does not alarm for inspiratory and expiratory agent limit violations until it has established a valid respiratory rate.

Automatic Agent ID

NOTE: The automatic agent ID setup is only relevant for gas analyzers with automatic agent recognition – Scio Four plus and Scio Four Oxi plus.

These gas analyzers are able to automatically identify up to two anesthetic agents, even in mixtures.

If the gas analyzer has not yet identified or cannot identify an agent, or has detected a mixture of three anesthetic agents (e.g. due to too low agent concentrations, a leaking vaporizer, or traces of disinfectants), the agent parameter box displays the message *Agent?*.

NOTE: The patient monitor does not alarm for inspiratory and expiratory agent limit violations until it has established a valid respiratory rate.

Mixed Agent

NOTE: The measurement of mixed agent is only relevant for gas analyzers with automatic agent recognition – Scio Four plus and Scio Four Oxi plus.

When the gas analyzer detects a mixture of two anesthetic agents, the displayed real time waveform is the primary agent concentration. The color of the waveform and the first agent label in the Agent parameter box represents the agent with the highest MAC value (primary agent). The label (e.g. SEV-DES) indicates the SEV agent with the highest MAC value. This label will switch to that of the second administered agent when its concentration exceeds that of the first agent.

Standard MAC Values

NOTE: The setting chosen in the MAC Calc. menu determines whether standard, age-corrected, or no MAC values are used.

The minimum alveolar concentration (MAC) value of the agent is a simple navigation aid for anesthetic agent delivery.

1 standard MAC is equal to the alveolar anesthetic concentration at one atmosphere (760 mmHg) at which 50 % of all patients no longer respond to noxious stimuli. The integrated MAC algorithm is based on the MAC values shown in the following table. The values specified in the table apply to a patient age of 40 years and only serve as a guide. The binding values are specified on the information leaflet of the anesthetic agent packaging.

	1 MAC corresponds to: (in 100% O_2)
Halothane	0.77 Vol%
Enflurane	1.7 Vol%
Isoflurane	1.15 Vol%
Desflurane	6.65 Vol%
Sevoflurane	2.10 Vol%

	1 MAC corresponds to: (in 100% O_2)
N_2O	105 Vol%

Once the monitor has detected an agent, the parameter box shows a MAC value.

For gas mixtures, the respective multiples for N2O and anesthetic agents are added according to the following equation:

$$MAC_{standard,\ total} = \frac{exp.\ conc.\ Anesth._1}{MAC_{standard}\ Anesth._1} + \frac{exp.\ conc.\ Anesth._2}{MAC_{standard}\ Anesth._2} + \frac{exp.\ conc.\ N_2O}{MAC_{standard}\ N2O}$$

NOTE: Age and other factors are not taken into account for standard MAC value calculation.

Age-Corrected MAC Values

NOTE: The setting chosen in the MAC Calc. menu determines whether standard, age-corrected, or no MAC values are used.

The age-corrected MAC values are calculated using an equation developed by W.W. Mapleson (British Journal of Anaesthesia 1996, pp. 179-185). The equation applies to patients older than 1 year.

$$MAC_{age\ corrected} = standard\ MAC \times 10^{(-0.00269 \times (age - 40))}$$

For gas mixtures, the respective multiples for N2O and anesthetic agents are added according to the following equation:

$$MAC_{age\ corrected,\ total} = \frac{exp.\ conc.\ Anesth._1}{MAC_{age\ corrected}\ Anesth._1} + \frac{exp.\ conc.\ Anesth._2}{MAC_{age\ corrected}\ Anesth._2} + \frac{exp.\ conc.\ N_2O}{MAC_{age\ corrected}\ N2O}$$

CAUTION: *Risk due to incorrect setting for patient age*
The patient's age is derived from the birth date entered in the Patient Admit menu. Incorrect settings can lead to inappropriate MAC values and therefore to inappropriate anesthetic gas delivery.
Always set the patient age correctly.

Once the monitor has detected an agent, the parameter box shows a MAC value.

Combined Multigas Parameter Box

The O_2/N_2O and agent parameters can be combined to share a single waveform channel and parameter box. In this case, the multigas parameter box takes the place of the O2 parameter box on the main screen.

NOTE: Ensure that the O_2 or the multigas parameter is appropriately assigned on the parameter priority list.

To enable the combined multigas parameter box display

1. Click on the O_2/N_2O parameter box
2. Select and click on **MultiGas Parameter**
3. Select and click on **ON**

or

4. Press the **Menu** fixed key
5. Click on **More** to go to the menu's second page
6. Select and click on **MultiGas Parameter**
7. Select and click on **ON**

NOTE: When the combined multigas parameter box is selected, N2O values are automatically enabled for display.

Typical combined multigas parameter box displays are shown below:

Parameter Box	Description
O2 ISO N2O i 35 1.5 64 et 33 1.3 58	The Scio module has identified an agent and displays concentration levels for O_2, isoflurane, and N_2O.

To access the combined multigas setup menu

1. Click on the combined multigas parameter box

or

2. Press the **Menu** fixed key
3. Click on **Patient Setup**
4. Click on **Parameters** to display a list of available parameters
5. Click on **Multigas Parameter**

To execute combined multigas setup functions click on the following items:

The Combined (O_2/Agent/N_2O) Setup Menu		
Menu Item	**Description**	**Settings**
Waveform	Selects a waveform for display.	• **O_2, Agent**
MultiGas Parameter	Enables the combined MultiGas parameter box display.	• **ON** • **OFF**
O2 Scale	Sets O_2 waveform scale (see page 24-6).	• **50 %**, **100 %**
N2O Display	Displays N_2O values in the O_2/N_2O parameter box (see page 24-8).	• **ON** • **OFF**
Agent Display	Displays a separate agent parameter box (see page 24-10).	• **ON** • **OFF**
NOTE: During the combined display, the N_2O and agent displays are automatically turned on and their selections are ghosted on the combined menu. You can only access these selections and turn the displays off, once you have turned off the combined MultiGas parameter display.		
Agent Scale	Sets the agent waveform scale.	• **1-20 %** in increments of 1
MultiGas Zero	Manually zeroes the Scio module. **NOTE**: During zeroing, the monitor temporarily blanks Scio parameter values.	Not applicable
Auto Zero Delay	Delays automatic zeroing for 5 minutes (see page 24-6 for detailed information).	Not applicable
O2 Calibration	Selects desired O2 calibration *See page 24-8 for further information on calibration functions.	• **1 Point Cal.*** • **2 Point Cal.*** • **Last O2 Cal.***
O2 Alarms	Accesses O_2 alarms in the Alarm Limits table (see chapter 5)	

Zeroing

The gas analyzer purges and zeroes itself and does not need any interaction by the user. Waveforms flatline and parameter box values blank from the screen during this cycle. The following status messages are displayed during this process:

Multigas Zero in Progress	The zeroing cycle is in progress.
MultiGas Zero Accepted	The zeroing cycle was successful.
MultiGas Zero Failed	The zeroing cycle failed. Causes might be occlusions or leaks, polluted ambient air, hardware or communication problems.

For further technical details on the zeroing process, refer to the gas analyzer's supplemental instructions for use.

Troubleshooting

CAUTION: *Risk due to gas measurement failure*
If gas measurement fails, the patient can no longer be adequately monitored.

- *Ensure corresponding substitute monitoring.*
- *Check sample line and water trap for damage or blockage and resolve these as needed.*
- *Observe the prescribed exchange intervals.*

Alarm - Cause - Remedy

If an alarm occurs, the table helps to quickly identify causes and remedies. The possible causes and remedial measures should be consulted in the order in which they are listed until the alarm is resolved.

The following table lists the alarm messages in alphabetical order.

Alarm Priority	Alarm	Cause	Remedy
Medium	iCO2* > #	Soda lime is depleted	• Check soda line • Increase fresh -gas flow • Check fresh-gas flow • Exchange soda line
		Leakage in breathing system	Exchange breathing system
		Gas measurement is inaccurate due to high respiratory rate	Adjust alarm limits if necessary
		Large dead space	Check ventilation settings
Medium	etCO2* > #	End-tidal CO_2 concentration has exceeded the upper alarm limit	Check ventilation
Medium	etCO2* < #	End-tidal CO_2 concentration has fallen below the lower alarm limit	Check ventilation
Medium	RRc* > #	The patient is breathing at a high respiratory rate	• Check patient condition • Check ventilation settings or spontaneous respiratory rate
		RRc* has exceeded the upper alarm limit	Check ventilation settings

Alarm Priority	Alarm	Cause	Remedy
Medium	RRc* < #	RRc* has fallen below the lower alarm limit	Check patient condition and ventilation settings
Escalate **NOTE**: See page 5-20 for information	RRc* Apnea	No breathing or ventilation	• Start manual ventilation! • Check ventilation settings • Check spontaneous breathing ability of the patient
		Sample line is not connected	Connect sample line to breathing circuit or gas analyzer
High	iO2 > #	Inspiratory O2 concentration has exceeded the upper alarm limit	Check O2 concentration and fresh-gas settings
High	iO2 < #	Inspiratory O2 concentration has fallen below the lower alarm limit	• Check O2 concentration and fresh-gas settings • Check breathing system for large leaks • Check O2 supply
Medium	i[agent] > #	Inspiratory anesthetic gas concentration has exceeded the upper alarm limit	Check vaporizer and fresh-gas settings
Medium	i[agent] < #	Inspiratory anesthetic gas concentration has fallen below the lower alarm limit	• Check vaporizer and fresh-gas settings • Check breathing system for large leaks
		Soda lime is dried out	Exchange soda lime
Medium	et[agent] > #	Expiratory anesthetic gas concentration has exceeded the upper alarm limit	Check vaporizer and fresh-gas settings
Medium	et[agent] < #	Expiratory anesthetic gas concentration has fallen below the lower alarm limit	• Check vaporizer and fresh-gas settings • Check breathing system for large leaks
		Soda lime is dried out	Exchange soda lime
Medium	i[parameter] out of range (high)	Inspiratory gas concentration has exceeded the upper measuring range	Check vaporizer, fresh-gas settings, and ventilation
Medium	i[parameter] out of range (low)	Inspiratory gas concentration has fallen below the lower measuring range	Check vaporizer, fresh-gas settings, and ventilation

Alarm Priority	Alarm	Cause	Remedy
Medium	et[parameter] out of range (high)	Expiratory gas concentration has exceeded the upper measuring range	Check vaporizer, fresh-gas settings, and ventilation
Medium	et[parameter] out of range (low)	Expiratory gas concentration has fallen below the lower measuring range	Check vaporizer, fresh-gas settings, and ventilation
Low	Agent?	The module has not yet identified or cannot identify the agent because of one of the following conditions: • Unknown agent (for example, not HAL, DES, ISO, SEV or ENF) • The agent concentration is too low • The vaporizer is leaking • Traces of disinfectant are present	(For Scio Four Oxi or Scio Four) select agent manually. • Check/replace vaporizer
Medium	etN2O > 82%	etN2O > 82%	• Check fresh-gas composition • Flush by pressing the "O_2+" button
Low	MultiGas Sample Line Occlusion	Sample line or patient-side filter is occluded	Check sample line and patient-side filter
		Water trap is defective or full	Check water trap
Low	Check Watertrap/ Sample Line	Sample line is blocked or not connected	Check sample line
		Water trap is full or not installed	Check water trap
Low	MultiGas Too Warm	The fan port is blocked or a hardware problem exists	• Clear or unblock the fan port • If the problem persists, call DrägerService
Low	MultiGas Data Invalid	Communication problem	• Check cable connections • Unplug and re-plug the gas analyzer • Power-cycle or undock and re-dock the patient monitor • If the problem persists, call DrägerService

Alarm Priority	Alarm	Cause	Remedy
Low	MultiGas Incompatible	Gas analyzer hardware and/ or software version not compatible with the patient monitor	• Check the software version • Check the gas analyzer variant • If the problem persists, call DrägerService
Low	MultiGas Unplugged	Gas analyzer has become disconnected	• Check cable connections • If the problem persists, call DrägerService
Low	MultiGas H/W failure	Loss of communication	• Check cable connections • Unplug and re-plug the gas analyzer • Power-cycle or undock and re-dock the patient monitor • If the problem persists, call DrägerService
		Failure of the entire gas analyzer	Call DrägerService

NOTE: Agent can vary between Halothane (HAL), Isoflurane (ISO), Enflurane (ENF), Sevoflurane (SEV), and Desflurane (DES)

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25 Neuromuscular Transmission (NMT) monitoring

Overview

The Infinity Trident (NMT) pod is a stimulator pod for the measurement of neuromuscular transmission (NMT) / neuromuscular blockade in adult or pediatric mode.

NOTE:

- The NMT pod is not supported in neonatal mode.
- Only EEG and BISx pods can be connected to the NMT pod.

The NMT pod provides automatic measurements of muscle response (thumb twitch) to electrical stimuli transmitted via electrodes placed over the peripheral nerve (for example Ulnar nerve). The NMT sensors measure muscle response as well as skin temperature and send this information to the pod and monitor for display. An accelerometer is used as the twitch sensor. A thermistor is used to measure skin temperature. It is important to understand the pulse characteristics of the stimulator (see monitoring modes on page 25-5 and specifications in appendix B for details).

At the start of NMT measurements, the pod sends several test pulses to the nerve in order to establish a supramaximal current, which is the pulse strength necessary to excite all the fibers in the nerve. Once the supramaximal current has been established, the pod performs a reference measurement consisting of four pulses to establish a reference muscle response level (reference twitch) in the unrelaxed patient. In subsequent measurements, the pod can compare the relaxed patient's muscle responses to this reference twitch.

NOTE:

- The supramaximal current and reference twitch should be established before you administer muscle relaxants to the patient.
- If the pod cannot establish a supramaximal current based on an actual measurement, it uses a set reference value of 60 mA.
- If the pod cannot establish a reference twitch, it uses an internal reference value for twitch response. A reference twitch is necessary for single-mode measurements.
- Patients with nerve damage or other neuromuscular problems may not respond properly to stimulation. The NMT pod may show unusual patterns when monitoring relaxation in these patients.

NMT values are displayed in the NMT parameter box and saved as trend values. You can set NMT alarm limits on the Alarm Limits table (see page 25-5).

Precautions

Refer to the "Safety Considerations" section starting on page 8, at the beginning of these Instructions for Use, for general precautions regarding safe device operation.

WARNING:

- **The NMT pod's high frequency pulses may interfere with other sensitive equipment such as cardiac pacemakers. Do not use the NMT pod on patients with implanted medical devices unless so directed by a medical specialist.**
- **To avoid adversely affecting the pod, do not use the pod in close proximity to shortwave or microwave therapy devices.**
- **Although the NMT pod is designed for use with electrosurgical equipment, in unusual circumstances simultaneous use of an NMT pod with such equipment may result in burns at the stimulation site and damage to the NMT pod.**
- **Use peripheral nerve stimulator electrodes with circular conductive areas between 1 cm (.39 in) and 1.5 cm (.59 in) in diameter. Apply these electrodes according to the Instructions for Use. Pay special attention to current densities > 2 mA r.m.s./cm^2. Stimulation voltage should not exceed the maximum specified by the electrode manufacturer.**
- **To avoid serious injury to the patient, apply the stimulation electrodes close together as described. Do not apply the electrodes trans-thoracically (across the chest) or transcerebrally (across the head). Doing so can cause electrical current to enter the chest or head and may lead to irregularities in cardiac rhythm, brain activity, or pain.**

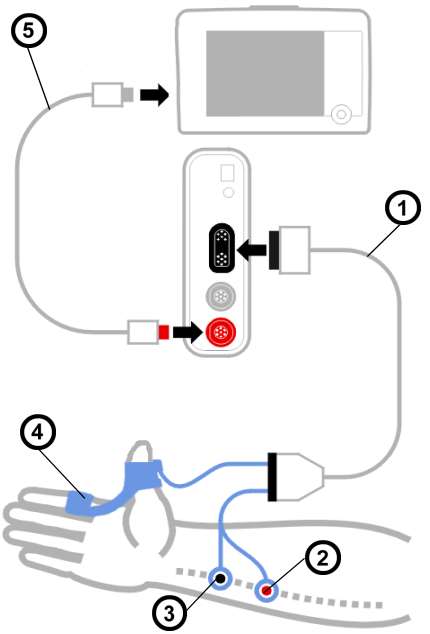
CAUTION:

- *The NMT pod's stimulus indicator flashes when stimulation is occurring. To avoid being shocked unintentionally, do not touch the stimulation electrodes when it is flashing.*
- *Do not use NMT skin temperature sensors to monitor core body temperature.*

Connections

1	Stimulus Indicator (LED)
2	NMT Cable connection port
3	To EEG pod or BISx pod
4	PodCom connection (to monitor)

1. Attach the distal (black) and proximal (red) electrodes above the Ulnar nerve as shown (3 to 5 cm. apart).
2. Connect the Trident pod with the PodCom cable to the monitor's PodCom connector.
3. Apply the NMT hand adaptor.
4. Connect electrode and sensor cables to the NMT cable (if applicable).
5. Connect the NMT cable to the Trident pod (NMT connector).



1	NMT intermediate cable
2	Red (positive) electrode grabber
3	Black (negative) electrode grabber
4	NMT hand adapter
5	PodCom cable

NOTE:

- Check that the thumb can move unconstrained before applying NMT sensor.
- An EEG or BisX pod can connect to the monitor directly or via the NMT pod's EEG connector. See chapter 11 for details about EEG monitoring and chapter 26 for details about BISx monitoring.
- Use the provided hand adaptor straps to secure the hand adaptor.

Monitoring Modes

CAUTION: *NMT stimulation can be painful to a non-sedated patient. Do not stimulate before adequate sedation.*

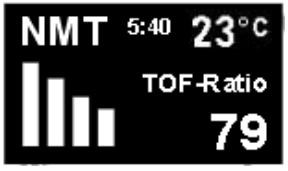
Single Twitch Mode

In this mode, the pod sends a single stimulation pulse and measures the magnitude of the resulting muscle twitch. The pod then calculates an NMT value (from 0 to 100 %) by comparing this magnitude to that of the previously established reference twitch (see page 25-2). For example: If the displayed value is 79, the magnitude of the measured twitch was 79 % of that of the reference twitch.

A bar graph in the NMT parameter box indicates the relative magnitude of the twitch. The pod repeats the stimulation automatically at regular, menu-selectable intervals (default is 20 seconds).

If the pod is unable to establish a reference twitch, it uses an internal reference value for single-mode measurements.

Train-of-Four (TOF)



In this mode (default), the pod sends a sequence of four stimulation pulses 0.5 seconds apart and measures the magnitude of the resulting muscle twitch after each individual pulse. The pod then calculates a TOF response value (TOF-ratio, from 4 to 100 %) using the ratio between the fourth twitch and the first twitch. A bar graph in the NMT parameter box indicates the relative magnitude of each twitch. The pod repeats this stimulation sequence automatically at regular, menu-selectable intervals (default is 20 seconds).

When fewer than four twitches are detected, the monitor displays a TOF-Count (TOF-Cnt) value instead, which represents the number of responses to the four TOF stimulation pulses.

You can set TOF-count alarm limits and alarm recordings in the Alarm Limits table (see chapter 5, Alarms).

NOTE: There is no AutoSet-function for TOF-count alarm limits.

Post-Tetanic Count (PTC)

In this mode, the pod sends stimuli at a 50 Hz rate for 5 seconds, pauses for 5 seconds and then sends single pulses at a 1 Hz rate. This continues until no twitches are detected or 20 stimuli are sent. The pod counts the number of detected twitch responses and displays the post-tetanic count in the NMT parameter box. The fewer responses detected, the deeper the neuromuscular blockade.

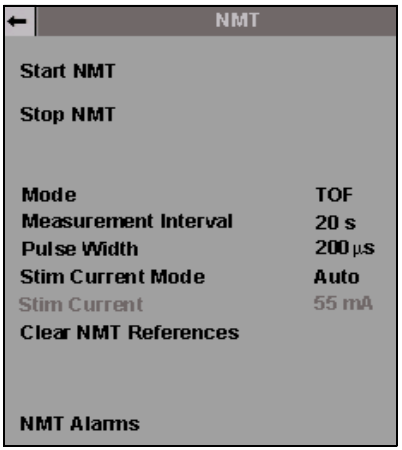
Measurement intervals are not available in the PTC mode. If you want to return to automatic measurement cycles after a PTC measurement, select the single or TOF monitoring mode and restart measurements.

NOTE:

- You can use PTC stimulation to measure deep neuromuscular blockade when no twitch responses are detected in single or TOF mode.
- If PTC measurements start showing a decrease of neuromuscular blockade, change to Single or TOF mode as soon as possible in order to limit the number of PTC measurements.

Taking NMT Measurements

To access the NMT Setup menu



1. Click on the **NMT** parameter box on the Main Screen (if displayed).

   or

1. Press the **Menu** fixed key.
2. Click on **Patient Setup**.
3. Click on **Parameters**.
4. Click on **NMT**.

To start NMT measurements

NOTE: To stop stimulation in an emergency disconnect the PodCom cable from the monitor.

- Click on **Start NMT**.

The pod automatically establishes a supramaximal current and reference twitch (see page 25-2). Once these have been found and stored, NMT measurements in the TOF mode begin automatically at a default measurement interval of 20 seconds.

During measurements, NMT setup functions (except for alarms) are not available and appear ghosted in the NMT menu. To change NMT settings after startup, stop measurements, change the settings and then restart measurements.

To stop NMT measurements

- Click on **Stop NMT**.

NOTE:

- If the pod cannot establish reference values or if you wish to start over, clear the stored references and repeat the startup procedure.
- Reference values should generally be obtained during start-up, before you administer muscle relaxants.

Clear NMT References

To clear the stored supramaximal current and reference twitch, click on **Clear NMT References**. After you clear NMT references, new references are automatically recalculated at the next measurement.

NOTE: Only use this selection before patient is relaxed. If you clear NMT references after the patient is already relaxed, the new references will be based on the existing level of patient relaxation, which could cause misleading NMT measurements.

NOTE: Changing the stimulation current or pulse width also clears stored references.

Quick Reference Table -- NMT Monitoring Settings

Menu Item	Description	Available Settings
Start NMT	Starts NMT measurements.	Not applicable
Stop NMT	Stops NMT measurements.	Not applicable
Mode	Allows you to select measurement mode.	• **Single** • **TOF** (default) • **PTC**
Measurement Interval	Allows you to select time interval for automatic NMT measurement cycles (in single and TOF modes).	**None, 1s, 10s, 20s (default), 1min, 5min, 15min, 30min** **NOTE**: in PTC mode, you cannot select a measurement interval; in TOF mode, 1s is not available.
Pulse Width *	Allows you to select duration for stimulation pulse.	**100 µs, 200 µs** (default)**, 300 µs**
Stim Current Mode	Allows you to select stimulation current mode. • In auto mode, the pod establishes a supramaximal current during the first measurement and uses it for subsequent measurements. • In manual mode, the user selects a stimulation current.	• **Auto** (default) • **Manual**
Stim Current *	Allows you to select stimulation current (read-only field in Auto mode)	• **Auto mode**: none (displays the stimulation current value) • **Manual mode**: **5 mA** (default) - **60 mA**, (in increments of 5 mA)
Caution: *Changing the stimulation current or pulse width invalidates the stored reference value. The pod recalculates the reference twitch at the next measurement, based on the existing level of patient relaxation, which could cause misleading NMT measurements.*		

Menu Item	Description	Available Settings
Clear NMT References	Clears stored supramaximal current and reference twitch. **NOTE**: Use this selection only before patient is relaxed. If you clear NMT references after the patient is already relaxed, the new references will be based on the existing level of patient relaxation, which could cause misleading NMT measurements.	Not applicable
NMT Alarms	Accesses the Alarm Limits table. **NOTE**: A TOF-count alarm is of medium priority. All other NMT alarms are of low priority (see page 5-4).	• **TOF-Cnt alarm on/off** (default is off). • **TOF-Cnt limits** (high-priority 1-4, low-priority 0-3) • **TOF-Cnt archive** (**Off**, **Record**, **Store**, **Str/Rec**)

Status Messages

Message	Possible Cause	Suggested Action
NMT Initializing	• The pod is performing power-up self-tests. • Supramaximal current and reference twitch detected. • The pod is recalibrating due to a rapid change in twitch amplitude.	• Wait until the self-tests are completed. • Wait until the references are established. • Wait or cancel, reapply, and retry.
NMT Using internal reference	• Reference twitch could not be established. • The patient might have been relaxed before reference was established.	• Check the acelerometer sensor. • Continue the measurement using an internal reference or change to TOF mode.
NMT Check electrodes	• The current cannot be delivered. • The electrodes or connections are not properly placed or are not functioning.	• Check the electrodes and reapply, if necessary. • Check the cable connections.

Message	Possible Cause	Suggested Action
NMT Check sensor	The sensor is malfunctioning or disconnected.	• Check the sensor application. • Replace the acelerometer sensor, if necessary.
NMT Artifact	• Excessive signal noise due to patient's movement/ tremor • Interference from auxiliary equipment	• Check the electrodes and reapply, if necessary. • Isolate the patient from auxiliary equipment, if necessary. • Isolate the patient from extraneous movement or vibration.
NMT Check temp sensor	The temperature cable is broken or missing.	Check the sensor and replace, if necessary.
NMT Temp Out of Range (High/Low)	The temperature value is outside the measuring range (high/low).	• Check the patient and treat, if necessary. • Check the sensor and replace, if necessary.
NMT *TOF-Cnt > UL* *TOF-Cnt < LL*	The number of twitches fall outside the set alarm limits.	• Check the patient and treat, if necessary. • Change the alarm limits as appropriate.
NMT Single Out of Range (High)	The single mode parameter value is outside the measuring range (high).	Check the patient and treat, if necessary.
NMT Pod H/W Failure	• Trident pod hardware failure • An unsupported pod is connected.	• Check the NMT pod connection. • Disconnect the unsupported pod and reconnect the NMT pod. • Call the hospital's technical personnel or DrägerService.
NMT Pod disconnected	The NMT pod is not connected to the monitor.	• Check the cables and connections. • Replace the cables, if necessary.
Duplicate device connected	More than one NMT pod is connected.	Remove the secondary pod.

26 Bispectral Index (BISx) monitoring

Overview

The BISx pod provides a Bispectral Index™ (BIS™) number that represents the patient's level of consciousness. The BIS number 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 in adults during general anesthesia and sedation.

The pod uses a sensor on the patient's forehead to collect the patient's EEG. BIS monitoring translates the EEG into a single number representing the patient's level of consciousness. A BIS value of 100 indicates that the patient is awake. A BIS value of 0 indicates a flatline EEG.. This number may be used as an aid to the clinician in monitoring the effects of certain anesthetic or sedative 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 and sedation.

Precautions

Refer to the "Safety Considerations" section starting on page 8, at the beginning of these Instructions for Use, for general precautions regarding safe device operation.

CAUTION:

- *Use clinical judgment in conjunction with other clinical vital signs to interpret BIS values. Reliance on BIS values alone for intraoperative anesthetic or sedative management is not recommended.*
- *Due to limited clinical experience, BIS values should be interpreted cautiously in patients with known neurological disorders, those taking psychoactive medications, and in children below the age of one.*
- *Artifact and poor signal quality may lead to inappropriate BIS values. Potential artifact may be caused by poor skin contact (high impedance), muscle activity or rigidity, head and body motion, sustained eye movements, improper sensor placement, and unusual or excessive electrical interference.*
- *The impedance checking signal from the BISx pod may interfere with other devices (for example, evoked potential monitors).*

Patient Preparation

Careful skin preparation and proper sensor placement provide strong signals with minimal artifact. In case of a technical alarm (for example, when the message *Sensor check failed* appears), re-prep the patient and press electrodes firmly to make good contact.

Use only Dräger sensors (see page C-28). To achieve a good quality signal, change sensor every 24 hours. Follow the sensor package instructions for patient skin preparation and correct placement.

Display Features

BIS parameters are displayed in the BIS parameter box. An associated EEG waveform can also be displayed.

1	**BIS** label
2	**BIS** value and alarm limits
3	**SQI** value
4	**EMG** value (0 to 100)
5	**EMG** label and bar graph The bar graph represents the EMG values as follows: • 0 to 30 – the bar is empty • 30 to 55 – the bar is filled proportionally • 55 and over – the bar is filled in completely
6	SQI label and bargraph
7	BSR label and value

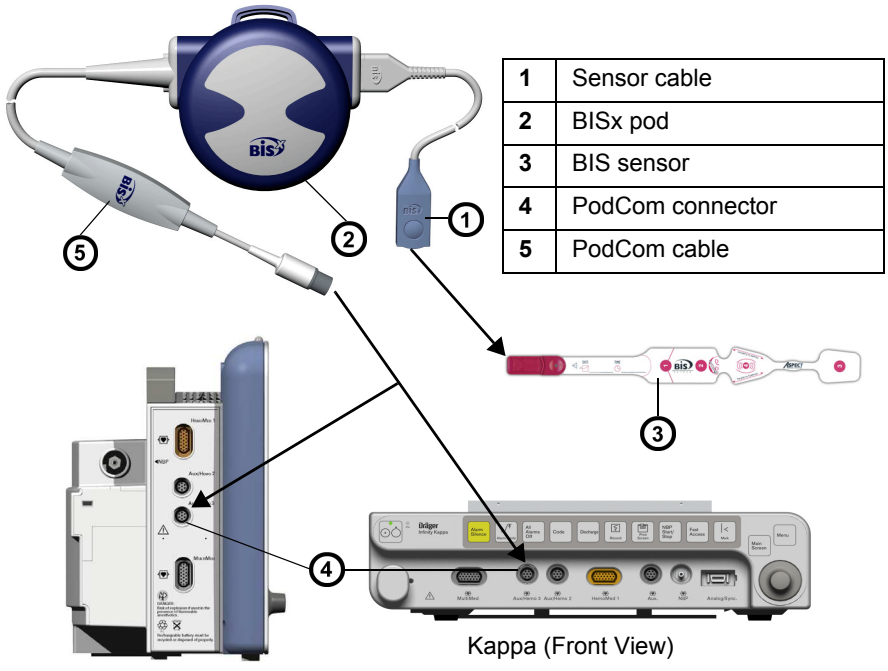
In the BIS parameter box, the display of BIS alarms, alarm limits, and parameter values follows the standard display of other parameters.

Connecting the BISx Pod

Connect the BISx pod to the Delta/Delta XL/Kappa monitor by plugging the PodCom cable into the PodCom connector in the monitor (see illustration below). Plug the sensor into the sensor cable. Attach the BISx pod to an IV pole, bed rail, or clip it to a bedsheet.

NOTE:

- An automatic sensor impedance check is initiated each time a BIS sensor is connected to the sensor cable.
- All signal status messages and alarms are suppressed for 60 seconds after a sensor impedance check has ended. This allows time for signal quality to recover.



1	Sensor cable
2	BISx pod
3	BIS sensor
4	PodCom connector
5	PodCom cable

Kappa (Front View)

Delta/Delta XL (Left View)

BIS Setup

NOTE: Before starting BIS monitoring, check that the sensor is connected properly and has passed the impedance check.

To access the BIS setup menu

- Click on the BIS parameter box (if displayed);

or

1. Press the **Menu** fixed key.
2. Click on **Patient Setup**.
3. Click on **Parameters**.
4. Click on **BIS**.

Quick Reference Table – BIS Setup menu

Menu Item	Description	Available Settings
Show all parameters	Opens a separate menu with all BISx parameters displayed.	**BIS:** Bispectral Index (range = 0 - 100) continuous processed EEG parameter that correlates to a patient's level of consciousness, where 100=awake and 0=flatline EEG. **SQI:** Signal Quality Index (Range = 0 - 100 %) a measure of the signal quality for the EEG channel source, which is calculated based on impedance data, artifact, and other variables. It is displayed in the form of a simple bar graph, located at the bottom of the Parameter box, above EMG. **EMG:** Electromyograph Indicator (Range = 0 - 100 dB) The power (in decibels) in the frequency range 70-110Hz is labeled "EMG". This frequency range contains power from muscle activity as well as power from other high-frequency artifacts. It is displayed as a simple bar graph, located at the bottom of the parameter box, below SQI. **BSR:** Suppression ratio (range = 0 - 100 %) A calculated parameter to give the user an indication when an isoelectric (flatline) condition may exist. Suppression ratio is the percentage of time over the last 63-second period that the signal is considered to be in a suppressed state. For example BSR=11 (isoelectric over 11% of the last 63-second review, or 7 seconds). **SEF:** Spectral Edge Frequency (range = 0.5 - 30.00 Hz) The frequency at which 95% of the total power lies below it and 5 % lies above it.

Menu Item	Description	Available Settings
Show all parameters (continued)		**PWR**: Total Power (Range = 40 - 100 dB in the frequency range from 0.5 - 30 Hz) A measure of absolute total power (in decibels) in the frequency range from 0.5 - 30 Hz. **BCT:** Burst Count (Range = 0 - 30) An alternative to BSR for quantifying the amount of suppression in the EEG. It gives the number of EEG bursts in the last minute. Burst Count is activated only when an Extend sensor is connected. BCT value is blank for any other type of sensor.
Check impedance	Performs an impedance check (tests the quality of BIS electrodes' connection) of the sensor (for more information, see page 26-8)	Not applicable
BIS smoothing rate	Selects the smoothing rate at which BIS value is averaged	• **15 sec.** (default): More responsive to state changes (for example, induction or awakening). • **30 sec**: A smoother trend (lower variability and less sensitive to artifact).
Filter	Allows you to set filters to ON or OFF **NOTE:** The BISx pod uses filters to screen out undesirable interference from the raw EEG signal. If you prefer to observe the raw EEG without the filters, they may be turned OFF.	• **ON** (default) • **OFF**
Parameter 2	Allows you to set second BIS parameter	• **BCT** • **PWR** • **SEF** • **BSR** (default)
SRS # of Use(s) available	Allows you to display the number (0-99) of uses that remain available. **NOTE**: This display is read only.	• Not applicable

Menu Item	Description	Available Settings
BISx Alarms	Accesses the Alarm Limits table. **NOTE**: BISx limit alarm is medium (see page 5-4).	• BIS alarms; **ON** or **OFF** (default **OFF**) • BIS high limit; **5** to **100** (default 100). • BIS low limit; **0** to **95** (default 20). • BIS archive; **OFF**, **Record, Store, Str/Rec (**default **OFF)**

Checking the Impedance

Impedance checking is an important part of BIS monitoring because it tests the quality of the BIS electrode connections. Make sure that the BIS sensor passes the impedance check before starting BIS monitoring to avoid misleading BIS data. To optimize performance, check the individual electrode status (provides a smoother trend with decreased variability and sensitivity to artifact in addition to the overall status. Individual electrode impedance value may display " ***", even though the overall impedance passes).

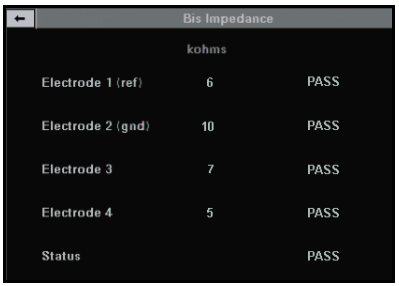
To check the BIS impedance

- Click on the BIS parameter box (if displayed);

or

1. Press the **Menu** fixed key.
2. Click on **Patient Setup**.
3. Click on **Parameters**.
4. Click on **BIS**.
5. Click on **Check impedance**

The BIS impedance menu, depicted below, classifies the status of each electrode.



- **Pass** - Indicates that the impedance check has passed based on the combined electrode impedance values. You can exit the impedance menu and resume normal monitoring.
- **Fail** - Indicates that the impedance check has failed. In this case, do the following:
  - — Press the electrodes firmly to in place to provide good contact.

— Replace the sensor, if it continues to fail.

- *** - if an electrode is not making contact (off) or if an electrode's impedance value is high or clipping. In this case, press on the electrode to improve contact and make sure its impedance value is within limits.

NOTE: The fourth electrode's impedance value and status are blank if a sensor with three electrodes (for example, a pediatric sensor) is used.

Status Messages

Message	Possible Cause	Suggested Action
BIS: Pod Initializing	The BISx pod is initializing and performing a self-test.	Wait until the initialization is completed.
BIS: Sensor impedance check in progress	The BISx pod is performing a sensor impedance check.	• Wait until the impedance check is completed. • Cancel and retry.
BIS: Sensor check failed	• The BISx pod failed the sensor impedance check. • Defective sensor cable.	• Retry the impedance check. • Re-prep the electrodes and retry the impedance check. • Replace the sensor, if necessary, and perform a manual impedance check. • Replace the sensor cable.
BIS > UL *BIS < LL*	The BIS parameter value is above higher/below lower alarm limit.	• Check the patient and treat, if necessary. • Change the alarm limits as appropriate.
BIS: EMG Out of Range (High)	The EMG parameter value is out of range high.	• Check the sensor. • Isolate the patient from auxiliary equipment, if necessary. • Isolate the patient from extraneous movement or vibration. • Check the patient and treat, if necessary.
BIS: PWR Out of Range (High/Low)	The PWR parameter value is out of range high/low.	
BIS: BCT Out of Range (High)	BCT parameter value out of range high/low.	
BIS: Signal quality poor, SQI < 50% *BIS: SQI too low, (SQI value < 15%)*	• Artifact caused by motion or eye blinks. • Interference from electro-surgical unit. • Electrode loosened from patient.	• Check the sensor. • Isolate the patient from extraneous movement or vibration. • Isolate the patient from auxiliary equipment, if necessary. • Re-prep the patient.
BIS: Sensor unplugged	• Sensor malfunctioning or disconnected. • Defective sensor cable.	• Check the cables and connections. • Replace the sensor, if necessary. • Replace the sensor cable.

Message	Possible Cause	Suggested Action
BIS: Sensor expired	The sensor is expired.	Remove the expired sensor and replace with a new/compatible sensor.

BIS: Check Sensor / Impedance	• Sensor fault
	• Defective sensor cable
		• Make sure the sensor is properly applied to the patient, then perform a manual impedance check to continue monitoring. If this fails, do one of the following:
		  • Disconnect and examine the sensor.
		  • Replace the sensor, if necessary.
		  • Replace the sensor cable.
		  • Call your hospital's technical personnel or DrägerService.

BIS: Pod disconnected	The BISx pod is not connected to the monitor.	• Check the cables and connections. • Replace the cables, if necessary.
BIS: Pod Failure	• BISx pod self-test failed • BISx pod hardware failure • BISx pod software failure • Defective sensor	• Check the BISx pod connection. • Replace the sensor, then disconnect and reconnect the pod to continue monitoring. • Call your hospital's technical personnel or DrägerService.
Duplicate devices connected	Multiple BISx pods or MIB BIS is connected.	Disconnect the unwanted duplicate pod or device.
BIS: SRS Final use	SRS cable last use in progress.	Replace the SRS cable after current use.
BIS: Replace Sensor	• Unknown sensor type • Too many uses/sensor worn out • Invalid sensor • Defective sensor cable • SRS no more uses available (When SRS is connected after last use.)	• Remove the unknown/worn out/invalid sensor and replace with a new/ compatible sensor. • Replace the sensor cable. • Replace the SRS cable before continuing.

27 Pulse Contour Cardiac Output (PiCCO) monitoring

Overview

The Infinity PiCCO pod monitors cardiopulmonary and circulatory variables. Cardiac output is determined both continuously through arterial pulse contour analysis and intermittently through transpulmonary thermodilution technique. In addition, the PiCCO pod measures systolic, diastolic and mean arterial pressure. Analysis of the thermodilution curve is used to determine the intra- and extra- vascular fluid volumes. If a patient's weight and height are entered, the PiCCO pod indexes the derived parameters to body surface area (BSA) and body weight (BW) respectively. The PiCCO pod monitors adult and pediatric patients (it is not available for neonatal patients).

The pulse contour PiCCO parameters are listed in the following table.

Pulse Contour parameters			
Label	**Parameter**	**Measurement Range**	**Normal Value**
PCCO	Pulse Contour Cardiac Output - uses a calibration factor (cal) determined by the thermodilution cardiac output measurement and the heart rate, as well as the integrated values for the area under the systolic part of the pressure curve, the aortic compliance and the shape of the pressure curve, represented by change of pressure over change of time.	0.25 to 25 L/min	Not applicable
PCCI	Continuous Cardiac Index - Pulse Contour Cardiac Output normalized to body surface area.	0.01 to 15 L/min/m^2	3.00 to 5.00 L/min/m^2
p-SV	Stroke Volume	1 to 250 ml	Not applicable
p-SVI	Stroke Volume Index - Stroke Volume normalized to body surface area.	1 to 125 ml/m^2	40 to 60 ml/m^2
p-SVR	Systemic Vascular Resistance - The quotient of driving pressure and cardiac output over the last 12 seconds. Here the driving pressure represents the difference between mean arterial pressure (MAP) and central venous pressure (CVP).	0 to 30000 dynes x sec x cm^{-5}	Not applicable

NOTE:

- Normal values reflect clinical experience and may vary from patient to patient. They are without guarantee.
- The prefix of "p-" before SV, SVI, SVR, SVRI is an indication that these parameters are derived by the PiCCO pod.

Pulse Contour parameters			
Label	**Parameter**	**Measurement Range**	**Normal Value**
p-SVRI	Systemic Vascular Resistance Index - Systemic Vascular Resistance normalized to body surface area.	0 to 30000 dynes x sec x cm^{-5} x m^2	1700 to 2400 dynes x sec x cm^{-5} x m^2
dPmax	Index of Left Ventricular Contractility - Estimated by the maximum velocity of the left ventricular (LV) pressure curve. The majority of maximum pressure velocity increase takes place in the ejection phase of the LV, which is represented by the upslope of the arterial pressure curve.	200 to 5000 mmHg/s	Not applicable
SVV	Stroke Volume Variation - Presented beat by beat as the change in stroke volume (in percent) calculated by the mean difference between the highest and lowest stroke volume, divided by a calculated mean stroke volume, over the last 30 seconds.	0 to 50 %	<10 %
PPV	Pulse Pressure Variation - The arterial pulse pressure (PP) is defined as the difference between the systolic and diastolic pressure: $PP = AP_{sys} - AP_{dia}$. Pulse pressure is directly proportional to stroke volume such that the pulse pressure variation (PPV) closely reflects the SVV. PPV is presented beat by beat as the change in PP (in percent) calculated by the mean difference between the highest and lowest PP divided by a calculated mean PP over the last 30 seconds.	0 to 50 %	≤10

NOTE:

- Normal values reflect clinical experience and may vary from patient to patient. They are without guarantee.
- The prefix of “p-” before SV, SVI, SVR, SVRI is an indication that these parameters are derived by the PiCCO pod.

The transpulmonary thermodilution PiCCO parameters are listed in the following table.

Transpulmonary Thermodilution parameters			
Label	**Parameter**	**Measurement Range**	**Normal Value**
p-CO	Cardiac Output - Transpulmonary thermodilution cardiac output serves as the basic parameter for calculation of various blood volumes.	0.25 to 25 L/min	Not applicable
p-CI	Cardiac Index - Cardiac output normalized to BSA (Body Surface Area).	0.10 to 15.00 L/min/m^2	3.0 - 5.0 L/min/m^2
GEDV	Global End Diastolic Volume - The sum of all end-diastolic volumes of the atria and the ventricles. GEDV is equivalent to preload volume of the total heart.	40 to 4800 ml	Not applicable
GEDVI	Global End Diastolic Volume Index GEDVI = GEDV / PBSA (Predicted Body Surface Area)	80 to 2400 ml/m^2	680 to 800 ml/m^2
EVLW	Extravascular Lung Water - correlates to extravascular thermal volume in the lungs and is determined by the mean transit time method.	10 to 5000 ml	Not applicable
EVLWI	Extravascular Lung Water Index - Extravascular Lung Water normalized to body weight. EVLWI = EVLW / PBW (Predicted Body Weight)	0 to 50 ml/kg	3.0 to 7.0 ml/kg
GEF	Global Ejection Fraction - equal to 4 times the stroke volume divided by the global end diastolic volume (GEDV).	1 to 99%	25 to 35%
PVPI	Pulmonary Vascular Permeability Index - Indicator of capillary leakage.	0.1 to 10	1.0 to 3.0
CFI	Cardiac Function Index - CFI = CI / GEDVI	1.0 to 15.0 L/min	4.5 - 6.5 L/min
ITBV	Intrathoracic Blood Volume.	50 to 6000 ml	Not applicable
ITBVI	Intrathoracic Blood Volume Index. ITBVI = ITBV / PBSA (Predicted Body Surface Area)	100 to 3000 ml/m^2	850 - 1000 ml/m^2

NOTE:

- Normal values reflect clinical experience and may vary from patient to patient. They are without guarantee.
- The prefix of “p-” before SV, SVI, SVR, SVRI is an indication that these parameters are derived by the PiCCO pod.

Body Surface Area (BSA), Predicted Body Weight (PBW), Predicted Body Surface Area (PBSA)

The input for height, weight, patient category, and sex are needed for the calculation of the body surface area (BSA), predicted body weight (PBW) and predicted body surface area (PBSA). These calculated body characteristics are required for the indexing of PiCCO parameters. For the indexing of volumetric parameters, the PiCCO pod uses the following calculated parameters which are dependent on the following body characteristics:

- BSA = Body Surface Area (m^2)
- PBW = Predicted Body Weight (kg); calculated according to height, sex, and patient category
- PBSA = Predicted Body Surface Area (m^2); calculated with the PBW instead of actual body weight.

Calculation	Category	Sex
PBW (kg) = 50 + 0.91 [height (cm) – 152.4]	Adult (habitus)[1]	Male
PBW (kg) = 45.5 + 0.91 [height (cm) – 152.4]		Female
PBW (kg) = 39 + 0.89 [height (cm) – 152.4]	Pediatric (>152.4 cm) (habitus)[1]	Male
PBW (kg) = 42.2 + 0.89 [height (cm) – 152.4]		Female
PBW (kg) = ((height (cm))^2 x 1.65) / 1000	Pediatric (<152.4 cm)	Male and female

[1] **NOTE**: In marginal cases the decision about the correct patient category for the individual patient must be based on the anatomy and appearance (habitus).

NOTE: PBW is used to calculate the parameter EVLWI. PBSA is used to calculate GEDVI/ITBVI while BSA is used to calculate all other index parameters.

Precautions

Refer to the “Safety Considerations” section starting on page 8, at the beginning of these Instructions for Use, for general precautions regarding safe device operation. Refer to the IBP chapter for general precautions related to IBP procedures. For a complete list of PiCCO accessories provided by Dräger for this product, see appendix C.

WARNING:

- **Do not use the PiCCO pod on patients for which placement of an indwelling arterial catheter is contraindicated.**
- **Do not place the catheter tip in the aorta or within the heart (intracardicac blood pressure measurements are not allowed).**
- **Patients on intra-aortic balloon counter pulsation (IABP) cannot be monitored with pulse contour analysis, however; the intermittent PiCCO thermodilution will give valid results.**
- **Always perform a discharge before monitoring a new patient, to make sure that previous patient data is not used for calculations.**
- **The correct patient category and the correct input of height, weight, sex and catheter position is mandatory for the accuracy of the displayed parameters and for the correct indexing of parameters. Confirm that the selections are accurate.**

CAUTION:

- *If the PiCCO pod appears to be damaged, do not use the pod; contact Dräger instead.*
- *If the pulse contour measurement values seem unreasonable, perform a thermodilution measurement. This will automatically recalibrate the PiCCO pod and provide more accurate continuous pulse contour cardiac output measurements. Recalibration is recommended if the hemodynamic conditions change significantly, due to volume shifts or medication changes.*
- *Inaccurate measurements can be caused by incorrectly placed catheters, defective connections or sensors, and by electromagnetic interference (for example, electric blankets, electric coagulation).*
- *The displayed GEDV value may be erroneously high in patients with an aortic aneurysm if thermodilution measurements are made via the femoral artery.*
- *Aortic aneurysms may cause the displayed blood volume (GEDV/ITBV) derived by thermodilution measurements to be erroneously high.*
- *As the pulse contour cardiac output of children has not been sufficiently validated thus far, the CO should be checked by thermodilution before therapeutic interventions. Recalibration is recommended with significant changes in hemodynamic conditions, such as volume shifts or changes to medication.*

PiCCO Setup including IBP

PiCCO monitoring is possible only after entering the following patient information:

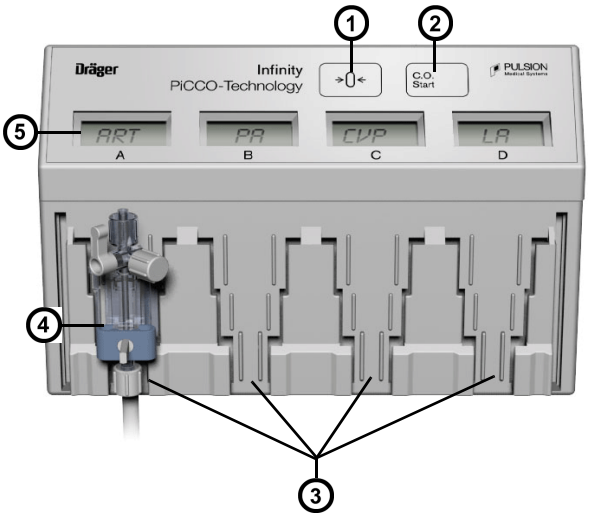
- Patient Height, Weight, Sex, in the Admit menu (see page 4-2)
- Catheter Position in the PiCCO parameter menu (see page 27-16).

Indexed values are only available if the values for Height and Weight are entered before a thermodilution measurement is acquired.

The monitor automatically detects whether a PiCCO pod is connected. The Hemo2/4, MPod – Quad Hemo or HemoMed and the PiCCO pod can be connected to the monitor simultaneously, if more than 4 IBP are required.

NOTE: For cardiac output only, the p-CO and C.O. parameters can not be supported simultaneously.

The parameter selections vary depending on whether you are dealing with discrete/ transpulmonary thermodilution parameters or pulse contour parameters. See tables below.



1	Initiates a zeroing of all connected pressures	**4**	Pulsion blood pressure transducer
2	Starts a p-CO measurement	**5**	Pressure label LCDs
3	Transducer slots		

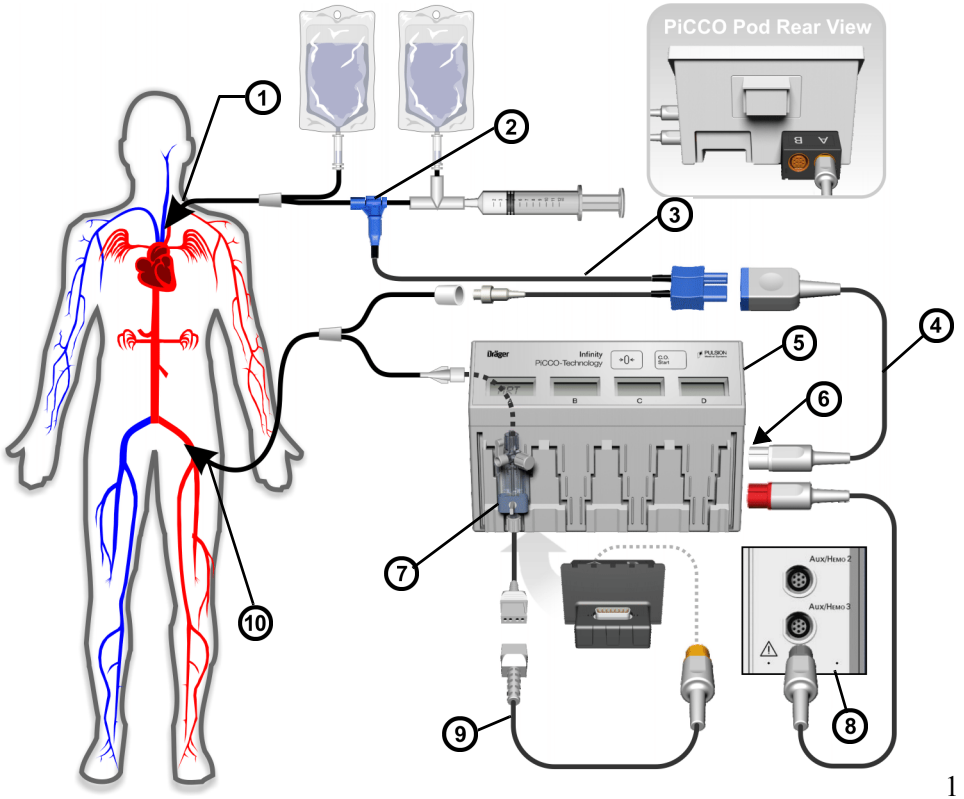
To set up the PiCCO pod and hardware

1. Insert a central venous catheter (CVC) into the patient.

NOTE: Make sure the pressure label for the Pulsion's arterial pressure transducer slot is labeled “ART”.

2. Prepare a pressure monitoring kit for arterial pressure monitoring. Fill the transducer kit carefully using the flush clip. Air bubbles in the pressure lines or in the transducer will influence the transmission and can cause measuring errors.

3. Insert an arterial thermodilution catheter into a suitable artery (femoral, brachial or axillary artery) of the patient. Take care that all air is evacuated from the blood pressure lumen.



1	CVP catheter1	**6**	CO port
2	Injectate temperature sensor housing1	**7**	Pulsion blood pressure transducer1
3	p-CO thermistor cable	**8**	Delta, Delta XL, or Kappa PodCom connection (Delta XL shown)
4	p-CO intermediate cable	**9**	10-pin cable to transducer
5	PiCCO pod	**10**	Pulsion arterial thermodilution catheters1

[1]Catheters and blood pressure transducers required for use with the PiCCO pod are only available from Pulsion Medical Systems. Contact your local sales representative for

4. Connect the pressure line of the monitoring kit to the lumen of the thermodilution catheter.

5. Fill the injectate temperature sensor housing, enclosed in the pressure monitoring kit and connect it to the distal lumen of the central venous line.
6. Connect the p-CO thermistor cable to the p-CO intermediate cable.
7. Plug the p-CO intermediate cable into the port labeled “CO” on the PiCCO pod.
8. Connect the “Injectate temperature sensor housing” to the p-CO thermistor cable.
9. Slide the ART blood pressure transducer into a slot on the front of the PiCCO pod. Make sure the slot’s pressure label is “ART”.
10. Slide the Central Venous Pressure transducer into another slot. Make sure this slot pressure label is “CVP”.
11. Connect the PiCCO catheter with the blood pressure transducer.
12. Use the 10-pin cable to connect the blood pressure transducer to the Delta/ Delta XL/Kappa.
13. If you have not already done so, enter the patient specific input parameters (height and weight) in the Patient Admit menu (see page 4-2).

NOTE: PiCCO measurements are only possible after the arterial pressure transducer is zeroed and the PiCCO pod is calibrated. For accurate measurements, calibrate the PiCCO pod within five minutes of zeroing the pressure.

14. A zero adjustment of the pressure transducer is now necessary. The following table outlines zeroing procedures:

<table>
<tr><th>Single Transducer Zero</th><th>Simultaneous “Smart Zero”</th></tr>
<tr><td colspan="2">1. Make sure the transducer is at heart level. Dräger recommends securing the transducer holders on the front of the PiCCO pod for proper height.</td></tr>
<tr><td colspan="2">2. Close the transducer stopcock to the patient and open it to air.</td></tr>
<tr><td>3(a). Click on the parameter box associated with the transducer you want to zero (ART, CVP, etc.). The parameter setup menu appears.
NOTE: You can also access the parameter menu as follows:
1) Press the Menu fixed key to display the Main menu.
2) Click on Patient Setup.
3) Click on Parameters.
4) Scroll to the desired pressure parameter and click.</td><td rowspan="2">3(b). Press the →0← key on the hemodynamic pod/MPod to zero all pressures whose transducers are open to air.
WARNING: Do not use the ‘Smart Zero’ function if any pressure waveform is flat (nearly static). Only use the ‘Smart Zero’ function when all the stopcocks are opened to air.
NOTE: If you use this step, 3(b), and are unable to zero a particular IBP with the →0← key, use the associated parameter box as described in 3(a). This method can be more effective.</td></tr>
<tr><td>4. Click on Zero.</td></tr>
<tr><td colspan="2">NOTE: If the procedure is successful, the monitor displays the message: <IBP> zero accepted. If the procedure fails, the monitor displays the message: <IBP> did not zero. Check the waveform. If spikes exceed three millimeters, repeat the procedure. If procedure fails after two attempts, replace the transducer or consult your hospital’s technical personnel.</td></tr>
</table>

NOTE: Make sure all patient connections are secure and valid blood temperature and injectate temperature readings are present before initiating a p-CO measurement.

15. Press the **C.O. Start** fixed key on the front of the PiCCO pod or p-CO start in the PiCCO main selection. A p-CO averaging screen appears on the screen. If you do not see a blood temperature baseline, exit the screen and repeat this step.

NOTE:

- In order to avoid disruption of p-CO thermodilution measurement, avoid connecting or disconnecting any cables or changing any menus when measurements are in progress.
- During a measurement, if p-IT or p-BT readings become invalid or go out of range, the averaging screen will disappear.

16. Inject the bolus solution into the patient's bloodstream only after you see the *READY* message. A thermodilution curve appears, displaying the change in blood temperature and a p-CO value is computed.

NOTE: If the *READY* message fails to appear or appears only intermittently, the blood temperature may be unstable. Check that all connections are correct and that the blood temperature is stable and valid and repeat step 15 (see page 27-23 for suggestions to optimize PiCCO measurements).

17. Repeat step 15 to take an additional measurement, making sure you wait for the *READY* message. If a temperature drop is not detected within four minutes, the Averaging screen closes, and the current p-CO values will be averaged and saved. You must repeat steps 15 and 16 if additional p-CO measurements are necessary.

Averaging p-CO Measurements

Differences in injection technique can cause variations in measurements performed on the same patient. To compensate for such discrepancies, you can review results of up to five measurements and use them to compute a p-CO average. The p-CO Averaging screen is displayed whenever you begin a p-CO measurement. The Review Curves screen duplicates the five values displayed on the p-CO Averaging screen with their corresponding thermodilution curves.

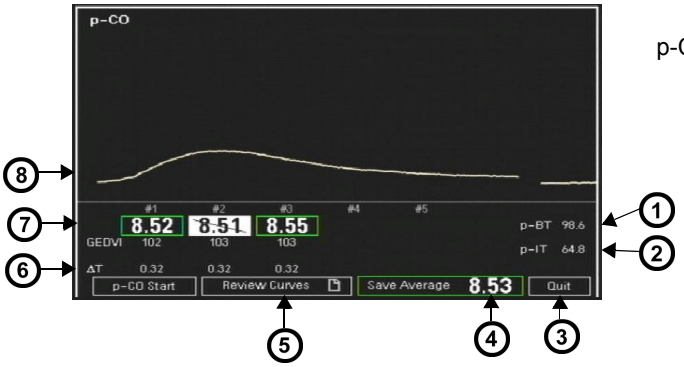
NOTE:

- During measurements, the patient's condition needs to be stable and administration of infusions and injections should be discontinued. The blood temperature (p-BT) should not be lower than 30 °C.
- Iced (< 8°C) or room-temperature injectate < 24 °C can be used. The maximum temperature decrease (ΔT) at the measurement point should be > 0.15 °C.
- To achieve a usable thermodilution signal, Pulsion recommends that the volume of injectate to be used should be based on the following table:

	EVLWI < 10	EVLWI > 10	EVLWI < 10
kg body weight	**iced**	**iced**	**room temperature**
< 3	2 ml	2 ml	3 ml
< 10	2 ml	3 ml	3 ml
< 25	3 ml	5 ml	5 ml
< 50	5 ml	10 ml	10 ml
< 100	10 ml	15 ml	15 ml
> or = 100	15 ml	20 ml	20 ml

NOTE:

- Discard results that are widely different from the general trend, and those associated with irregularly-shaped waveforms.
- If more than five measurements are taken, the oldest measurement (#1) will be deleted and the subsequent measurements will be shifted to the left.
- If any measurement is deleted by the user, the subsequent measurements will also be shifted to the left.

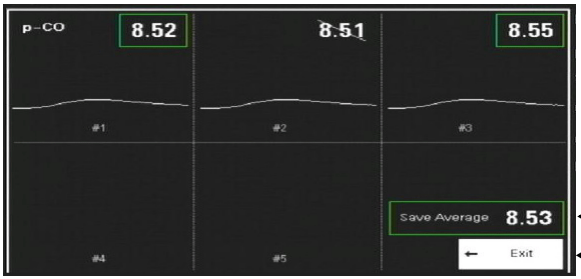


p-CO Averaging

1	Current blood temperature	**5**	Accesses Review Curves screen (see below).
2	Current injectate temperature	**6**	T – Temp difference – The difference between the lowest blood temperature and the baseline blood temperature for each thermodilution measurement.
3	Exit p-CO Averaging screen	**7**	p-CO measurement values (newest value is located at the right; click on the value to exclude it from averaging and mark it with slash).
4	Current average of p-CO values (Click to save them; screen displays *** if the values are out of range) and exits Averaging screen.	**8**	Thermodilution curve -- the highest point represents the lowest blood temperature (measured at the exit from the heart).

NOTE:

- When you save an average the Averaging screen closes.
- Deleting and/or undeleting p-CO measurements is not possible after a p-CO Averaging calculation is completed.



1	Current average of p-CO values (click to save it; the screen displays *** if values are out of range)
2	Returns to p-CO Averaging screen

Review Curves

Saving a p-CO Average

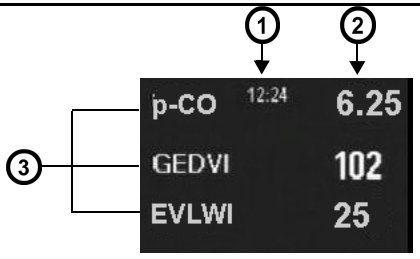
Click on **Save AVG** to save the average of all thermodilution parameter values and end the p-CO measurement session. The average is written to trends and updated in the main screen parameter box to the time of the latest measurement included in the average. You also save the calculated average any time you quit the p-CO Averaging screen by accessing another menu or the Main Screen, or whenever four minutes to pass without a p-CO measurement. A time stamp indicating the last average saved is displayed in the parameter box.

NOTE:

- It takes a few seconds for the PiCCO algorithm to compute certain p-CO values. The **Save Average** button is ghosted until all the values are computed. A new p-CO measurement cannot be started during this time. When all the values are available, the **Save Average** button is unghosted. An attention tone sounds to indicate that an average can be saved or a new p-CO measurement can be started.
- When performing a set of thermodilution (TD) measurements, the TD values in the parameter box are blank. The values appear after the p-CO average has been saved.

Display Features

Special features characterize the display of PiCCO parameter values and waveforms. Parameter boxes vary in appearance according to whether the parameter is Continuous Pulse Contour Analysis parameter or a Transpulmonary Thermodilution parameter. Parameter boxes for Transpulmonary Thermodilution parameter will display GEF, p-CO, GEDV, GEDVI, EVLW, EVLWI, PVPI with a time stamp associated with the Thermodilution measurement taken. A typical Transpulmonary Thermodilution parameter box is shown in the following graphic.

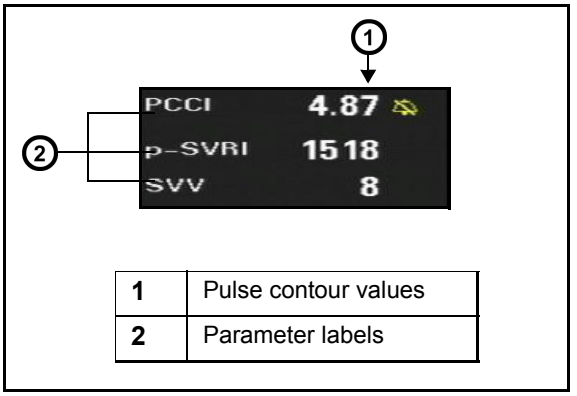


1	Timestamp of last saved p-CO average
2	Thermodilution values
3	Parameter labels

NOTE:

- If ART pressure transducer, ART catheter, and injectate temperature cable are disconnected for 30 minutes or if the PiCCO pod is disconnected from the monitor, the PiCCO calibration data will be lost.
- If no new measurements have been taken for 24 hours, the C.O. average and time stamp are blanked and the PiCCO calibration data will be lost.

Parameter boxes for Continuous Pulse Contour Analysis parameters will display PCCI, PCCO, p-SVI, SVV, p-SVR, p-SVRI and dPmax.Parameter boxes for Continuous Pulse Contour Analysis parameters will display PCCI, PCCO, p-SVI, SVV, p-SVR and p-SVRI. A typical Continuous Pulse Contour Analysis parameter box is shown in the illustration to the right:



1	Pulse contour values
2	Parameter labels

PiCCO Parameter Setup

To access the setup menu for the PiCCO pod

- Click on the PiCCO parameter box on the main screen.

  or

1. Press the **Menu** fixed key to display the Main menu.
2. Click on **Patient Setup**.
3. Click on **Parameters**.
4. Click on **PiCCO-PC**.
5. Click on **Parameter 1**
6. Scroll to the PiCCO pulse contour parameter you want to assign as Parameter 1 (PCCO, PCCI, p-SV, p-SVI, SVV, p-SVR, p-SVRI, PPV, or dPmax, PCCO, PCCI, p-SV, p-SVI, SVV, p-SVR, p-SVRI, or PPV) and click.
7. Repeat the previous two steps for **Parameter 2** and **Parameter 3**.

NOTE: Values for p-BT and p-IT are displayed in the Pulse Contour and Thermodilution menu selections that appear after you select the appropriate parameter box. These references are shown below the p-CO selection (see page 27-20).

To access the transpulmonary thermodilution setup menu for the PiCCO pod:

- Click on the p-CO parameter box on the main screen;

  or

1. Press the **Menu** fixed key to display the Main menu.
2. Click on **Patient Setup**.
3. Click on **Parameters**.
4. Click on **PiCCO-TD**.
5. Click on **Parameter 1**
6. Scroll to the PiCCO transpulmonary thermodilution parameter you want to assign as Parameter 1 (p-CO, p-CI, GEDV, GEDVI, EVLW, EVLWI, GEF, PVPI, CFI, ITBV, or ITBVI)(p-CO, p-CI, GEDV, GEDVI, EVLW, EVLWI, CFI, ITBV, or ITBVI) and click.
7. Repeat the previous two steps for **Parameter 2** and **Parameter 3**.

Quick Reference – PiCCO Setup

Available functions, present on Pulse Contour parameters setup menu, are described in the following table.

Pulse Contour Parameters Setup Menu		
Menu Item	**Description**	**Available Settings**
Show All Parameters	Displays all the PiCCO (continuous and discrete) parameters in a separate window.	Not applicable
Parameters Setup	Allows user to designate which parameter displays as **Parameter 1**, **Parameter 2**, and **Parameter 3**.	**Parameter 1:** **PCCI** (default), **PCCO, p-SV, p-SVI, p-SVR, p-SVRI, SVV, PPV, dPmax** **Parameter 2:** **p-SVRI** (default), **PCCO, PCCI, p-SV, p-SVI, p-SVR, p-SVRI, SVV, PPV, dPmax** **Parameter 3** **SVV** (default), **PCCO, PCCI, p-SV, p-SVI, p-SVR, p-SVRI, PPV, dPmax**
PiCCO Mini Trend	Designates which parameter will be trended for Mini Trend.	**PCCI** (default), **PCCO, p-SV, p-SVI, p-SVR, p-SVRI, SVV**
Catheter type	Read-only field. Displays the catheter type in use. **NOTE: Other** is displayed if the catheter that is connected requires manual entry of an ACC value. Selecting **Other** displays a key pad for manual entry.	**PV2013L07, PV2014L08, PV2014L16, PV2014L22, PV2015L20, PV2014L50, Other**
Catheter Position	Selects the position of the catheter. **NOTE**: The selection **Radial artery** is only visible when the catheter PV2014L50 is connected.	**Femoral artery**, **Axillary artery**, **Brachial artery**, **Radial artery** **NOTE**: When a patient is initially admitted, this field displays '---' until the catheter position is selected. ***CAUTION***: Confirm that the selected catheter position is accurate before starting a measurement. Changing the catheter position after starting a measurement, has no effect on the current measurements. To correct the catheter position, discharge and readmit the patient.

Pulse Contour Parameters Setup Menu		
Menu Item	**Description**	**Available Settings**
Injectate Volume	Selects injectate volume used.	**15.0 cc** (default) **2.0 cc** to **20.0 cc**, in increments of 1.0 cc
Manual CVP	Enables/disables the Manual CVP Value menu. **NOTE:** If the **Manual CVP** setting is set to **Enabled**, the **CVP Value** selection is available.	**Disabled** (default), **Enabled** (When enabled - user can manually input CVP value)
CVP Value	Allows user to select a CVP value. **NOTE:** The auto **CVP Value**, if available, is used until the manual **CVP Value menu** is enabled. If auto **CVP Value** is unavailable, a default of 5 mmHg is used until manual **CVP Value menu** is enabled.	**5 mmHg** (default) **0 mmHg** to **300 mmHg** (in increments of 1 mmHg)
Manual CVP Log	CVP value is logged in with a time stamp.	Not applicable **NOTE:** A total of 20 entries per patient can be stored in the log.
p-CO Start	Activates the p-CO Averaging screen and starts a p-CO measurement. **NOTES:** • After each thermodilution measurement completes, click on **p-CO Start** in the Averaging screen to perform another measurement (the monitor does not automatically start a new measurement). • A p-CO measurement can be started using the **CO Start** fixed key on the PiCCO pod (the remote keypad's C.O. key is not available with the PiCCO pod). • If p-BT or p-IT values are invalid or out of range, the **p-CO Start** button is ghosted and the Averaging screen cannot be accessed. During this time the **C.O. Start** fixed key on the PiCCO pod is also inactive.	Not applicable

Pulse Contour Parameters Setup Menu		
Menu Item	**Description**	**Available Settings**
p-BT <value> **p-IT <value>**	Read only display of p-BT and p-IT values. **NOTE:** If p-BT or p-IT values are out of range, the values will display "***". p-BT range: –3 to –31°C (27 to 88°F) p-IT range: 25 to 43°C (77 to 109°F)	Not applicable
PBW <value> **PBSA** <value>	Read only display of PBW and PBSA values.	Not applicable
PiCCO Alarms	Allows user to set PiCCO parameter alarms via alarm limits menu. See page 5-8. **NOTE:** PiCCO alarms annunciate/ flash in the parameter box even if alarming parameter is not selected to be displayed in the parameter box.	Not applicable

Available functions, present on Thermodilution setup menu, are described in the following table.

NOTE: The user can perform a TD measurement even if ART pressure is not monitored.

Thermodilution Setup Menu		
Menu Item	**Description**	**Available Settings**
Show All Parameters	Displays all the PiCCO (continuous and discrete) parameters in a separate window	Not applicable
Parameters Setup	Allows you to designate which parameter displays as **Parameter 1**, **Parameter 2** and **Parameter 3**.	**Parameter 1:** **GEDVI** (default), **p-CO, p-CI, GEDV, ITBV, ITBVI, EVLW, EVLWI, CFI, PVPI, GEF** **Parameter 2:** **EVLWI** (default), **p-CO, p-CI, GEDV, GEDVI, ITBV, ITBVI, EVLW, CFI , PVPI, GEF** **Parameter 3** **GEF** (default), **p-CO, p-CI, GEDV, GEDVI, ITBV, ITBVI, EVLW, EVLWI, CFI, PVPI**

Thermodilution Setup Menu		
Menu Item	**Description**	**Available Settings**
Catheter type **NOTE: Other** is displayed if the catheter that is connected requires manual entry of an ACC value. Selecting Other displays a key pad for manual entry.	Read-only field. Displays the catheter type in use.	**PV2013L07, PV2014L08, PV2014L16, PV2014L22, PV2015L20, PV2014L50, Other**
Catheter Position	Selects the position of the catheter. **NOTE**: The selection **Radial artery** is only visible when the catheter PV2014L50 is connected.	**Femoral artery**, **Axillary artery**, **Brachial artery**, **Radial artery** **NOTE**: When a patient is initially admitted, this field displays '---' until the catheter position is selected. ***CAUTION***: Confirm that the selected catheter position is accurate before starting a measurement. Changing the catheter position after starting a measurement, has no effect on the current measurements. To correct the catheter position, discharge and readmit the patient.
Art. Catheter Const. (ACC)	Field ghosted when catheters with automatic ACC detection are connected. This field will be unghosted and available to catheters (other than **Catheter Type** field) requiring manual entry of catheter constant values (available range is 0-999). Selecting this key displays a keypad for manual entry.	Not applicable
Manual CVP	Allows you to enable/disable manual **CVP Value** menu. **NOTE:** If **Manual CVP** is Enabled, **CVP Value** selection is ghosted (unavailable).	**Disabled** (default), **Enabled**

Thermodilution Setup Menu		
Menu Item	**Description**	**Available Settings**
CVP Value	Allows user to select a CVP value. **NOTE:** Auto **CVP Value**, if available, is used until the manual **CVP Value menu** is enabled. If auto **CVP Value** is unavailable, a default of 5mmHg is used until manual **CVP Value** is **menu** is enabled.	**5 mmHg** (default) **0 mmHg** to **300 mmHg** (in increments of 1 mmHg)
Injectate Volume	Selects the injectate volume.	**15.0 cc** (default), **2.0 cc** to **20 cc**, in increments of 1.0 cc
p-CO-Start	Brings up a p-CO Averaging screen and starts p-CO measurement. **NOTES:** • After each thermodilution measurement completes, select **p-CO Start** in the Averaging screen to perform another measurement (the monitor does not automatically start a new measurement). • A p-CO measurement can be started using the **CO Start** key on the PiCCO pod (the keypad's C.O. key does not work). • If p-BT or p-IT values are invalid or out of range, the **p-CO Start** button is ghosted and the Averaging screen cannot be accessed. During this time the **C.O. Start** fixed key on the PiCCO pod is also inactive.	Not applicable
p-BT <value> **p-IT** <value>	Read only display of p-BT and p-IT values. **NOTE:** If p-BT or p-IT values are out of range, the values will display "***". p-BT range: 25 to 43°C (77 to 109°F) p-IT range: -3 to 31°C (27 to 88°F)	Not applicable
PBW <value> **PBSA** <value>	Read only display of PBW and PBSA values.	Not applicable
Manual CVP Log	CVP value is logged in with a time stamp.	Not applicable **NOTE:** A total of 20 entries per patient can be stored in the log.

Thermodilution Setup Menu		
Menu Item	**Description**	**Available Settings**
PiCCO Alarms	Allows user to set PiCCO parameter alarms via alarm limits menu. See page 5-8. **NOTE:** PiCCO alarms annunciate/ flash in the parameter box even if alarming parameter is not selected to be displayed in the parameter box.	Not applicable

NOTE:

- See page 15-16 for instructions on labeling pressure channels.
- See page 15-19 for instructions on pressure label conflicts.

Optimizing Results for PiCCO Measurements

Various factors like injection, blood temperature baseline, cables, etc. could affect PiCCO measurements. Below are some suggestions for optimizing results for PiCCO measurements.

Blood temperature baseline

- A good stable baseline is very important before the start of a TD measurement. Avoid or minimize patient motion or movement during a TD measurement so baseline errors do not contribute to error conditions.
- Temperature fluctuation can also be induced by massive infusion with roller pumps, patient warming devices (for example, an electric blanket) or injections just before the TD measurement and pressure changing mattresses.

Arterial blood pressure signal

- A good arterial blood pressure signal is mandatory (not under or over dampened). Before TD measurements, check arterial signal, and if necessary flush pressure line to optimize pressure signal/values. If there is an unstable or static ART pressure signal, the p-CO curve or value may not be generated because the calibration in this situation may not be accurate.

Central Venous pressure

- Check for accurate CVP signal and values before performing TD measurement and calibration of Pulse Contour parameters.

Amount of Bolus

- 15 cc is normally adequate for most adult patients but can be changed as necessary.

Temperature of Injectate

- The signal is better with iced temperature injectate or cold temperature injectate (refrigerated) or at least 10 ^{o}C below blood temperature as opposed to warmer/room temperature injectate. The reason for this is that the bolus has to traverse a longer path (especially femoral catheter) before being detected at the blood temperature thermistor end (as opposed to regular RH Thermodilution CO where the path is much shorter). If warmer temperature injectate is used, the difference in temperature will be very small, making it hard to calculate a good CO measurement.
- In case there is no pulmonary edema, room temperature injectate can be used. Usually, warmer temperature injectate could be used if EVLWI <10.
- If individual measurements are not in good agreement and the TD peak is low, < 0.15 °C (59 °F), it is good to use iced injectate or at least injectate coming out of the refrigerator.
- Injectate temperature generally must not be warmer than 24 °C (75 °F). If injectate temperature is above 31°C (88°F) or fluctuates and is invalid, no measurement will be possible. An error message *Check Injectate Probe* will be displayed and the p-IT values will display ***. Before starting a measurement, make sure the thermistor is not exposed to an external heat source like a warming blanket, etc. Flushing with a cold saline before the first measurements helps to overcome these issues.

Injection time

- The injection time must be within 7 sec. The injection should be done as quickly as possible via the distal CV lumen.
- A shorter injection makes a better signal. Also, the injection should be done as smoothly as possible.

Catheter types

- Art catheter is a femoral artery catheter.
- When a long radial artery (or brachial artery) catheter is in use, the TD baseline may show fluctuations in frequency of the HR. This is because the artery is quite narrow and the thermistor knocks at the vessel walls with every heart beat. This could cause measurement issues. Repositioning of patient's arm could help reduce fluctuations to get a stable baseline.

Thermodilution (TD) Measurements

- Always try to make at least 3 TD measurements to calibrate PCCO.
- Wait until READY is displayed before injection
- Check that good C.O average values are obtained before saving as average.
- During a measurement, if p-IT or p-BT readings become invalid or go out of range the averaging screen will disappear. Check that p-IT and p-BT are in range in order to restart the measurement.
  [p-BT range: -3 to -31 °C (27 to 88 °F), p-IT range: 25 to 43 °C (77 to 109 °F)]

Cables

- Use of good cables is very important. Always inspect the cables before use. Check for bent or damaged cable pins before use.
- Make sure the cable connections are free from moisture or other saline deposits. Moisture could cause the intermittent errors in measurements, which may be harder to understand and troubleshoot.
- Make sure the ART catheter connection is done carefully. Avoid force when making this connection. Rotate it gently to align with the notch. Bent or shorted pins in the connector could cause loose or no connection affecting the measurements.

General measurement problems

If, after trying the suggestions above, you still experience problems with the measurements, exit the p-CO Averaging screen. Rectify possible problems with respect to injectate or blood temperature based on above suggestions before restarting a TD measurement.

Status Messages

Message	Possible Cause	Suggested Action
PiCCO: Ht/Wt/ Sex/Catheter Position?	The patient's height, weight, sex, and/or catheter position information was not entered.	Enter the height and weight information. **WARNING: The correct patient category and the correct input of height, weight, sex and catheter position is mandatory for the accuracy of the displayed parameters and for the correct indexing of parameters. Confirm that the selections are accurate.**
PiCCO: Calibration Failed	• PiCCO calibration failed (p-CO out of range) • Static, unstable, or invalid ART pressure • Error in bolus injection due to p-IT invalid or out of range. **NOTE:** For successful PiCCO calibration, always perform TD measurements with valid arterial pressure values.	• Check the pressure measurement and retry calibration. • Verify the valid pressure is displayed before performing thermodilution. • Check the pressure line and transducer on air bubbles. • Make sure the arterial catheter is correctly positioned. • Check all connections from the catheter to the PiCCO pod.
PiCCO Blood Temp Sensor Failure	Sensor accessory malfunction (ART blood temp sensor failure/ malfunction).	• Check the connections. • Check the expiration date of catheter. • Disconnect and examine the catheter or cable. • Replace the catheter, if necessary. • Check the patient.
P-CO: p-BT Out of Range	The blood temperature (p-BT) is out of range (high/low).	
P-CO: Time Out	The thermodilution curve is longer than 90 seconds. • The thermistor of arterial catheter defective/ malfunctioning • The arterial thermodilution cable is loose or defective • The injection is outside of the central veinous catheter • Unlikely high thermal volume • Unlikely low CO	• Change the arterial catheter • Check the connection of temperature interface cable and arterial thermodilution cable. If necessary, change the cable. • Check the stopcocks and make sure the injectate is injected in the CV-line. • Check the patient and treat, if necessary
ART/CVP: Please Check Zero	Zero required (always zero before calibration).	• Zero the transducer from the menu selection • Press the zero (→0←) fixed key.
ART/CVP: Zero Accepted	ART/CVP zeroing is completed.	Informational message; no action required

Message	Possible Cause	Suggested Action
ART/CVP: Did Not Zero	Transducer zeroing failed because of: • Excessive signal noise • A non-static waveform	• Keep all tubing motionless, then rezero. • Change the transducer. • Check the stopcock, then rezero.
ART/CVP: Did Not Zero - Offset Error	Transducer zeroing failed because the static pressure was too high or too low.	• Rezero the transducer. • Loosen and retighten the transducer dome, then rezero the transducer. • Replace the transducer and rezero.
PiCCO: Unknown Catheter	Unknown/unsupported catheter type is being used.	• Unplug the unknown catheter and replace with the correct catheter type (see “Precautions” on page 27-6.)
PiCCO: ART Catheter Unplugged	• The arterial catheter is unplugged. • Injectate probe thermistor open circuit.	Replug the catheter/cable. **NOTE:** If the ART catheter is disconnected then re-connected, TD values are restored and pulse contour values are updated.
PiCCO: Cal Required **NOTE:** This message will continue to display until a successful PiCCO calibration with a valid ART pressure value is completed.	Thermodilutions were performed, then the ART pressure transducer was connected.	• Check the transducer and connections. • Reconnect and recalibrate, if necessary, with a valid ART pressure. • Replace the transducer, if necessary.
ART/CVP Transducer disconnected	The ART/CVP pressure transducer has been disconnected.	• Check if necessary transducer and connections. • Reconnect, if necessary, and rezero. • Replace the transducer, if necessary.
P-CO Check Injectate Probe	• The injectate probe is disconnected. • Injectate probe thermistor open circuit/malfunction. • The p-IT value is out of range.	• Make sure the probe is connected properly and repeat the measurement. • Check the cable and/or the injectate temperature sensor housing. • Make sure the injectate temperature housing is not exposed to extraneous warming source (for example warming blanket). • Change the sensor cable and/or injectate temperature housing, if necessary.
PiCCO Injectate probe Failure	• The injectate temperature sensor cable is loose or defective. • The injectate temperature sensor housing is defective.	• Make sure the probe is connected properly and repeat the measurement. • Check the cable and/or injectate temperature sensor housing. • Change the sensor cable and/or injectate temperature housing, if necessary.

Message	Possible Cause	Suggested Action
P-CO: Change to Iced Injectate	• Tinjectate > Tblood • The injectate is warmer than 12 °C (53.6 °F) and EVLWI > 10	• Use iced injectate and repeat the measurement. • Make sure the injectate temperature housing is not exposed to extraneous warming source (for example, warming blanket).
P-CO: Inject Faster than 10 sec	The injection was done too slowly (derived length of injection >10 sec).	Repeat the injection. Inject rapidly and smoothly.
P-CO Injection Error	Error in bolus injection (injection too short < 0.5 seconds).	
P-CO Baseline Error	The baseline curve did not return to baseline (unstable baseline).	• Minimize the patient motion/movement. • Stabilize the patient temperature (stop the infusion, if necessary). • Change the arterial catheter. • Check the connection of the temperature interface cable and the arterial thermodilution cable. • Change the cables, if necessary. • Check for possible error source, such as infusion pumps, warming blankets, etc. • Wait for *READY* message to display, then repeat the measurement. If message persists, replace the defective components.
PCCO > UL/< LL	The PCCO is value above upper/below lower limit.	• Check the patient and treat, if necessary. • Change the alarm limits as appropriate. • Check the connections.
PCCO Out of Range (High/ Low)	The PCCO parameter value is out of range (high/low).	• Check the patient and treat, if necessary. • Check the connections and settings. • Retry.
PCCI > UL/< LL	The PCCI value is above the upper/below the lower limit.	• Check the patient and treat, if necessary. • Change the alarm limits as appropriate. • Check the connections.
PCCI Out of Range High	The PCCI parameter value is out of range (high).	• Check the patient and treat, if necessary. • Check the connections. • Retry.
C.O. already in use	PiCCO pod and C.O. via Hemo pod connected simultaneously. **NOTE:** Hemo pod can be used in conjunction with PiCCO pod for pressure measurements only, not for C.O.	Disconnect the C.O. sensor from the hemo pod and use the PiCCO pod only for C.O.
Duplicate Device Connected	Multiple PiCCO pods are connected.	Disconnect the duplicate pod.

Message	Possible Cause	Suggested Action
PiCCO: Pod Failure	PiCCO pod hardware failure.	• Immediately remove sensor from patient. • Check sensor; check pod and pod connections. Replace sensor or pod, if necessary. • Plug and unplug the pod. • Call your hospital's technical personnel or DrägerService.
PiCCO: Pod Disconnected	The PiCCO pod is disconnected.	Check the cable and connection and replace, if necessary.
<xx> Transducer Failure **NOTE:** This status message will not be available when backwards compatibility is enabled.	Transducer failure (IBP transducer electrically open or shorted) or electrical interference due to electro-surgery equipment. **NOTE**: This error condition will not be displayed if PICCO pod part number MS17441 hardware revision 4 or lower is used.	Check the transducer cable and/or transducer and replace if necessary. Make sure there is no direct electrical interference present.
NOTE: <xx> represents the IBP parameter label associated with the displayed message.		

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28 Body Temperature

Overview

The monitor measures core and body surface temperature by means of a temperature probe connected to the MultiMed, NeoMed, Hemo2, or Hemo4 pod (the HemoMed pod does not measure body temperature). Blood temperature is also measured if a hemodynamic pod is used to acquire cardiac output data (see page 16-4 for more information).

The NeoMed, Hemo2, Hemo4 pods and the MPod – Quad Hemo are each equipped with two temperature probe connectors. The MultiMed pod has one temperature probe connector; however, a Y-cable allows it to also monitor two temperature signals. All clinical thermometer readings are direct measurement.

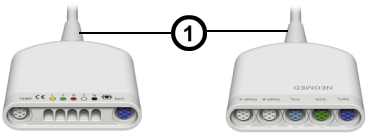
NOTE: The temperature feature and temperature probes should be calibrated at least every two years by qualified personnel to obtain accuracy of ± 0.1 ºC.

NOTE: Use rectal/esophagal temperature probe sheaths to cover internally placed temperature sensors.

To measure body or blood temperature, connect the monitor to the appropriate device as shown below.

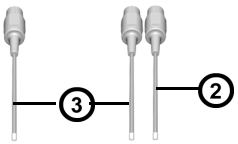
Follow the instructions on page 16-4 to monitor blood temperature with one of the hemodynamic pods. Use the MultiMed or NeoMed to measure body temperature.

HemoMed Pod

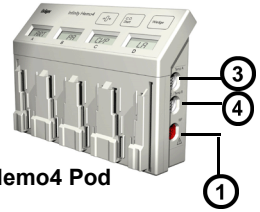


MultiMed 5/6 Pod NeoMed Pod

Hemo2 Pod

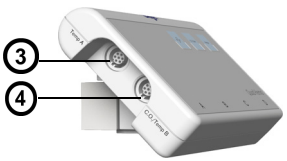


Temperature probe(s)



Hemo4 Pod

1	To monitor
2	Temp B
3	Temp A
4	C.O/Temp B
5	C.O.



MPod – Quad Hemo

Temperature Display

All temperature readings appear on the main screen according to their position in Parameter Priority (see page 2-6). The following display conventions govern temperature labels and values.

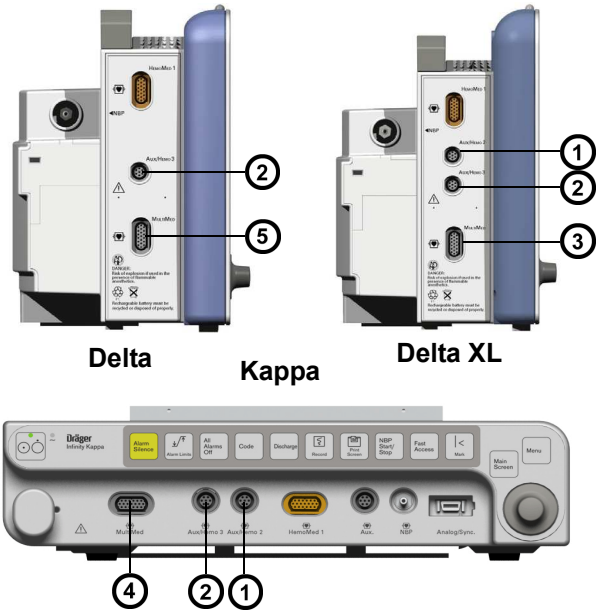
The monitor displays temperature values in one parameter box for each pod connector (MultiMed, Hemo2/Hemo4). The variables “a” and “b” denote the first or second probe connector from the MultiMed with Y-cable, NeoMed, Hemo2, Hemo4 pod or the MPod – Quad Hemo. When acquired via the MultiMed or NeoMed pod, temperature signals are displayed as Ta <value> or Tb <value>. (If you are using a MultiMed without a Y-cable, only Ta displays a value.)

MultiMed temperature reading (no Y-cable)

Hemo2/4, MPod - Quad Hemo temperature reading

When monitoring temperature using the Hemo2, Hemo4 pod, or the MPod – Quad Hemo, temperature values are further identified according to where they are connected to the monitor. The temperature value corresponding to the device hooked up to the Aux/Hemo2 PodCom connector is labeled T2a or T2b, while the temperature

value corresponding to the device hooked up to the Aux/Hemo3 connector is labeled T3a or T3b.



1	T2 (a or b)
2	T3 (a or b)
3	T (a or b) w/ Y-cable
4	T (a or b)
5	Ta, or T (a or b) w/ Y-cable

NOTE: The second PodCom connector is optional on the Delta and standard on the Delta XL.

When two temperature probes are connected, the monitor displays either the corresponding temperature values (for example, T2a and T2b) or one temperature value with a delta temperature value (for example, T2a and ΔT2). The second value in either case appears in the bottom of the temperature parameter box.

Temperature Setup

To access the temperature setup menu

- Click on the desired temperature parameter box (if displayed);

or

1. Press the **Menu** fixed key.
2. Click on **Patient Setup**.
3. Click on **Parameters**.
4. Click on **TEMP**, **TEMP2** or **TEMP3**, depending on which temperature signal you wish to monitor (see page 28-4).

The TEMP setup menu displays only two items:

- TEMP display – Configures the bottom half of the parameter box to display either the reading of the second temperature probe (b) or the difference between the first probe's reading and the second (DT, the delta value).
- TEMP alarms – Accesses temperature alarm settings on the Alarm Limits table (see page 5-8).

Status Messages

Message	Possible Cause	Suggested Action
> # < #	The temperature exceeds the upper or lower alarm limits.	• Check the patient and treat, if necessary. • Check equipment and replace if necessary.
Out of Range (High) *Out of Range (Low)*	The temperature value is greater or less than the measuring range.	
Can't Derive ΔT(#)	The cable is defective or unplugged.	• Check equipment and replace if necessary. • Connect the second temperature probe.
Unplugged		Check the equipment and replace if necessary.
H/W Failure	Temperature circuitry failure.	Contact DrägerService.

29 Peripheral Devices and Associated Software

Overview

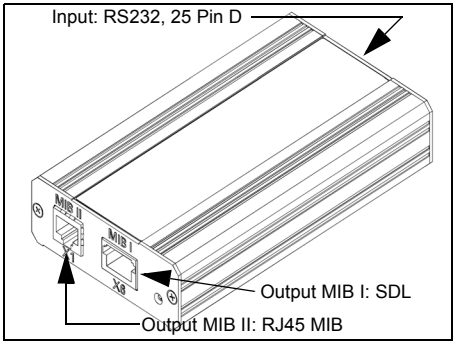
This chapter describes interfaces that can be used to connect the bedside monitor to peripheral devices such as the Edwards/Baxter Vigilance monitor, the Aspect A-2000 BIS monitor, and supported ventilators and anesthesia systems. This chapter also describes the Open Lung tool and the Independent Surgical Display.

A monitor with compatible software displays waveforms and parameter values acquired from peripheral devices via either the general Medical Information Bus (MIB) interface protocol or via proprietary interface protocols. These protocols (especially the MIB protocol), significantly expand the monitor's capabilities. The MIB protocol requires the monitor to be connected to an Infinity Docking Station (IDS) since MIB functions are not available when the monitor is in DirectNet mode.

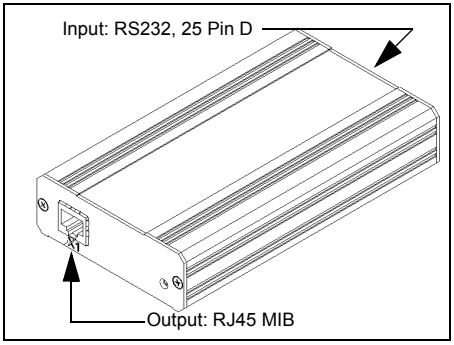
Parameter values acquired from peripheral devices are trended in graphical and tabular format. When you modify the parameter display, a message identifies the trend data that will be lost if the trend storage capacity is reached.

In the list of parameters available from specific peripheral devices later in this chapter, an asterisk (*) identifies parameters that duplicate the monitor's parameters.

Consult device documentation for details on setup and operation.



MIB II Duo Protocol Converter
(PN: 72 56 949)



MIB II Protocol Converter
(PN: 72 56 931)

The following devices require an MIB interface protocol for display on the bedside monitor.

WARNING: The following table lists all of the peripheral devices and related software versions that Dräger has validated. Dräger cannot make any claim for the reliability of the data for subsequent or previous software versions or for any devices that have not been validated. In the interest of patient safety and device performance, do not connect devices to the monitor which have not been approved by Dräger. The hospital is responsible for contacting Dräger to determine the compatibility and warranty status of any connection made to another manufacturer's medical devices.

Device	Supported Software Version
Dräger Cato	Tested to published protocol Medibus anesthesia devices 3.00/4.00
Dräger Julian	
Dräger Cicero (B, C, EM)	
Dräger Julian Primus anesthesia device	
Dräger Zeus	Tested to published protocol Medibus for Zeus 3.n/4.n
Dräger Zeus Infinity Empowered **NOTE**: With IDS version 5.1 no MIB converter is required.	Tested to published protocol Medibus for Zeus Infinity Empowered 1.n
Dräger Fabius CE	Tested to published protocol Medibus anesthesia devices 4.00
Dräger Fabius GS	Tested to published protocol Medibus anesthesia devices 4.00
Dräger Tiro	
Dräger Primus **Note**: This device is not sold in the United States.	Tested to published protocol Medibus for Primus 1.n/2.n with software version 4.03.
Dräger Apollo	Tested to published protocol Medibus 1.n, 2.n, and 3.n
Dräger Narkomed IIC	1.30
Dräger Narkomed IV	2.01
Dräger Narkomed 6000	4.01
Dräger Narkomed 6400	4.01
Dräger Babylog ventilator	5.00
Dräger Evita 1 ventilator	Tested to published protocol Medibus Intensive Care 3.00/4.00
Dräger Evita 2 ventilator	2.00
Dräger Evita 4 ventilator	03.21
Dräger Evita XL ventilator	05.00

Device	Supported Software Version
Dräger Evita Infinity V500	Tested to MIB II protocol converter and Medibus software protocol 1.20
Dräger Savina ventilator	02.10
Hamilton Galieo ventilator	GMP02.11a
Siemens Servo^{i}	1.00
Siemens SV900	not applicable
Siemens SV300	2.00
Puritan Bennett 7200 AE ventilator	SP1/PM Revision .005
Taema Horus ventilator	3.055/mdv-1.170
Puritan Bennett 840 ventilator	4-070212-85-D
Aspect A-2000 BIS Monitor	1.06, 2.21, 2.10, 3.21
Ohmeda 7900 / Modulus CD anesthesia machine	2.8
Abbott Q2 Continuous Cardiac Output/SVO_2	4.00
Abbott Q2+ Continuous Cardiac Output/SVO_2	4.32
Abbott Oxy 3 SvO_2/CCO monitor	104
Edwards/Baxter Vigilance, Edwards/Baxter Vigilance II SvO_2/CCO monitor	4.42, 5.02
Radiometer MicroGas 7650 Monitor **NOTE:** Works only with MIB II hardware	10.02
VIA V-ABG-1 blood gas monitor	1.18JT
OSI OpticalCAM blood gas monitor	OSI 01838 Rev. C
AVL OPTI2 blood gas monitor	AOPX1.50ds
Viasys BEAR 1000® Ventilator	1003 3011
Viasys BEAR Cub Ventilator	1003 3011
Dräger Infant Incubator C2000/C2000e	2.19
Dräger Caleo Infant Incubator	2.11
Dräger Babytherm Infant Warmer	1.00
GE Aestiva/Aspire 7100 anesthesia machine	1.2
GE Aestiva/Aspire 7900 anesthesia machine	7.4
Somanetics INVOS Cerebral/Somatic Oximeter 5100C	40.07.07

Precautions

See sections “Electrosurgery” on page 17 and “General Electrical Safety” on page 14 for general precautions regarding device operation.

WARNING:

- **To reduce the risk of patient injury due to electrical shock, always position the external device connectivity kit (the kit) as far from the patient as possible. Make sure that any cables or other conducting devices do not come in contact with the patient. The kit is electrically isolated from the monitor and any peripheral devices, but the kit’s enclosure is not electrically isolated from the peripheral device itself.**
- **The monitor does not annunciate alarms for external device parameters.**

CAUTION:

- *Data transferred using the Medibus protocol is for information only and is not intended as a basis for diagnostic or therapeutic decisions. Always refer to the primary data source for these decisions.*
- *Connecting peripheral devices is supported via the device connection option's RS232 connection. Only connect peripheral medical devices to a patient monitor if those devices comply with the electrical safety requirements found in IEC 60601-1. Refer to the Electrical Safety section for information on how to connect devices safely.*

NOTE:

- The MIB II option will not work if a network cable is connected to it. Likewise the MIB II duo protocol converter will not work if it is connected to an IDS network connector.
- An RJ-45 cable can plug into the MIB II duo protocol convertor's X6 connector (MIB I output); however, this cable cannot be removed if it locks into place (the protocol convertor is unusable and must be returned for service if this occurs). Only remove the label that covers the X6 connector if the protocol converter is to be operated in MIB I mode.

Ventilation and Anesthesia Devices

NOTE: Refer to the Instructions for Use of the source device for detailed information on external parameter.

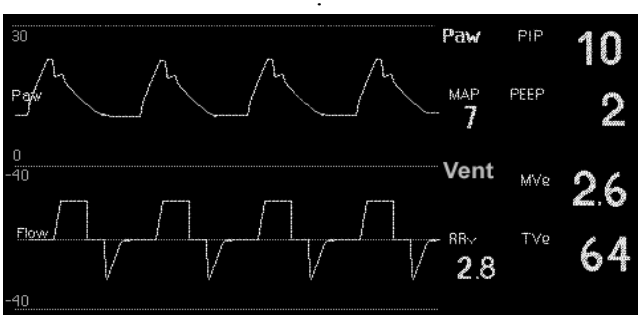
Refer to the Instructions for Use for your network devices such as an Infinity CentralStation, Innovian, Gateway, Symphony for a list of parameters transferred from the ventilator.

Refer to page 29-14 for detailed information on Primus, Zeus and Apollo anesthesia devices which also provide gas monitoring.

The bedside monitor uses the airway pressure (Paw) and the ventilation (Vent) parameter boxes and waveform channels to display ventilation parameter values, waveforms, and loops. Parameter values acquired from the ventilator are trended in graphical and tabular form.

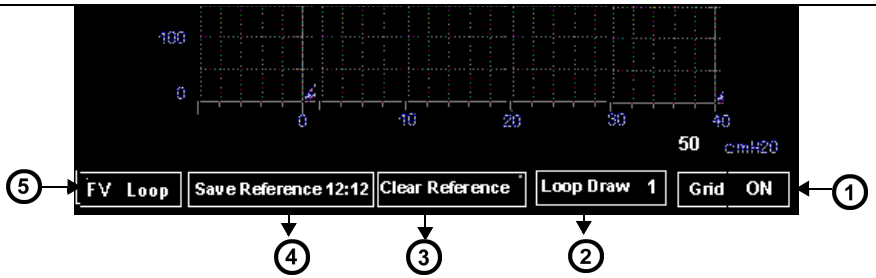
The ventilator provides the range and resolution for all parameters. Parameter settings, alarms, and error messages do not display on the bedside monitor; they are displayed on the network device instead.

The monitor displays a ventilator pressure waveform next to the Airway Pressure (Paw) parameter box and on a ventilator flow waveform next to the Flow/Volume (Vent) parameter box.



Loops

Pressure/Volume loops and Flow/Volume loops offer valuable information about the patient's response to mechanical ventilation. The monitor automatically erases older loops and replaces them with newer ones. The most recent loop is the brightest.You can save and display a Reference Loop, which serves as a useful point of analysis and comparison. Control buttons at the bottom of the Loop screen allow access to a variety of functions.



1	Display or hide grid	**4**	Save last completed loop with time stamp
2	Set number of loops displayed	**5**	Display Flow/Volume loop
3	Clear reference loop		

To access the loop display

1. Click on the **Paw** or **Vent** parameter box
2. Click on **PV Loop** to display the Pressure Volume Loop.
3. Click on **FV Loop** at the bottom of the Pressure/Volume loop screen to display the Flow/Volume loop.

You can view smaller loops on the main screen while continuing to display waveforms and parameter boxes:

1. Open the Paw/Vent setup menu as described above.
2. Click on **Split Screen.**
3. Click on **Ventilation.** The small loop display appears in the upper left corner of the screen.

NOTE: For more information on loop display and analysis, see chapter 22.

Supported Ventilator Parameters

The following table lists the parameters for all ventilators except Evita Infinity V500 whose parameters are listed separately on page 29-9.

NOTE: For information on calculating parameter values, see the documentation for the peripheral device you are using

CAUTION: *The parameter abbreviations on the bedside monitor may differ from those displayed on the ventilator (refer to the table on page 29-9).*

The bedside monitor displays pressure units in cmH_2O while the ventilator displays pressure units in mbar (1 cmH_2O being equal to 1 mbar approximately).

Parameter	Bedside monitor label	Bedside and Infinity network units of measure	Where displayed
Peak Airway Pressure	PIP	cmH_2O	• **Show All Parameter**s screen • **Paw** (Flow and Volume) parameter box • Vent view (Infinity CentralStation)
Mean Airway Pressure	MAP	cmH_2O	
Positive End Expiratory Pressure	PEEP	cmH_2O	
Minute Volume (Expired)	MVe	L/min	• **Show All Parameter**s screen • **Vent** (Flow and Volume) parameter box • Vent view (Infinity CentralStation)
Respiration Rate (Breathing Frequency)	RRv	bpm	
Tidal volume	TVe	l	
Plateau (Pause) Pressure **NOTE**: Pause appears blank on the monitor for Fabius GS.	PAUSE	cmH_2O	• MIB **Show All Parameters** screen • Vent view (Infinity CentralStation)
Inspired:Expired Ratio	I:E	Not applicable	
Inspired Oxygen	iO_2	%	
Minute Volume (Inspired)	MVi	L/min	
Inspired Tidal Volume	TVi	l	
Inspiration Time	InspT%	sec	
Spontaneous Minute Ventilation [1]	MVe s	1/min	
Spontaneous Respiration Rate (Spontaneous Breathing Frequency) [1]	RRs	breaths/min	

Parameter	Bedside monitor label	Bedside and Infinity network units of measure	Where displayed
Dynamic Compliance[1]	Cdyn	L/bar	• MIB **Show All Parameters** screen • Vent view (Infinity CentralStation)
Airway Resistance[1]	Raw	mbars/L/s	
[1]Available for Evita/Evita XL only.			

Evita Infinity V500 Ventilation Parameters

Parameter	Evita Infinity V500 Label	Bedside monitor label[1]	Evita Infinity V500 units of measure	Bedside and Infinity network units of measure	Where displayed
Peak Airway Pressure	PIP	PIP	mbar	cmH_2O	• **Show All Parameters** screen • **Paw** (Flow and Volume) parameter box • Vent view (Infinity CentralStation)
Mean Airway Pressure	Pmean	MAP	mbar	cmH_2O	
Positive End-Expiratory Airway Pressure	PEEP	PEEP	mbar	cmH_2O	
Minute Volume	MV	MVe	L/min	L/min	• **Show All Parameters** screen • **Vent** (Flow and Volume) parameter box • Vent view (Infinity CentralStation)
Breathing Frequency RRTotal	RR	RRv	1/min	br/m	
Tidal volume	VT	TVe	mL	mL	
Plateau Airway Pressure	Pplat	Pause	mbar	cmH_2O	• **Show All Parameters** screen • Vent view (Infinity CentralStation)
I:E (Expiratory Component)[1]	E (I:E)	I:E E-Part	Not applicable	Not applicable	
I:E (Inspiratory Component)[1]	I (I:E)	I:E I-Part	Not applicable	Not applicable	

Parameter	Evita Infinity V500 Label	Bedside monitor label[1]	Evita Infinity V500 units of measure	Bedside and Infinity network units of measure	Where displayed
Inspired Oxygen (FiO_2)	FiO_2	iO_2	%	%	• **Show All Parameters** screen • Vent view (Infinity CentralStation)
Inspiratory Tidal Volume	VTi	TVi	mL	mL	
Spontaneous Minute Volume	MVspon	MVe s	L/min	L	
Spontaneous Breathing Frequency	RRspon	RRs	1/m	br/m	
Dynamic Compliance	Cdyn	Cdyn	mL/mbar	mL/cmH_2O	
Resistance	R	Raw	mbar/L/s	cmH_2O/L/s	
[1] The expiratory/inspiratory component) are displayed in the Show all Parameters screen.					

Quick Reference Table – Paw/Vent Setup Menu

The airway pressure and Flow/Volume parameter boxes are configured on a common setup menu. To access this menu, click on the **Paw** or **Vent** parameter box.

Functions on the Paw/Vent menu are listed in the following table. To access or execute ventilator functions, select a menu item, scroll to the appropriate setting and click.

Menu Item	Description	Available Settings
Show All Parameters	Lists all ventilator parameters and current values (read-only list displays values for PIP, MAP, PEEP, TVe, MVe, RRv, Pause, I:E, InspT%, iO2, TVi, MVi)	Not applicable
Open Lung Tool	Accesses Open Lung Tool screen (see pages 29-12)	Not applicable
PV Loop	Displays Pressure/Volume Loop	Not applicable
Paw Scale	Sets or changes size of the displayed airway pressure (Paw) waveform	• **10, 15, 20, 25, 30, 40, 50, 60, 80, 100, 120 cmH20** **NOTE**: The upper scale value is selected. The monitor automatically selects the lower scale value as indicated above.

Menu Item	Description	Available Settings
Flow Scale	Sets size of the displayed Flow waveform	• **5, 10, 15, 20, 35, 50, 100, 150, or 200 L min** • **NOTE**: The upper scale value is selected. The monitor automatically selects the lower scale value as indicated above.
Vol Scale	Sets size of currently displayed Volume waveform	• **5, 10, 25, 50, 75, 100, 250, 500, 750, 1000, or 1500 ml**
Split Screen	Configures main screen to display ventilator or trend data	• **OFF** • **60 Min Trends** • **10 Min Trends** • **Ventilation**
Vent Mini Trend	Determines parameter displayed when Split Screen is set to 10 Min or 60 Min Trends **NOTE:** For a list of parameters displayed via the etCO2/Respiratory Mechanics pod, see page 22-16.	**RRv, MVe, MVi, PIP, TVe, TVi**
Loop Draw	Sets number of loops displayed	• **1** • **4**
Clear Reference	Clears reference loop from screen	Not applicable

Open Lung Tool

For each breath cycle the monitor detects, it displays three channels of trended data on the Open Lung screen, following the color scheme outlined in the following table.

Display channel	Parameter	Definition	Color
Trend Graph 1	PIP or Pause	Peak Inspiratory Pressure or Pause Pressure	Blue
	PEEP	Positive End-Expiratory Pressure	White
Trend Graph 2	TVi *	Inspired Tidal Volume	Blue
	TVe *	Expired Tidal Volume	White
Trend Graph 3	Cdyn *	Dynamic Compliance (ventilators, Primus and Apollo anesthesia machines)	White

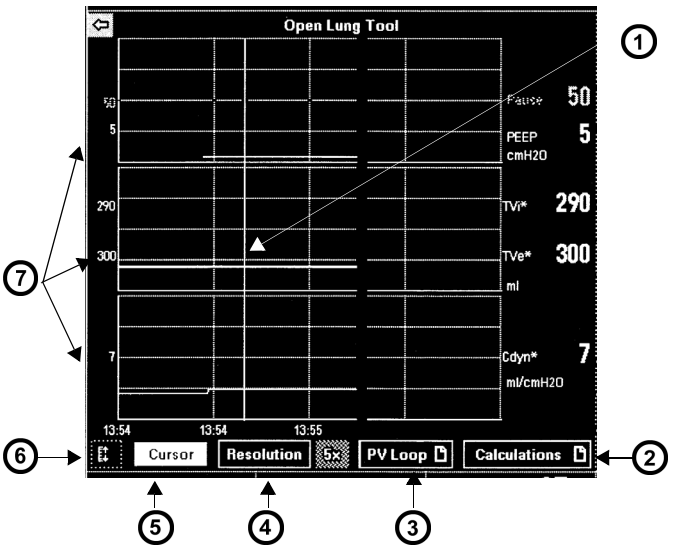
To access the Open Lung Tool

1. Press the **Fast Access** fixed key on the front of the monitor.
2. Highlight **Open Lung Tool** and click.

NOTE: The Open Lung Tool is available only when a supported ventilator or anesthesia machine is connected to the monitor via MIB.

Open Lung tool - Ventilator/Anesthesia Machines

This Open Lung Tool presents data that comes from a Dräger Evita 2D/4/XL, Savina, or Siemens SV300/300A ventilator and Primus or Apollo anesthesia machines.



1	Cursor	**5**	Click and scroll to highlight trend values of individual breaths
2	Open Calculations	**6**	Adjust scale
3	Display PV Loop	**7**	Cursor time values
4	Enlarge and diminish OLT		

Primus, Zeus and Apollo Anesthesia Devices

The Delta/Delta XL/Kappa monitor displays data from the devices listed at the beginning of this chapter.

When the monitor is connected to an Infinity Primus or Apollo anesthesia machine, it displays the concentrations of CO_2, O_2, N_2O, and of anesthetic agents (Halothane, Isoflurane, Enflurane, Sevoflurane, or Desflurane). The table on page 29-15 lists all displayed parameters.

NOTE: The Infinity Primus and the Zeus anesthesia machines are not sold in the United States.

The monitor uses the multigas parameter box and waveform channels to display parameter values, waveforms, and loops. The agent parameter box displays agent concentrations for anesthetic gases.

Parameter values acquired from the anesthesia machine are trended in graphical and tabular form.The anesthesia machine provides the range and resolution for all parameters.

NOTE: The bedside monitor displays the Minimum Alveolar Concentration (MAC*) values only if available and sent by the Infinity Primus or Apollo anesthesia machine.

Parameter settings, alarms, and error messages are not displayed on the monitor, they are displayed on the network device such as an Infinity CentralStation, Innovian, Gateway, Symphony instead. See the Instructions for Use for your network device for the list of parameters transferred from the anesthesia machine. Refer to the Primus and Apollo instructions for Use for details on calculating parameter values.

Supported Primus, Apollo, and Zeus Parameters

Refer to the table on page 29-3 for supported MEDIBUS software protocol versions.

Parameter	Anesthesia device label	Anesthesia device units of measure	Bedside and Infinity network label[1]	Bedside and Infinity network units of measure	Where displayed
Peak Inspiratory Pressure	Pinsp.	mbar	PIP	cmH2O	• **Show All Parameters** screen • **Paw** (Flow and Volume) parameter box Vent view (Infinity CentralStation
Mean Airway Pressure	MAP	mbar	MAP	cmH2O	
Peak End Expiratory Airway Pressure	PEEP	mbar	PEEP	cmH2O	
Respiratory Minute Volume	MV	L	MVe	L/min	• **Show All Parameters** screen • **Vent** (Flow and Volume) parameter box • Vent view (Infinity CentralStation)
Respiratory Rate	Freq.	1/min	RRv	br/m	
Expired Tidal Volume	VTEXP	mL	TVe	mL	
Pause Pressure	PLAT	mbar	Pause	cmH2O	• **Show All Parameters** screen • Vent view (Infinity CentralStation)
Inspired O_2	inO2	%	iO2	%	
Expired O_2	etO2	%	etO2	%	• Vent view (Infinity CentralStation)
Inspired CO_2	inCO2	mmHg	iCO2*	mmHg	
end-Tidal CO_2	etCO2	mmHg	etCO2* [2]	mmHg	
Respiratory Rate (CO_2)	RRc	1/min	RRc	br/m	
Inspired N_2O	N2O	%	iN2O	%	
Expired N_2O	etN2O	%	etN2O	%	

Parameter	Anesthesia device label	Anesthesia device units of measure	Bedside and Infinity network label[1]	Bedside and Infinity network units of measure	Where displayed
Compliance	CMP	mL/mbar	Cdyn	L/cmH2O	• Vent view (Infinity CentralStation)
Expired MAC (minimum alveolar concentration)- see Note	exp. MAC	none	MAC*	none	
Inspired Halothane	insp. Hal.	%	i HAL	%	
Expired Halothane	exp. Hal.	%	et HAL	%	
Inspired Enflurane	insp. Enf.	%	i ENF	%	
Expired Enflurane	exp. Enf.	%	et ENF	%	
Inspired Desflurane	insp. Des.	%	i DES	%	
Expired Desflurane	exp. Des.	%	et DES	%	
Inspired Sevoflurane	insp. Sev.	%	i SEV	%	
Expired Sevoflurane	exp. Sev.	%	et SEV	%	
Inspired Isoflurane	insp. Iso.	%	i ISO	%	
Expired Isoflurane	exp. Iso.	%	et ISO	%	
Note: The source for the etCO2* parameter is the Scio module (see chapter 23 for details.)					

SvO2/CCO Monitors

An SvO2/CCO monitor measures cardiac output and related hemodynamic parameters. This Dräger monitor accepts data via an MIB interface from an Abbott Q2 (Q2+) SvO2/CCO monitor or from the Edwards/Baxter Vigilance and Vigilance II SvO2/CCO monitors.

NOTE: The bedside monitor calculates the Body Surface Area (BSA) using the patient height and weight that was entered in the "Admit Patient" menu (see page 4-2). It uses this BSA value to calculate the Index parameters (for example, ICI, CCI, SVRI etc) for the Baxter MIB device. Although the Baxter device can calculate BSA internally and send ICI and CCI values to the monitor, the monitor will still calculate the index values based on its BSA.

The following table lists the parameters available for display.

Label	Parameters	Units	SvO2/CCO Monitor from
BT*	Blood Temperature	°C	Q2, Vigilance and Vigilance II
CCO	Continuous Cardiac Output	L/min.	Q2, Vigilance and Vigilance II
CCI	CCO Index	L/min./m^2	Vigilance and Vigilance II
ICO	ntermittent Cardiac Output	L/min.	Q2, Vigilance and Vigilance II
ICI	ICO Index	L/min./m^2	Vigilance and Vigilance II
SaO2*	Arterial Oxygen Saturation	%	Vigilance and Vigilance II
SvO2	Venous Oxygen Saturation	%	Q2, Vigilance and Vigilance II
SVR	Systemic Vascular Resistance	dynes x sec x cm^{-5}	Vigilance and Vigilance II
SVRI	SVR Index	dynes x sec x cm^{-5} x m^2	Vigilance and Vigilance II
VO2	O_2 Consumption	mL/min	Vigilance and Vigilance II
DO2	O_2 Delivery	mL/min	Vigilance and Vigilance II
SV	Stroke Volume	mL	Vigilance II
SVI	SV Index	mL/m^2	Vigilance II
EDV	End Diastolic Volume	mL	Vigilance II
EDVI	EDV Index	mL/m^2	Vigilance II
ESV	End Systolic Volume	mL	Vigilance II
ESVI	ESV Index	mL/m^2	Vigilance II
EF	Ejection Fraction	%	Vigilance II
The Abbott Oxymetrix 3 SvO2/CCO monitor also provides CCO and SvO2. See the documentation accompanying that device for information about these parameters and their calculation.			

A waveform channel is not available for a SvO2/CCO monitor. You can, however, display up to three parameters and access a complete list of all parameters and their current values. Data acquired from an SvO2/CCO monitor is displayed in the SvO2 parameter box and is configured in the MIB SvO2/CCO setup menu.

To access the MIB: SvO2/CCO Setup menu

- Click on the SvO2 parameter box main screen.

or

1. Press the **Menu** fixed key.
2. Click on Patient Setup.
3. Click on Parameters.
4. Click on MIB SvO2.

Quick Reference Table – SVO2/CCO Setup

To access or execute SVO2/CCO functions listed below, select a menu item, scroll to the appropriate setting and click.

Menu Item	Description	Available Settings (Edwards/Baxter)	Available Settings (Abbott)
Show All Parameters	Displays a read-only list of continuously updated parameter values	**BT*, CCO, DO2, ICO, SaO2, SvO2, SVR, CCI, VO2, ICI, SVRI, SV, SVI, EDV, EDVI, ESV, ESVI, EF**	**SvO2, BT*, CCO, ICO**
Parameter 1 **Parameter 2** **Parameter 3**	Selects up to 3 parameters for display in SvO2 parameter box	**SvO2, SaO2, BT*, CCO, CCI, ICO, ICI, SVR, SVRI, DO2, VO2, SV, SVI, EDV, EDVI, ESV, ESVI, EF**	**SvO2, BT*, CCO, ICO**
SvO2 Mini Trend	Determines which SvO2 parameter is displayed when Split Screen (see page 2-10) is set to 10 Min or 60 Min Trends		

Radiometer MicroGas 7650 Monitor

NOTE: The Radiometer MicroGas 7650 monitor is only supported on MIB II hardware.

The Radiometer MicroGas 7650 monitor measures tpO_2 and $tpCO_2$ data. The data from the MicroGas 7650 monitor is acquired through an MIB interface. This data is displayed in a non-configurable tpO2 and tpCO2 parameter box.

A waveform channel is not displayed for the MicroGas 7650 monitor's data. There are also no site timers and no alarms.

The tpO_2 and $tpCO_2$ entries in the Alarm Limits menu disappear when the MicroGas 7650 monitor is connected. These entries do not reappear until this MIB device is removed and a tpO_2 and $tpCO_2$ pod is reconnected.

If you click the tpO_2 and $tpCO_2$ parameter box, the setup menu displays with the text "No user selections."

MIB tpO_2 and $tpCO_2$ trends appear in the trend/graph table similar to the tpO_2 and $tpCO_2$ pod parameters (see page 6-3).

Aspect A-2000 BIS® Monitor

The Bispectral Index (BIS) is a continuously processed EEG parameter that measures the state of the brain during the administration of anesthetics and sedatives. The Aspect Medical BIS monitor A-2000 is connected to the bedside monitor via an MIB interface. BIS and its associated parameters are trended and available for display on the bedside monitor.

NOTE: For information about the BIS parameters, see documentation provided with the Aspect A-2000 BIS Monitor.

Label	Parameters Supported	Units
BIS	Bispectral Index	-
SQI	Signal Quality Index	%
EMG	Electromyography Power (70-110 Hz)	dB
BSR	Burst Suppression Ratio	%

Label	Parameters Supported	Units
SEF	Spectral Edge Frequency	Hz
Power	Total Signal Power	dB

NOTES:
• SEF and Power are available for viewing only on the Show All Parameters display.
• EEG parameters do not alarm.

Independent Surgical Display (ISD)

The Independent Surgical Display (ISD) is a special interface that allows patient monitoring data to be shown on a remote video display. The Surgical Display Controller connects the patient monitor to the remote video display, and allows you to access and use the ISD interface.

A non-medical grade video display may be used if that display and the Surgical Display Controller are properly positioned. The video display must comply with IEC 60950 rather than IEC 60601-1 and the Surgical Display Controller must be kept out of the patient's vicinity.

To access the Surgical Display main menu

1. Press the **Menu** fixed key on the front of the bedside monitor.
2. Click on **Surgical Display**.

NOTE:

- The ISD only displays those parameters which appear on the ISD Parameter Priority screen. Set ISD parameter priority using the procedures described on page 2-6.
- The ISD does not display units of measure, alarm status (alarm limits or alarm off icons) or visual indications that alarms are occurring.
- There is a short (200 ms) but perceptible time delay between the waveforms shown on the bedside monitor and the corresponding waveforms on the Surgical Display.

The configuration of ISD menus does not affect other monitor functions, displays, menus, or setups.

Quick Reference Table – ISD Setup Menu

Menu Selection	Description	Settings
Review	Governs display of trend graphs on ISD screen.	• Click on **Remove Trend** to clear current trend graphs from Surgical Display screen. • Click on **10 Min Trends** to Configures graphs to monitor trends in 10 minute intervals. • Click on **60 Min Trends** to configure graphs to monitor trends in one-hour intervals. • Click on **Exit** to return to ISD Main menu.
The Surgical Display - Main Screen Submenu This submenu allows you to configure the following functions.		
Param Color Mode	Allows user to choose parameter colors from the monitor or to set different parameter colors for the ISD.	• Click on **Monitor** (default) to display the parameter colors as they are received from the monitor. • Click on **Manual** to select parameter colors that are different from the monitor settings. (See page 2-29 for information on Parameter Color selection.)
Display Mode	Determines whether the ISD Main Screen displays unconnected as well as connected parameters	• Click on **Manual** to display the parameters in the order you have determined, regardless of whether or not they are connected. • Click on **Auto** to display only connected parameters, which appear in the order selected on the Surgical Display's parameter priority table. • Click on **Monitor** to display parameters exactly as they are configured on the bedside monitor screen.
Parameter Priority	Displays all ISD parameters in their current order of priority and allows you to change the sequence	Set the ISD Parameter Priority using the procedures described in chapter 2, *Monitor Setup* (page 2-5).
Max. Channels	Sets the maximum number of waveform channels displayed on Surgical Display screen	Click on one of the following settings: • 4, 5, 6, 7, or 8.
ECG Channel	Determines the number and format of ECG waveforms displayed on ISD screen	Click on one of the following settings: • **ECG1** • **ECG 1 & 2** • **ECG 1 & 2 & 3**
Bottom Channel	Configures bottom channel of ISD screen to show waveform or parameter boxes	Click on one of the following settings: • **Parameters** • **Waveform**

Menu Selection	Description	Settings
The Surgical Display - Display Options Submenu Click on one of the following settings to configure the indicated functions:		
Pressure Overlap	When **ON**, the first set of adjacent invasive pressure waveforms (up to four, counting from the top) are overlapped in single channel. The bottom line is a common zero point. The top line is the upper limit of whatever scale was configured for each overlapped waveform. Parameter names and their assigned scales are listed across the top of the overlap channel.	• **ON** • **OFF**
1 Sec. Time Lines	Displays vertical markers at 1-s intervals in waveform channels	• **ON** • **OFF**
Pressure Grids	Determines setting for the pressure grids displayed in the invasive pressure channels.	• **None** • **25%** • **50%**
Video Resolution	Determines quality of the video display	• **High** • **Medium** • **Low**
Sweep Speed	Determines waveform sweep speed	• **Slow** • **Normal** • **Fast**
Parameter Display	Moves parameter boxes to right or left of the waveform display	• **RIGHT** • **LEFT**
The **Elapsed Time** Key		
Elapsed Time	Displays or removes up to two timers in bottom left corner of ISD screen **NOTE:** Click on timer to reset after displayed.	Click on one of the following settings: • **Begin Timer A** • **Begin Timer B** • **Remove Timer A** • **Remove Timer B**
The Surgical Display - Save/Restore Submenu This submenu allows you to configure the following functions.		
Restore Setup	Restores setup highlighted in second menu column	Click on the setting of your choice.
Save Setup	Saves setup highlighted in second menu column	Click on the setting of your choice.
Rename Setups	Accesses data entry screen	Name and rename ISD setups using the procedures described in chapter 2, Monitor Setup (page 2-5).
Last Saved/ Restored	Displays most recently saved or restored ISD setup	Not applicable
New Setup	Displays current ISD setup	Not applicable

MIB Status Messages

Message	Condition	Suggested Action
@ Out of Range	The MIB parameters displayed in the parameter box fall outside the monitor's processing range.	Check the patient and treat, if necessary.
MIB Disconnected	The connection between the external device and the monitor has been interrupted (after already having been connected).	Check the cable and reconnect it, if necessary.
Duplicate Device Connected	The monitor can accommodate only one MIB connection.	Make sure that only one MIB device is connected to the monitor.
Note: The variable @ stands for the parameter displayed next to the message.		

Dräger Infant Incubator C2000/C2000e

The monitor, when connected to a C2000/C2000e infant incubator via MIB, displays skin temperature, air temperature, humidity, oxygen levels and weight in a parameter box on the monitor.

NOTE:

- The C2000/C2000e Infant Incubator is only available in neonatal patient category.
- T1 skin and T2 skin are plotted on the same graphical trend channel.

Label	Parameters	Units
Tair	Air Temperature	°C (°F)
T1 skin & T2 skin	Skin Temperature	°C (°F)
Wt	Weight	g (oz)
R.H	Humidity	%
%O2	Oxygen	%

There are two parameter boxes associated with the incubator, each with the ability to display up to three parameters. The Incub1 parameter box appears by default when the device is connected. However, the user can select Incub1 or Incub2 separately from the parameter pick list depending on the number of parameter boxes selected in the menu selection.

To access the Infant Incubator: C2000/C2000e Setup menu

- Click on the Incub1/Incub2 parameter box main screen.

or

1. Press the **Menu** fixed key.
2. Click on **Patient Setup**.
3. Click on **Parameters**.
4. Click on **Incub1/Incub2**.

Quick Reference Table – C2000/C2000e Setup

To access or execute C2000/C2000e functions listed below, select a menu item, scroll to the appropriate setting and click

The Incub1 presents the following selections:

Menu Item	Description	Available Settings
Show All Parameters	Displays all parameters	
# Parameter Boxes	Select number of Parameter Boxes	**1** (default), **2** **NOTE:** • Incub2 Parameter box is not displayed on screen or in parameter priority list when the number of Parameter Boxes is set to 1 • When set to 2, the parameter box must be selected from the pick list to be displayed in the appropriate channel
Parameter 1	Selects up to 3 parameters for display in Incubator parameter box	**T1skin** (default), **T2skin**, **Tair**, **%O2**, **R.H.**, **Wt**, **None**
Parameter 2		**T1skin, T2skin**, **Tair**, **%O2**, **R.H.** (default), **Wt**, **None**
Parameter 3		**T1skin**, **T2skin**, **Tair** (default), **%O2**, **R.H.**, **Wt**, **None**
Incubator Mini Trend	Allows you to select parameters for display in mini trends (See page 6-7 for more information on mini trend display). **NOTE**: Both Incub1 & Incub2 can display a mini trend.	**T1skin** (default), **T2skin**, **Tair**, %**O2**, **R.H.**, **Wt**
Wt	This is a read-only field. Only the time, month, and day appears with the Weight label.	Not applicable

The Incub2 menu has the following selections.

Menu Item	Description	Available Settings
Show All Parameters	Displays all parameters	
# Parameter Boxes	Select number of Parameter Boxes	1, 2 (default) **NOTE**: Incub2 Parameter box is not displayed when the number of Parameter Boxes is set to 1
Parameter 1	Selects up to 3 parameters for display in Incubator parameter box	**T1skin**, **T2skin** (default), **Tair**, **%O2**, **R.H.**, **Wt**, **None**
Parameter 2		**T1skin**, **T2skin**, **Tair**, **%O2** (default), **R.H.**, **Wt**, **None**
Parameter 3		**T1skin**, **T2skin**, **Tair**, **%O2**, **R.H.**, **Wt** (default), **None**
Incubator Mini Trend	Allows you to select parameters for display in mini trends (See page 6-7 for more information on mini trend display). **NOTE**: Both Incub1 & Incub2 can display a mini trend.	**T1skin**, **T2skin**, **Tair**, **%O2** (default), **R.H.**, **Wt**
Wt	This is a read-only field. Only the time, month, and day appears with the Weight label	Not applicable

C2000/C2000e Status Messages

Message	Condition	Suggested Action
Duplicate Device Connected	Multiple devices are connected.	Make sure only one incubator is connected to the monitor.
Tair Out of Range	The Tair value is out of range.	• Check the patient and treat, if necessary. • Check the connections. • Unplug and reconnect the incubator. • Power-cycle the monitor or undock and redock the monitor. • Call the manufacturer.
T1skin Out of Range	The T1skin value is out of range.	
T2skin Out of Range	The T2skin value is out of range.	
Wt Out of Range	The weight value is out of range.	
R.H Out of Range	The R.H value is out of range (low).	
%O2 Out of Range	The %O2 value is out of range.	

Dräger Infant Incubator Caleo

The monitor, when connected to a Caleo infant incubator via MIB, displays skin temperature, air temperature, humidity, oygen levels and weight.

NOTE:

- The Caleo infant incubator is only available in neonatal patient category.
- T1 skin and T2 skin are plotted on the same graphical trend channel.

Label	Parameters	Units
Tair	Air temperature	°C (°F)
T1skin & T2skin	Skin temperature	°C (°F)
Wt	Weight	g (oz)
R.H	Humidity	%
%O2	Oxygen	%

There are two parameter boxes associated with the Incubator, each with the ability to display up to three parameters. The Incub1 parameter box appears by default when the device is connected. However, the user can select Incub1or Incub2 separately from the parameter pick list depending on the number of parameter boxes selected in the menu selection.

To access the Infant Incubator: Caleo Setup menu

- Click on the Incub1/Incub2 parameter box main screen.

or

1. Press the **Menu** fixed key.
2. Click on **Patient Setup**.
3. Click on **Parameters**.
4. Click on **Incub1/Incub2**.

Quick Reference Table – Caleo Setup

To access or execute Caleo functions listed below, select a menu item, scroll to the appropriate setting and click

. The Incub1 presents the following selections:

Menu Item	Description	Available Settings
Show All Parameters	Displays all parameters	Not applicable
# Parameter Boxes	Select number of Parameter Boxes	1 (default), 2 **NOTE:** • Incub2 Parameter box is not displayed on screen or in parameter priority list when the number of Parameter Boxes is set to 1 • When set to 2, the parameter box must be selected from the pick list to be displayed in the appropriate channel
Parameter 1	Selects up to 3 parameters for display in Incubator parameter box	**T1skin** (default), **T2skin**, **Tair**, **%O2**, **R.H.**, **Wt**, **None**
Parameter 2		**T1skin**, **T2skin**, **Tair**, **%O2**, **R.H.** (default), **Wt**, **None**
Parameter 3		**T1skin**, **T2skin**, **Tair** (default), **%O2**, **R.H.**, **Wt**, **None**
Incubator Mini Trend	Allows you to select parameters for display in mini trends (See page 6-7 for more information on mini trend display). **NOTE**: Both Incub1 & Incub2 can display a mini trend.	**T1skin** (default), **T2skin**, **Tair**, **%O2**, **R.H.**, **Wt**
Wt	This is a read-only field. Only the time, month, and day appears with the Weight label.	Not applicable

The Incub2 presents the following selections:

Menu Item	Description	Available Settings
Show All Parameters	Displays all parameters	
# Parameter Boxes	Select number of Parameter Boxes	1, 2 (default) **NOTE**: Incub2 Parameter box is not displayed when the number of Parameter Boxes is set to 1
Parameter 1	Selects up to 3 parameters for display in Incubator parameter box	**T1skin**, **T2skin** (default), **Tair**, **%O2**, **R.H.**, **Wt**, **None**
Parameter 2		**T1skin**, **T2skin**, **Tair**, **%O2** (default), **R.H.**, **Wt**, **None**
Parameter 3		**T1skin**, **T2skin**, **Tair**, **%O2**, **R.H.**, **Wt** (default), **None**
Incubator Mini Trend	Allows you to select parameters for display in mini trends (See page 6-7 for more information on mini trend display). **NOTE**: Both Incub1 & Incub2 can display a mini trend.	**T1skin**, **T2skin**, **Tair**, **%O2** (default), **R.H.**, **Wt**
Wt	This is a read-only field. Only the time, month, and day appears with the Weight label	Not applicable

Caleo Status Messages

Message	Condition	Suggested Action
Duplicate Device Connected	Multiple devices are connected.	Make sure only one incubator is connected to the monitor.
Tair Out of Range	The Tair value is out of range (high or low)	• Check the patient and treat, if necessary. • Check the connections. • Unplug and reconnect the incubator. • Power-cycle the monitor or undock and redock the monitor. • Call the manufacturer.
T1skin Out of Range	The T1skin value is out of range (high or low).	
T2skin Out of Range	The T2skin value is out of range (high or low).	
Wt Out of Range	The weight is out of range (high).	
R.H Out of Range	The R.H value is out of range (low).	
%O2 Out of Range	The %O2 value is out of range (low).	

Dräger Babytherm Infant Warmer

The monitor, when connected to a Babytherm Infant Warmer via MIB, displays skin temperature, mattress temperature and heater power in a parameter box on the monitor.

NOTE:

- The Babytherm Infant Warmer is only available in neonatal patient category.T1 skin and T2 skin are plotted on the same graphical trend channel.

Label	Parameters	Units
T1skin & T2skin	Skin Temperature	°C (°F)
Tmatt	Mattress Temperature	°C (°F)
HtrPwr	Heater Power	%

There are two parameter boxes associated with the warmer, each with the ability to display up to three parameters. The Warmer1 parameter box will be displayed by default when the device is connected, and will be listed at the end of the parameter priority list by default. However, the user will be able to select the warmer1 and/or warmer2 separately from the parameter pick list depending on the number of parameter boxes selected in the menu selection.

To access the Infant Warmer: Babytherm Setup menu

- Click on the Warmer1/Warmer2 parameter box main screen.

or

1. Press the **Menu** fixed key.
2. Click on **Patient Setup**.
3. Click on **Parameters**.
4. Click on **Warmer1/Warmer2**.

Quick Reference Table – Babytherm Setup

The Warmer1 menu has the following selections.

Menu Item	Description	Available Settings
Show All Parameters	Displays all parameters	
# Parameter Boxes	Select number of Parameter Boxes	**1** (default), **2** **NOTE:** • Warmer2 Parameter box is not displayed when the number of Parameter Boxes is set to 1 • When set to 2, the parameter box must be selected from the pick list to be displayed in the appropriate channel
Parameter 1	Selects up to 3 parameters for display in warmer parameter box	**T1skin** (default), **T2skin**, **Tmatt**, **HtrPwr**, **None**
Parameter 2		T1skin, **T2skin** (default), **Tmatt**, **HtrPwr**, None
Parameter 3		**T1skin**, **T2skin**, **Tmatt** (default), **HtrPwr**, **None**
Warmer Mini Trend	Allows you to select parameters for display in mini trends (See page 6-7 for more information on mini trend display). **NOTE**: Both Warmer1 and Warmer2 can display a mini trend.	**T1skin** (default), **T2skin**, **Tmatt**, **HtrPwr**

. The Warmer2 menu has the following selections.

Menu Item	Description	Available Settings
Show All Parameters	Displays all parameters	
# Parameter Boxes	Select number of Parameter Boxes	**1**, **2** (default) **NOTE**: Warmer2 Parameter box is not displayed when the number of Parameter Boxes is set to 1
Parameter 1	Selects up to 3 parameters for display in warmer parameter box	**T1skin**, **T2skin**, **Tmatt**, **HtrPwr** (default), **None**
Parameter 2		**T1skin**, **T2skin**, **Tmatt**, **HtrPwr**, **None** (default)
Parameter 3		**T1skin**, **T2skin**,**Tmatt**, **HtrPwr**, **None** (default)
Warmer Mini Trend	Allows you to select parameters for display in mini trends (See page 6-7 for more information on mini trend display).	**T1skin**, **T2skin**, **Tmatt**, **HtrPwr** (default)

Babytherm Status Messages

Message	Condition	Suggested Action
Duplicate Device Connected	Multiple devices are connected.	Make sure only one incubator is connected to the monitor.
T1skin Out of Range	The T1skin value is out of range (high or low).	• Check the patient and treat, if necessary. • Check the connections. • Unplug and reconnect the incubator. • Power-cycle the monitor or undock and redock the monitor. • Call the manufacturer.
T2skin Out of Range	The T2skin value is out of range (high or low).	
Tmatt Out of Range	The Tmatt value is out of range (high or low).	
HtrPwr Out of Range	The HtrPwr value is out of range (high).	

Somanetics INVOS Cerebral/Somatic Oximeter 5100C

The monitor, when connected to a Somanetics INVOS Cerebral/Somatic Oximeter 5100C via MIB, displays cerebral oximetry.

NOTE: The Somanetics INVOS Cerebral/Somatic Oximeter 5100C is available in adult and pediatric patient categories only.

Label	Parameters	Units
LrSO2	Regional Oxygen Saturation Index (left channel)	%
RrSO2	Regional Oxygen Saturation Index (Right Channel)	%
S1rSO2 & S2rSO2	Regional Oxygen Saturation Index - Somatic (1 & 2)	%
BL	Baseline saturation	%

There is one parameter box associated with the cerebral oximeter with the ability to display up to two parameters. The rSO2% parameter box appears by default when the device is connected.

To access the Cerebral Oximetry Setup menu

- Click on the rSO2% parameter box main screen.

or

1. Press the **Menu** fixed key.
2. Click on **Patient Setup**.
3. Click on **Parameters**.
4. Click on **rSO2%**.

Quick Reference Table – Cerebral Oximetry Setup

To access or execute cerebral oximetry functions listed below, select a menu item, scroll to the appropriate setting and click

The rSO2% menu has the following selections.

Menu Item	Description	Available Settings
Show All Parameters	Displays all parameters (including baseline index parameters and % change)	Not applicable
Parameter 1	Selects up to 2 parameters for display in rSO2% parameter box	**LrSO2, RrSO2** (default), **S1rSO2, S2rSO2**
Parameter 2		**LrSO2** (default), **RrSO2, S1rSO2, S2rSO2**
rSO2% Mini Trend	Allows you to select parameters for display in mini trends (See page 6-7 for more information on mini trend display).	**LrSO2, RrSO2** (default), **S1rSO2, S2rSO2**

Cerebral Oximetry Messages

Message	Condition	Suggested Action
Duplicate Device Connected	Multiple devices are connected.	Make sure only one MIB device is connected to the monitor.
MIB Disconnected	The connection between the external device and the monitor has been interrupted (after already having been connected).	Check the cable and reconnect it, if necessary.

30 Cleaning and Disinfecting

Overview

WARNING: Because of the danger of electric shock, never remove the cover of a device while it is in operation or connected to power.

CAUTION:

- *The use of more aggressive reagents such as undiluted alcohol should not be used on the monitor's glass because the glass may be damaged.*
- *Do not use disinfectants that contain phenol as they can spot plastics. Do not autoclave or clean accessories with strong aromatic, chlorinated, ketone, ether, or ester solvents. Never immerse electrical connectors or the NIBP connector.*

Clean and disinfect the product per hospital approved protocol. Agents tested by Dräger and shown to have no harmful effect on the materials utilized in the device include:

- Diluted alcohol - a 1:3 solution of alcohol should be used
- A 1:10 solution of sodium hypochlorite (household bleach)

Dräger makes no claims regarding the efficacy of the listed chemicals, their methods as a means for disinfecting, the ability of the agents to control infection, their environmental impact, safe handling, or any related precautions in their use. Refer to the information provided by the manufacturer of the cleaning solution for more information on these topics.

Monitor and Peripheral Devices

Moisture can damage the monitor and its peripherals (for example, the MultiMed pod, MultiGas module). Please read the following instructions carefully before you clean the base unit or peripheral devices. Special instructions for cleaning particular devices and accessories are provided in the following pages.

- Do not spray cleaning agents on the monitor or peripherals. Wipe them with a cloth moistened with a soap solution.
- Disinfect the surfaces with a gauze moistened with diluted alcohol.
- Dry thoroughly with a lint-free cloth.

CAUTION:

- *Do not immerse or rinse the monitor and its peripherals. If you accidentally spill liquid on a device, disconnect the unit from the power source. Contact your technical personnel regarding the continued safety of the unit before placing it back in operation.*
- *To avoid damaging the device, do not use sharp tools or abrasives. Never immerse electrical connectors in water or other liquids. Avoid letting fluids puddle near the edge of the screen while you are cleaning it.*

Patient Cables

1. Clean the patient cables with a gauze pad moistened with a soap solution.
2. Dry thoroughly with a lint-free cloth.
3. To disinfect patient cables, wipe the cables with a gauze moistened with diluted alcohol.
4. Dry thoroughly with a lint-free cloth.

CAUTION: *Do not use disinfectants that contain phenol as they can spot plastics. Do not autoclave or clean accessories with strong aromatic, chlorinated, ketone, ether, or ester solvents. Never immerse electrical connectors or the NBP connector.*

CAUTION: *Do not use excessive pressure or flex cables unnecessarily when cleaning. Excessive pressure can damage the cables.*

ECG

Reusable ECG Electrodes

Periodically clean the electrode cup with a toothbrush. Use a soft brush under running water to remove any gel residue. Wipe electrodes with a gauze pad moistened with a soap solution.

1. Disinfect electrodes by wiping with a cloth moistened with diluted alcohol.
2. Dry thoroughly with a lint-free cloth.

ESU Block

Do not immerse or rinse the ESU block. Clean it with a cloth moistened with soap solution. Read the operating instructions accompanying the ESU for additional information.

NBP

For proper Cleaning and Disinfecting of reusable cuffs please refer to the respective instructions for use accompanying the blood pressure cuffs.

IBP

Transducers

Always handle transducers and other pressure accessories with great care. Do not apply excessive pressure to a transducer diaphragm. Do not subject transducers to water, steam, hot air sterilization, ether, chloroform, or similar chemicals. Always protect the connector from moisture.

Consult the documentation supplied with your transducer for specific cleaning and sterilizing instructions.

Hemodynamic Pod Transducer Plate

Remove the transducer mounting plate from the front of the hemodynamic pod. Wash the plate with hot soapy water.

PiCCO Pod

1. Disconnect the pod from the monitor.
2. Clean the pod with a gauze moistened in enzymatic detergent or a solution of green tinctured soap and water. Dry thoroughly with a lint-free cloth.

CAUTION:

- *Do not use organic solvents.*
- *Do not sterilize by steam, heat, radiation or ETO.*
- *Do not use sharp objects.*
- *Make sure that NO liquid enters the pod.*

MPod – Quad Hemo

CAUTION: *Do not autoclave the MPod - Quad Hemo.*

Agents tested by Dräger and shown to have no harmful effect at the time of testing on the materials utilized in the MPod – Quad Hemo include:

— Isopropyl alcohol 40 %

CAUTION: *If using alcohol, it should only be a 40 % diluted solution. Higher concentrations could damage the device.*

— Compliance™; this cleaning agent may discolor soft plastic material

— Sporox II

— Dismozon pur

To clean the MPod – Quad Hemo

1. Disconnect the MPod – Quad Hemo from the bedside monitor.
2. Clean the MPod – Quad Hemo with a gauze pad moistened with soapy water or with an approved cleaning agent.
3. Dry thoroughly with a lint-free cloth.

To disinfect the MPod – Quad Hemo

1. Disconnect the MPod – Quad Hemo from the bedside monitor.
2. Disinfect the MPod – Quad Hemo with a gauze pad moistened with diluted alcohol.
3. Dry thoroughly with a lint-free cloth.

SpO_2

Clean reusable SpO_2 sensors by wiping them with a gauze pad moistened with a soap solution. To disinfect sensors, wipe using a cloth moistened with a 70% alcohol solution. Dry thoroughly with a lint-free cloth before applying to patient.

Reusable SpO_2 Sensor

Refer to the cleaning instructions and recommendations provided with the sensor.

Infinity Masimo SET SpO_2 Pod

1. To clean the Masimo SET SpO_2 pod disconnect it from the monitor.
2. Clean the pod with a gauze moistened in enzymatic detergent or a solution of green tinctured soap and water. Dry thoroughly with a lint-free cloth.

CAUTION:

- *Do not use organic solvents.*
- *Do not sterilize by steam, heat, radiation or ETO.*
- *Do not use sharp objects.*
- *Make sure that NO liquid enters the pod.*

Infinity Nellcor Oximax SpO_2 Pod

1. To clean the Nellcor Oximax SpO_2 pod, disconnect it from the monitor.
2. Clean the pod with a gauze moistened in enzymatic detergent or a solution of green tinctured soap and water. Dry thoroughly with a lint-free cloth.

CAUTION:

- *Do not use organic solvents.*
- *Do not sterilize by steam, heat, radiation or ETO.*
- *Do not use sharp objects.*
- *Make sure that NO liquid enters the pod.*

Trident (NMT) Pod

Clean the pod with a gauze moistened in a soap solution. Dry thoroughly with a lint-free cloth.

CAUTION:

- *Do not use any other cleaners or solvents.*
- *Do not autoclave.*

$etCO_2$ and Respiratory Mechanics

$etCO_2$ and $etCO_2$/Respiratory Mechanics Pod

Follow the general instructions on page 30-2 to clean the $etCO_2$ and $etCO_2$/ Respiratory Mechanics pods.

CAUTION: *Do not attempt to sterilize the $etCO_2$/Respiratory Mechanics pod by immersing it in liquids.*

Capnostat Sensor

Clean sensor surfaces, including the sensor windows, with a damp cloth. Never immerse the sensor or attempt to sterilize it. Dry with a lint-free cloth. Making sure the sensor windows are clean and dry before you use them.

Flow Sensor

Flow sensors are for single use only and therefore do not require cleaning.

Reusable Airway Adapter

1. Rinse airway adapters in a warm soapy solution, then soak them in a liquid disinfectant.
2. Dry with a lint-free cloth, making sure adapter windows are dry and free of any residue before they are used.

Sidestream Sampling Pump ($etCO_2$ only)

The $etCO_2$ module and pod contain a small pump that draws air from the nasal cannula, through the sidestream airway adapter, and out the exhaust port. Suggested cleaning procedures are outlined below.

WARNING: Used sampling tubing, T-connectors, and water traps could be contaminated and must be handled and disposed of with care. Infection hazard may be present. Dispose of these items in accordance with local regulations.

The following fluids are acceptable for cleaning:

- Isopropyl alcohol.
- A 5.25 % water solution (by weight) of sodium hypochlorite (bleach).

The following items are required for cleaning the $etCO_2$ module or pod:

- A 60 cc catheter-tip syringe.
- A 2-foot section of 1/8- or 3/16-inch tubing to drain off fluid after it passes through the $etCO_2$ pump.
- A receptacle to receive the fluid after it drains.

Cleaning the Sidestream Pump

CAUTION:

- *Always use a syringe to flush cleaning solutions through the pump as described in the instructions below.*
- *Do not attempt to use the sidestream sampling pump itself to move cleaning solutions through the system. This may cause accelerated wear on the pump bearings.*

To clean the sidestream pump

1. Set $etCO_2$ measurement mode to **Side** (for Sidestream monitoring).
2. Remove the $etCO_2$ module or pod from the monitor.
3. Remove all sidestream sampling tubing from the module or pod connectors.
4. Attach the section of 1/8- or 3/16-inch tubing to the exhaust (sidestream output) port on the module or pod, and run it to a drainage receptacle placed below the module.
5. Fill the 60cc catheter-tip syringe with cleaning fluid, and fix it to the sidestream input connector on the $etCO_2$ module or pod.
6. Flush the fluid slowly through the pumping system and out through the tubing connected to the exhaust port. Repeat two more times for a total of 180cc of fluid.
7. Remove the syringe. Leave remaining fluid in the pumping system for 30 minutes. This disinfects the system.
8. After 30 minutes, fill the syringe with distilled water and flush through the system. Repeat two more times.
9. Empty the syringe and use it to push several volumes of air slowly through the system. This clears most of the solution from the pump.
10. Repeat step 9 one or more times to make sure that as much fluid as possible has been cleared from the system.
11. Remove the syringe from the module or pod, but keep the drain tubing in place.

Drying the Sidestream Pump Subsystem

After you have cleaned and removed most of the fluid, it is important to dry the pump subsystem completely.

To dry the sidestream pump subsystem

1. Reattach the etCO_2 module or pod to the monitor. The sidestream sampling pump starts running, and there is suction at the input port on the face of the module or pod.

NOTE: If the sidestream pump fails to start, make sure the Capnostat sensor is disconnected. The pump is designed to shut down while a connected sensor is warming up.

2. With the input sidestream port still open and the drain tubing still connected, let the pump run for several minutes to remove any water still trapped in the system.
3. Block the sidestream input port with your finger for several seconds and then unblock it. Repeat at least ten times.
4. Move your finger to the sidestream output port and block the port with your finger for several seconds and then unblock it. Repeat at least ten times.
5. Remove the drain tubing, and allow the sidestream pump to continue running for at least 30 minutes.

Infinity $etCO_2$ Microstream SmartPod

WARNING:

- **Do not autoclave or sterilize this device.**
- **To reduce the risk of infection, remember that airway and flow sensors are for single patient use only and cannot be sterilized. To avoid blocking the sampling tube, do not attempt to sterilize the pod by immersing it in liquids.**

CAUTION:

- *Do not spray or pour any liquid directly on the pod, accessories or consumables.*
- *Do not use caustic or abrasive cleaners, or harsh solvents, including petroleum-based or acetone solutions, to clean the device.*
- *Microstream ® $etCO_2$ consumables are designed for single patient use and are not to be reprocessed. Do not attempt to clean, disinfect, sterilize or flush out the FilterLine as this can damage the monitor*

1. To clean the pod's surfaces, lightly dampen a cloth with a 70% alcohol solution.
2. Wipe all surfaces.

Alcohol wipes may also be used. The frequency of the cleaning procedure should be determined by hospital policy.

FiO_2

Clean the FiO_2 sensor by wiping external surfaces with a cloth lightly dampened with a mild detergent or isopropyl alcohol. Disinfect the external surface of the FiO_2 sensor using a cloth moistened with ethanol.

CAUTION: *Do not autoclave, gas sterilize, or irradiate the oxygen sensors. Do not clean the sensor with chemicals other than alcohol or a mild cleaning agent.*

Temperature

Reusable Temperature probes and cables

Do not use excessive pressure or flex the cables as this can stretch the covering and break the internal wires.

1. Clean the probes with a 3% hydrogen peroxide or 70% alcohol.
2. Quickly immerse the cables in a detergent solution.
3. Make sure the probe's tip is firmly connected.

CAUTION: *Do not use phenol disinfectants because vinyl absorbs them. Do not use strong aromatic, chlorinated, ketone, ether or ester solvents. Do not immerse the cables for any prolonged period in alcohol, mild organic solvents, or highly alkaline solutions.*

CAUTION: *Never boil or autoclave the cable. Vinyl withstands temperatures up to 100 °C but begins to soften at around 90 °C. Handle gently when hot and wipe away from the tip toward the cable.*

Continuous Non-Invasive Arterial Blood Pressure (CNAP) Pod

Read the following instructions carefully before you clean the CNAP. Special instructions for cleaning particular parts are provided in the following section.

CAUTION: *Moisture can damage the pod and its accessories. Do not spray cleaning agents on the pod or accessories. Make sure that NO liquid enters the pod/accessories.*

CAUTION: *Do not immerse or rinse in liquid. If you accidentally spill liquid on a device, disconnect the unit from the power source. Contact your Biomed regarding the continued safety of the unit before placing it back in operation.*

CAUTION: *Components could be damaged by use of organic solvents or sterilization by steam, heat, radiation or ETO.*

CAUTION: *When cleaning the Dual Finger Cuff, take special care to wipe the inner bladder extremely gently or the inner bladder may become torn or ruptured.*

To clean the CNAP pod and cuff controller

1. Disconnect the pod and cuff controller from the monitor.
2. Wipe with a cloth moistened in enzymatic detergent or a solution of green tinctured soap and water. Do not spray cleaning agents on the pod, cuff controller or accessories.
3. Clean the surfaces of the pod/accessories with a gauze moistened with diluted alcohol
4. Dry thoroughly with a lint-free cloth.

To clean the sensor cuff and patient cables

1. Clean sensor cuff and CNAP cables with a gauze pad moistened with a soap solution.
2. Clean sensor cuff and CNAP cables with a gauze pad moistened with diluted alcohol. Wipe the inside bladder of the sensor cuff gently.
3. Dry thoroughly with a lint-free cloth.

To clean the NBP cuff

For proper cleaning and disinfecting of reusable cuffs please refer to the respective instructions for use accompanying the blood pressure cuffs.

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A Glossary

Ω	Ohm
µA	Micro Ampere
µV	Micro Volt
%PACED	Percentage of pacemaker-initiated beats
AC	Alternating Current
ACE	Arrhythmia Classification Expert
Airway adapter	In $etCO_2$ monitoring, a device inserted in a patient's airway tubing to which a capnostat sensor is attached See also *Capnostat.*
Airway CO_2	See *$etCO_2$.*
AIVR	Accelerated Idioventricular Rhythm
Agent	A gas used in anesthesia The MultiGas modules detect and measure five agents: Halothane, Isoflurane, Enflurane, Sevoflurane, and Desflurane
ART	Arterial pressure
ARTF	Artifact
ASY	Asystole
aVF (ECG)	Left leg augmented lead
aVL (ECG)	Left arm augmented lead
aVR (ECG)	Right arm augmented lead
Battery-backed memory	The circuits inside the monitor that retain information after turning off the monitor Patient settings, for example, are saved in battery-backed memory.
bbhr	beat-to-beat Heart Rate
BGM	Bigeminy
BRDY	Sinus Bradycardia
BSA	Body Surface Area (m^2)
BT	Blood Temperature
Capnogram	A waveform indicating the changing levels of CO_2 measured in the patient's breathing cycle

Capnostat	A sensor used to measure CO_2 levels in a patient's expired and inspired air
CCI	Continuous Cardiac Index
Cdyn	Dynamic Compliance
CI	Cardiac Index
CNAP	Continuous Non-invasive Arterial Pressure
CO	Cardiac Output
CO2	Minute Elimination
CPP	Cerebral Perfusion Pressure
CPT	Ventricular Couplet
CVP	Central Venous Pressure
D or Dia	Diastolic pressure
Desflurane	An anesthetic agent
Docking Station™	A mounting device that supports the monitor mechanically See also *Pick and Go.*
EEF	End Expiratory Flow
End-Tidal CO_2	The carbon dioxide level measured at the peak of the exhalation phase of the breathing cycle See also *iCO_2* and *RRc.*
Enflurane	An anesthetic agent
ESU	Electro-Surgical Unit
etCO2	End-Tidal CO_2
Exit arrow	A left-pointing arrow found at the top left of each menu and at the end of certain menu lists Click on the arrow to return to the previous menu.
FiO_2	Fractional inspired oxygen
Fixed keys	Function buttons located on the front of the monitor Fixed keys are also found on the hemodynamic pods, on the NBP module, and on the R50 Recorder.
G or g	Gravity force
Generic Pressure parameter	A general-purpose blood pressure parameter that enables you to configure pressure channels for later assignment
GP1, GP2	See *Generic Pressure parameter*
Halothane	An anesthetic agent
Hemo2, Hemo4, HemoMed	See *hemodynamic pod*
Hemodynamic pod	A module used to mount blood pressure transducers and pass invasive blood pressure and temperature data to the monitor
hr	Hour

HR	Heart Rate
Hz	Hertz
IBP	Invasive Blood Pressure
iCO_2	Inspired CO_2
ICS	Infinity CentralStation
ICP	Intracranial Pressure
I:E	Inspiratory/Expiratory Ratio
Impedance respiration	Respiration monitoring based on the measurement of changes in electrical impedance that accompany the expansion and contraction of the chest
in	inches
Inspired CO_2 (iCO_2)	In $etCO_2$ monitoring, the level of carbon dioxide measured during the inspiration phase of the breathing cycle
InspT%	Inspiratory Time %
Internal battery	A permanent lithium-ion battery capable of powering the monitor for up to 240 minutes when new.
Isoelectric line	In electrocardiology, a reference line representing the resting state of the heart
Isoflurane	An anesthetic agent
IT	Injectate Temperature
LA (ECG)	Left Arm
LA (IBP)	Left-Atrial pressure
LCD	Liquid Crystal Display
LL	Left Leg
Local message area	Along the top left of the main screen; displays error and status messages See also *Network Message Area.*
LV	Left-Ventricular pressure
M or Mean	Mean pressure
Main menu	The top level menu in the Delta/Delta XL menu system Press the **Menu** fixed key to access.
MAP	Main Arterial Pressure
MCL	Modified Chest Lead
Memory card	A PCMCIA storage device used for upgrading software, retrieving monitor logs for use by DrägerService personnel, and for storing monitor setups A memory card reader is on the left side of the monitor.
Medical Information Bus (MIB)	A communications protocol used to facilitate the transfer of waveform and numeric data between medical devices
MIB	Medical Information Bus

min	Minute
mm/s	Millimeter per Second
mmHg	Millimeter of Mercury
ms	Millisecond
MultiMed	The pod that receives the following patient cables: ECG lead set, SpO_2 extension cable, and a temperature probe
MV	Minute Volume
MValv	Alveolar Minute Volume
Network message area	Along the top right of the main screen; displays network messages when the monitor is connected to the network See also *Local Message Area.*
NBP	Non-Invasive Blood Pressure
NBP hose	The plastic tube used by the NBP module to inflate the blood-pressure cuff
OxyCRG or OCRG	Oxycardiorespirogram
PA	Pulmonary-Arterial pressure
Parameter	A monitored physiological function (eg, heart rate, blood temperature)
PAUS	Pause
PeCO2	Mixed Expired CO2
PEEP	Positive end-expiratory pressure
PEF	Peak Expiratory Flow
Pick and Go	Pick and Go allows continuous monitoring for a patient moving from one care unit to another, while leaving each unit's setups intact.
PIF	Peak Inspiratory Flow
PIP	Peak Inspiratory Pressure
PLS or pls	Pulse Rate as calculated from the SpO_2 measurements
Protocol converter	A device that converts RS232 signals from an external monitoring device into the MIB interface protocol See *Medical Information Bus.*
Pulse Oximetry (SPO2)	A technique for calculating the percentage of functional (ie, oxygen-saturated) hemoglobin in the patient's blood
PVC/min	Premature Ventricular Contractions per minute
PWP	Pulmonary Wedge Pressure
R50	A strip recorder used to print a paper copy of patient data (alarms, waveforms, and trends)
RA (ECG)	Right Arm
RA (IBP)	Right Atrial pressure
Raw	Airway Resistance
RESP	Respiration Rate as measured by ECG electrodes

RL	Right Leg
Rv	Right Ventricular pressure
RRc	Respiratory Rate as calculated from the end-tidal CO_2 ($etCO_2$) capnograph
RSBI	Rapid Shallow Breath Index
RUN	Arrhythmia call
s	Second, Spontaneous
S or Sys	Systolic pressure
Sevoflurane	An anesthetic agent
SpO_2	Percentage of oxygen-saturated hemoglobin in the blood, as measured by pulse oximetry
ST deviation	The displacement of the ST segment of the ECG waveform over the isoelectric line
STCVM	ST Change in Vector Magnitude
STVM	ST Vector Magnitude
Strip chart	The paper copy of patient data printed out from a recorder
SV	Stroke Volume
SVI	Stroke Volume Index
SVR	Systemic Vascular Resistance
SVRI	Systemic Vascular Resistance Index
SYNC or Sync	Synchronization
T1a, T1b T2a, T2b T3a, T3b	Patient temperature (through the hemodynamic pods)
Ta	Patient temperature (through the MultiMed pod)
TACH	Tachychardia
TENS	Transcutaneous Electric Nerve Stimulator
TV	Tidal Volume
TValv	Alveolar Tidal Volume
TVCO2	Tidal Volume CO2
V	Volt
V (ECG)	Chest
VCO2	minute elimination
Vent	Flow/Volume

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B Technical Data

Overview

This appendix contains technical specifications for the physical and functional aspects of the patient monitoring system. These specifications apply to adult, pediatric, and neonatal patients.

Upon request, Dräger makes any technical information required to perform maintenance and/or calibration of serviceable items available to qualified technical personnel.

Electromagnetic Compatibility (EMC)

This section is intended to provide information with regard to electromagnetic compatibility for the Dräger Delta series of patient monitors (hereafter referred to as 'equipment'). It supplements the information that already exists elsewhere in the instructions for use.

Much of the information below is derived from requirements specified in the electromagnetic compatibility standard for medical electrical equipment IEC 60601-1-2: published by the International Electrotechnical Commission and, available from a variety of sources. While primarily aimed at device manufacturers this contains a large amount of information that may be useful to interested users of medical equipment.

The information contained in this section (such as separation distances) is in general specifically written with regard to the Dräger patient monitors specified above. The numbers provided will not guarantee, but should provide reasonable assurance of, faultless operation. This information may not be applicable to other medical electrical equipment, older equipment may be particularly susceptible to interference.

NOTE:

- Medical electrical equipment needs special precautions regarding electromagnetic compatibility (EMC) and must be installed and put into service according to the EMC information provided in this section and the instructions for use which accompanied your monitor.
- Portable and mobile RF communications equipment can affect medical electrical equipment.

NOTE:

- Cables and accessories not specified within the instructions for use are not authorized. Using other cables and/or accessories may adversely impact safety, performance and electromagnetic compatibility (increased emission and decreased immunity).
- The equipment should not be used adjacent to or stacked with other equipment; if adjacent or stacked use is inevitable, the equipment should be observed to verify normal operation in the configuration in which it will be used.
- This patient monitoring equipment may communicate over a 2.4 GHz 802.11 b/g wireless network. Other equipment could interfere with data reception in this wireless network, even if that equipment complies with CISPR emission requirements. When using patient monitoring equipment that communicates over a wireless network, carefully ensure that any (existing or new) wireless systems (for example, cell phones, pager systems, cordless phones, etc.) are compatible. For example, a Bluetooth compatible device in the 2.4 GHz frequency band may interfere with the patient monitor's wireless communication. For details on wireless deployment, contact your Dräger representative.
- Low amplitude signals such as EEG and ECG are particularly susceptible to interference from electromagnetic energy. While the equipment meets the testing described below, it is not a guarantee of perfect operation, the 'quieter' the electrical environment the better. In general, increasing the distance between electrical devices, will decrease the likelihood of interference.

Electromagnetic Emissions

This equipment is intended for use in the electromagnetic environment specified below. The user of this equipment should assure that is used in such an environment.		
Emissions:	**Compliance according to:**	**Electromagnetic environment:**
RF emissions (CISPR 11)	Group 1	The monitor only uses RF energy internally. Therefore, its RF emissions are very low and are not likely to cause any interference in nearby electronic equipment. Also see the following note.
CISPR emissions Classification	Delta - Class B Delta XL -Class B Kappa - Class B	The equipment is suitable for use in all establishments including domestic establishments and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes.
Harmonic emissions (IEC 61000-3-2)	Class A	
Voltage fluctuations / flicker (IEC 61000-3-3)	Complies	

NOTE: When the monitor is configured with the wireless option, that option's radio emits electromagnetic energy in order to communicate with the Infinity network. This may affect nearby equipment. See the documentation that accompanies the wireless option's radio for further details.

WARNING: Do not place monitor with radio operational next to paced patients.

Electromagnetic Immunity

This equipment is intended for use in the electromagnetic environment specified below. The user of this equipment should assure that is used in such an environment.			
Immunity against	**IEC 60601-1-2 test level:**	**Compliance level (of this device:**	**Electromagnetic environment:**
Electrostatic discharge, ESD (IEC 61000-4-2)	Contact discharge: ±6 kV air discharge: ±8 kV	±6 kV ±8 kV	Floors should be wood, concrete or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30% so that electrostatic charges are at suitable levels.
Electrical fast transients / bursts (IEC 61000-4-4)	Power supply lines: ±2 kV longer input / output lines: ±1 kV	±2 kV ±1 kV	Mains power quality should be that of a typical commercial or hospital environment.

Surges on AC mains lines (IEC 61000-4-5)	Common mode: ±2 kV Differential mode: ±1 kV	±2 kV ±1 kV	Mains power quality should be that of a typical commercial or hospital environment.
Power frequency magnetic field 50/ 60 Hz (IEC 61000-4-8)	3 A/m	3 A/m	Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment.
Voltage dips and short interruptions on AC mains input lines (IEC 61000-4-11)	Dip >95 %, 0.5 periods Dip 60 %, 5 periods Dip 30 %, 25 periods Dip >95 %, 5 seconds	>95 %, 0.5 per. 60 %, 5 per. 30 %, 25 per. >95 %, 5 sec.	Mains power quality should be that of a typical commercial or hospital environment. If the monitor's user requires continued operation during power mains interruptions, the monitor should be powered from an uninterruptible power supply or a battery.
Electromagnetic environment guidance: Portable and mobile RF communications equipment should be used no closer to any part of the monitor, including cables, than the recommended separation distance calculated from the equation that applies to the frequency of the transmitter listed below. In this equation, P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer and d is the recommended separation distance in metres (m). Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey[1], should be less than the compliance level in each frequency range[2]. Interference may occur in the vicinity of equipment marked with the following symbol: 			

Immunity test	IEC 60601 test level:	Compliance level:	Recommended separation distance:
Conducted RF rf coupled into lines (IEC 61000-4-6)	150 kHz to 80 MHz	3 V	$d = 1.2 * \sqrt{P}$
Radiated rf (IEC 61000-4-3)	80 MHz to 800 GHz 800 MHz to 2.5 GHz	3 V/m	$d = 1.2 * \sqrt{P}$ $d = 2.3 * \sqrt{P}$ where *P* is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer and *d* is the recommended separation distance in metres (m).

[1] Field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcast and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. If the measured field strength in the location in which the equipment is used exceeds the applicable RF compliance level above, the equipment should be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as reorienting or relocating the equipment.

[2] Over the frequency range 150 kHz to 80 MHz, field strengths should be less than 3 V/m.

Recommended separation distances

Recommended separation distances between portable and mobile RF communications equipment and the equipment

Rated maximum output power of transmitter W	Separation distance according to frequency of transmitter in meters		
	150 kHz - 80 MHz $d = 1.2 * \sqrt{P}$	80 MHz to 800MHz $d = 1.2 * \sqrt{P}$	800 MHz to 2.5 GHz $d = 2.3 * \sqrt{P}$
0.01	0.12	0.12	0.23
0.1	0.38	0.38	0.73
1	1.2	1.2	2.3
10	3.8	3.8	7.3
100	12	12	23

NOTE:

- For transmitters rated at a maximum output power not listed above, the recommended separation distance d in meters (m) can be estimated using the equation applicable to the frequency of the transmitter, where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer.
- At 80 MHz and 800 MHz, the separation distance for the higher frequency range applies.
- These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.

System Components

Delta/Delta XL Base Unit

Physical Attributes	
Size (H x W x D): (without modules)	Delta: 253 x 365 x 190 mm (10.0 x 14.4 x 7.5 in) [SC 7000:224 x 330 x 102 mm (8.8 x 13.0 x 4.0 in)] Delta XL: 272 x 384 x 190 mm (10.7 x 15.1 x 7.5 in) [SC 9000XL:254 x 360 x 190 mm (10.0 x 14.2 x 7.5 in)]
Weight:	Delta: 5.8 kg (12.7 lb) [SC 7000: 7.0 kg (15.5 lb)] Delta XL: 6.2 kg (13.6 lb) [SC 9000XL:7.7 kg (16.9 lb)]
Cooling:	Convection
Enclosure:	Plastics: ABS/PC, FR 110
Printed circuit boards:	Board: Glass/epoxy Fr4 Solder: Lead/tin Copper etch Lithium battery
Heatsink assemblies:	Cast magnesium alloy
Internal battery:	Lithium Ion
NBP assembly:	Silicon tubing, steel, copper wire
Electrical Specifications	
Input voltage:	11 to 15 V DC
Power consumption:	≤70 Watts (fully loaded)
Protection class:	Class 1 system when used in conjunction with an approved power supply. If the monitor operates on the built-in battery, it falls under protection class "internally powered" according to IEC 60601-1 (connected to IDS Class II, connected to power supply Class II, in transport Internally Powered)
Protection against electric shock	According to DIN EN 60601-1 (3rd edition), the Delta/Delta XL base unit is not an applied part. The classificaton of the monitor depends on the actual classification of the connected device. For example, the $etCO_2$-module is classified as type CF, while the $etCO_2$-Microstream module is classified as type BF. See the part's degree of protection against electric shock in the respective technical data. Modules for hemodynamic parameters are usually classified as CF. Further information regarding the classification of each module, can be found in the module-specific sections of this chapter.
Battery voltage range:	**Internal:** 12 - 16VDC

Battery capacity (for a new battery):	Approximately 240 minutes with MS30502 Approximately 180 minutes with MS18340 **NOTE**: MS18340 is not IEC 60601-1 3rd edition compliant. **NOTE:** Battery life varies with parameter configuration. The battery life specified above is under the following load conditions with a new battery: MultiMed with ECG leads and SpO_2 sensor, 2 temperature probes, HemoMed pod with 4 IBP transducers and a catheter, NBP taking measurements every 15 minutes, LCD Transport Brightness at 50%, and no continuous tone being generated.
Battery charge time:	Internal: Approximately 6.5hrs at 25 C (77 F) for 90% charge Approximately 8hrs at 25 C (77 F) for 100% charge
Patient leakage current:	≤10 µA
Mode of operation:	Continuous with external power supply; for a limited time with battery backup.
Alarm Tone Sound Pressure L(A) Alarm Tone Sequence	Free Field Measurements (complying with ISO 3744) IEC/Infinity • High alarms - 56dB(A) to 69dB(A) / 56dB(A) to 76dB(A) • Medium-priority alarms - 56dB(A) to 69dB(A) / 54dB(A) to 72dB(A) • Low-priority alarms - 52dB(A) to 65dB(A) / 41dB(A) to 58dB(A)
Environmental Requirements	
Temperature range:	Operating: 10 to 40 °C (50 to 104 °F) Storage: –20 to +40 °C (–4 to +104 °F) **NOTE:** Storage of the monitor at ≥ 40 °C (104 °F) for an extended period of time (3 - 5 months) will degrade the battery capacity.
Relative humidity:	Operating: 20 to 90 %, non-condensing Storage: 10 to 95% (with packaging)
Atmospheric pressure:	Operating: 525 to 795 mmHg (70 to 106 kPa) Storage: 375 to 795 mmHg (50 to 106 kPa)
Protection against ingress of water:	IPX1 (per IEC 60529)
Analog Output	
Signals:	ECG, arterial blood pressure (ART)
Delay:	≤25 ms
Pacemaker pulses:	Pacemaker pulses in the auxiliary output (analog output) signal are an enhanced signal summed with the ECG signal.
Output range:	–5 V to +5 V
Signal gain:	ECG: X 1000
	ART: X 10 mV/mmHg
ECG bandwidth:	0.67 to 20 Hz (ESU filter mode)
	0.67 to 40 Hz (other filter modes)

Pacemaker pulses:	Amplitude: 5 V (nominal)
	Duration: 4 ms
	Rise time: <18 ms
	Fall time: <20 ms
QRS Sync Output	
Delay:	≤35 ms
Output high (QRS detected):	Duration: 50 ms
	Amplitude: +9 V ±5 % (nominal)
	Source impedance: 5100 Ω
	Rise time: <7 µs
	Fall time: <1 µs
Output low (no QRS):	<0.8V @30 mA sink current
Pacemaker pulses:	Not included
User Interface	
Controls:	Fixed keys and rotary knob
Alarms:	3 levels: High, Medium, Low
Screen	
Type:	Thin Film Transistor Liquid Crystal (TFT-LCD) Display, Active Matrix.
Size:	Delta: 264 mm (10.4 in) diagonal Delta XL: 310 mm (12.2 in) diagonal
Viewing area:	Delta: 211 x 158 mm (8.3 x 6.2 in) Delta XL: 246 x 184.5 mm (9.7 x 7.3 in)
Resolution:	Delta: 640 x 480 pixels Delta XL: 800 x 600 pixels
Color capability:	512
Sweep speed:	6.25, 12.5, 25 and 50 mm/s ±10 %
Parameter value	Monitor updates on value change, worst case every 2 seconds
Trend storage	
Data storage:	24 hours of trended parameter information
Data resolution:	30 second sampling
Trend graphs:	1, 2, 4, 8, 12 and 24 hour display formats
Trend tables:	1, 5, 15, 30, and 60-minute display formats

Kappa CPU Base Unit

Physical Attributes	
Size (H x W x D):	102 x 368 x 368 mm (4 x 14.5 x 14.5 in)
Weight:	8.4 kg (19 lb.)
Cooling:	Fan
Enclosure:	Plastics: ABS/PC, FR 110 Painted, cold-rolled steel
Printed circuit boards:	Board: Glass/epoxy Fr4 Solder: Lead/tin Copper etch Lithium battery
Heatsink assemblies:	Cast aluminum
NBP assembly:	Silicon tubing, steel, copper wire
Electrical Specifications	
Power requirements:	100-240 VAC, 2.5 A to1.3 A 50/60 Hz
Protection class:	Internally powered (per IEC 60601-1) and for use with specified Class 1 power supplies.
Chassis leakage:	300 µA @ 120 VAC 500 µA @ 240 VAC
Battery type:	Lithium Ion
Battery capacity (for a new battery) :	Approximately 240 minutes with MS30502 Approximately 180 minutes with MS18340 **NOTE:** MS18340 is not IEC 60601-1 3rd edition compliant.
Battery charge time:	Approximately 6.5hrs at 25 C (77 F) for 90% charge Approximately 8hrs at 25 C (77 F) for 100% charge
Patient leakage current:	≤10 µA
Mode of operation:	Continuous with external power supply; for a limited time with battery backup

NOTES:

- Battery life varies with parameter configuration. The battery life specified above is under the following load conditions: MultiMed with SpO_2 sensor, 2 temperature probes, HemoMed pod with 4 IBP transducers and a catheter, NBP taking measurements every 15 minutes and no continuous tone being generated.
- Advanced Communication Options are not supported during battery operation.

Environmental Requirements	
Temperature range:	Operating: 10 to 45 °C (50 to 113 °F) Storage: –20 to +50 °C (–4 to +122 °F) **NOTE**: Storage of the monitor at ≥ 40 °C (104 °F) for an extended period of time (3 - 5 months) will degrade the battery capacity.
Relative humidity:	Operating: 20 to 90 %, non-condensing Storage: 10 to 95 % (with packaging)
Atmospheric pressure:	Operating: 525 to 795 mmHg (70 to 106 kPa) Storage: 375 to 795 mmHg (50 to 106 kPa)
Protection against ingress of water:	IPX1
Analog Output	
Signals:	ECG, arterial blood pressure (ART)
Delay:	≤25 ms
Pacemaker pulses:	Included
Output range	–5 V to +5 V
Signal gain	ECG: X 1000
	ART: X 10 mV/mmHg
ECG bandwidth	0.5 to 20 Hz (ESU filter mode)
	0.5 to 40 Hz (other filter modes)
Pacemaker pulses	Amplitude: 5 V (nominal)
	Duration: 4 ms
	Rise time: <18 ms
	Fall time: <20 ms
QRS Sync Output	
Delay:	≤35 ms
Output high (QRS detected):	Duration: 50 ms
	Amplitude: +7.1 V ±5 % (nominal) – rear panel sync. connector
	Amplitude: +12 V ±5 % (nominal) – analog/sync. connectors
	Source impedance: 5100 Ω
	Rise time: <7 µs
	Fall time: <1 µs
Output low (no QRS):	<0.8 V @30 mA sink current
Pacemaker pulses:	Not included
User Interface	
Controls:	Fixed keys and rotary knob
Alarms:	3 levels: High, Medium, Low

Screen	
Resolution:	800 x 600
Sweep speed:	6.25, 12.5, 25 and 50 mm/s ±10 % (accuracy only guaranteed for a 15" display)
Trend storage	
Data storage:	24 hours of trended parameter information
Data resolution:	30 second sampling
Trend graphs:	1, 2, 4, 8, 12, and 24 hour display formats
Trend tables:	1, 5, 15, 30, and 60-minute display formats

Infinity Docking Station (IDS)

Physical Attributes	
Connections:	Delta/Delta XL series, 15” VGA Display (remote display), R50 Recorder, Infinity network, MIB, ISD, CAN bus, Communication Ports 1 & 2
Cooling:	Convection
Size (W x D x H):	228 x 210 x 102 mm (9 x 8.25 x 4 in)
Weight:	2 kg (4.5 lbs)
Electrical Specifications	
Input voltage range:	+12 VDC, +15 %, –3%
Mains frequency:	Not applicable
Power consumption:	0.7 A @12 V with no devices attached
Power output:	10.1 A @12 V with all devices attached
Protection class:	Part of a class 1 system when used in conjunction with an approved class 1 power supply.
Chassis leakage current:	100 µA
Mode of operation:	Continuous
Environmental Requirements	
Temperature range:	Operating: 10 to 40 °C (50 to 104 °F) Storage: –20 to 50 °C (–4 to 122 °F)
Relative humidity:	Operating: 20 to 90 %, non-condensing Storage: 15 to 95 % (with packaging)
Atmospheric pressure:	Operating: 525 to 795 mmHg (70 to 106 kPa) Storage: 375 to 795 mmHg (50 to 106 kPa)

Power Adapter (Monitor and IDS) – MS18284

Physical Attributes	
Connections:	AC Power connector, DC power cable/connector, potential equalization connector
Cooling:	Convection
Size (W x D x H):	135 x 111 x 270 mm (5.3 x 4.4 x 10.6 in) Depth is 71 mm (2.8 in) without the mounting bracket.
Weight:	2.0 kg (4.4 lbs)
Power requirements:	100 to 240 V AC, 3 A
Mains frequency:	50/60 Hz
Power output:	+13V DC, 10.8 A
Environmental Requirements	
Temperature range:	Operating: 10 to 40°C (50 to 104 °F) Storage: –40 to 70°C (–40 to 158 °F)
Relative humidity:	Operating: 20 to 95 %, non-condensing Storage: 10 to 95 % (with packaging)
Atmospheric pressure:	Operating: 525 to 795 mmHg (70 to 106 kPa) Storage: 375 to 795 mmHg (50 to 106 kPa)

Power Adapter (Monitor and IDS) – 5955393

Physical Attributes	
Connections:	AC power connector, dc power cable/connector, potential equalization connector
Cooling:	Convection
Size (W x D x H):	135 x 111 x 270 mm (5.3 x 4.4 x 10.6 in) Depth is 71 mm (2.8 in) without the mounting bracket.
Weight:	1.85 kg (4.1 lbs)
Power requirements:	100 to120 V AC, 3.4 A or 200 to 240 V AC,1.7 A (switch selectable)
Mains frequency:	50/60 Hz
Power output:	+13V DC, 10.8 A
Protection Class:	Class 1
Chassis leakage current:	<300 µA @120 V AC, <500 µA @220 V AC
Mode of operation:	Continuous
Protection against ingress of water:	Ordinary
Environmental Requirements	

Temperature range:	Operating: 10 to 40°C (50 to 104 °F) Storage: –40 to 70°C (–40 to 158 °F)
Relative humidity:	Operating: 20 to 95 %, non-condensing Storage: 10 to 95 % (with packaging)
Atmospheric pressure:	Operating: 525 to 795 mmHg (70 to 106 kPa) Storage: 375 to 795 mmHg (50 to 106 kPa)

AC Power Adapter, Universal – 5188607

Physical Attributes	
Connections:	AC power connector, dc power cable/connector 10A 250V IEC 320 receptacle
Cooling:	Convection
Size (W x D x H):	95.25 x 69.85 (including rubber feet) x 165.1 mm (3.75 x 2.75 x 6.50 in)
Weight:	704 g (1.5 lb)
Input voltage range:	100 to 250 VAC
Mains frequency:	50/60 Hz
Power output:	+12V DC, 8.0 A
Power consumption:	3.0A @100 VAC, 1.3A @240 VAC (fully loaded)
Protection class:	Class 1
Mode of operation:	Continuous
Environmental Requirements	
Temperature range:	Operating: 10 to 40°C (50 to 104 °F) Storage: –40 to 70°C (–40 to 158 °F)
Relative humidity:	Operating: 20 to 95 %, non-condensing Storage: 10 to 95 % (with packaging)
Atmospheric pressure:	Operating: 525 to 795 mmHg (70 to 106 kPa) Storage: 375 to 795 mmHg (50 to 106 kPa)

R50 N Infinity Recorder

Physical Attributes	
Size (H x W x D):	180 x 120 x 222 mm (7.1 x 4.72 x 8.74 in)
Weight:	1.64 kg (3.6 lb)
Connections:	AC power connector; X14 Infinity Network; X7 R50 recorder; potential equalization connector
Cooling:	Convection

Type:	Transportable equipment
Electrical Specifications	
Input voltage range:	100 to 240 VRMS
Mains frequency:	50/60 Hz
Power consumption:	1.0 A max
Protection class:	Class 1
Chassis leakage current:	<300 µA @ 120 VAC, <500 µA @ 220 VAC
Mode of operation:	Continuous
Protection against water ingress:	Ordinary (IPX0 per IEC 60529)
Fuses	Replace as marked, F2A-250V **NOTE**: There are no other user-replaceable parts for this device.
Environmental Requirements	
Temperature range:	Operating: 15 to 40 °C (55 to 104 °F) Storage: –20 to 40 °C (–4 to 104 °F)
Relative humidity:	Operating: 30 to 95 %, non-condensing Storage: 10 to 95 %, non-condensing (with packaging)
Atmospheric pressure:	Operating: 550 to 775 mmHg (73 to 103 kPa) Storage: 375 to 795 mmHg (50 to 106 kPa)

Medical Information Bus (MIB) II Duo Protocol Converter (72 56 949)

Physical Attributes	
Connections:	Input: RS 232 25-pin D subminiature connector Output, MIB II: RJ45 low speed MIB (IEEE 1073.3.2) Output, MIB I: SDL high speed MIB (IEEE 1073.3.1)
Size (H x W x D):	29 x 84 x 170 mm (1.2 x 3.3 x 6.7 in)
Weight:	<0.4 kg (0.9 lbs)
Visual indicators:	2 LEDs
Cooling:	Convection cooled
Electrical Specifications	
Power source:	DC powered, directly from Dräger IDS
Power consumption:	<4 Watts
Isolation:	Not Isolated
Mode of operation:	Continuous
Environmental Requirements	
Temperature range:	Operating:10 to +40 °C (50 to 104 °F) Storage: –20 to +50 °C (–4 to +122 °F)
Relative humidity:	Operating:20% to 90%, non-condensing Storage: 10% to 95% (with packaging)
Atmospheric pressure:	Operating:525 to 795 mmHg (70 to 106 kPa) Storage: 375 to 795 mmHg (50 to 106 kPa)

MIB II Protocol Converter (72 56 931)

Physical Attributes	
Connections:	Input: RS 232 25-pin D subminiature connector Output: RJ45 Low Speed MIB (IEEE 1073.3.2)
Size (H x W x D):	29 x 84 x 170 mm (1.2 x 3.3 x 6.7 in)
Weight:	<0.4 kg (0.9 lbs)
Visual indicators:	2 LEDs
Cooling:	Convection cooled

Electrical Specifications	
Power source:	DC powered, directly from Dräger IDS
Power consumption:	<4 Watts
Isolation:	Not Isolated
Mode of operation:	Continuous
Environmental Requirements	
Temperature range:	Operating:10 to +40 °C (50 to 104 °F) Storage: –20 to +50 °C (–4 to +122 °F)
Relative humidity:	Operating:20 to 90 %, non-condensing Storage: 17 to 95 % (with packaging)
Atmospheric pressure:	Operating:525 to 795 mmHg (70 to 106 kPa) Storage: 375 to 795 mmHg (50 to 106 kPa)

Displays

Display Unit (Kappa only)

See user manuals for the video monitor you are using. Dräger Medical recommends TFT Medical Grade 15”/17”/19” display. The requirements for the Kappa flat panel are as follows.

VGA Display	
Output resolution:	High resolution mode: 1024 x 768 Medium resolution mode: 800 x 600 Low resolution mode: 640 x 480
Horizontal frequency:	High resolution mode: 35.5 kHz Medium resolution mode: 37.9 kHz Low resolution mode: 31.5 kHz
Vertical frequency:	High resolution mode: 87 Hz (interlaced) Medium resolution mode: 60 Hz (non-interlaced) Low resolution mode: 60 Hz (non-interlaced)
Video signal level:	1 Vpp
Sync. signal level:	High resolution mode: TTL (positive) Medium resolution mode: TTL (negative) Low resolution mode: TTL (negative)
Isolation:	Galvanically isolated from IDS

Surgical Display Controller

Physical Attributes	
Size (H x W x D):	40 x 84 x 170 mm (1.6 x 3.3 x 6.7 in)
Weight:	0.45 kg (1.0 lb.)
Connections	
Inputs:	IDS Com #2
Outputs:	VGA (RGB, video signal, Hsync, Vsync) Analog output
Connector:	15-pin Dsub
Electrical Specifications	
Power source:	DC powered, directly from Dräger Medical IDS
Power consumption:	< 5 Watts
Mode of operation:	Continuous
Video resolution:	High, medium, and low resolution
VGA Display	
Output resolution:	High resolution mode:1024 x 768 Medium resolution mode:800 x 600 Low resolution mode:640 x 480
Horizontal frequency:	High resolution mode:35.5 kHz Medium resolution mode:37.9 kHz Low resolution mode:31.5 kHz
Vertical frequency:	High resolution mode:87 Hz (interlaced) Medium resolution mode:60 Hz (non-interlaced) Low resolution mode:60 Hz (non-interlaced)
Video signal level:	1 Vpp
Sync. signal level:	High resolution mode:TTL (positive) Medium resolution mode:TTL (negative) Low resolution mode:TTL (negative)
Isolation:	Galvanically isolated from IDS

8-Channel Analog Output	
Number of channels:	8
Channel assignment:	Follows ISD display order
Channel offset:	<±10 mV
Gain adjustment range:	NA
Gain accuracy:	<±10 mV
Offset adjustment range:	NA
D/A resolution:	12 bits (2.5 mV / LSB)
Sampling range:	250 s/sec
Output range:	–5 V to +5 V
Noise:	5 mVpp at .01 to 1 kHz
Output impedance:	100 Ohms ±5 %
Frequency range:	DC to 60 Hz (–3Db)
Environmental Requirements	
Temperature range:	Operating:10 to 40 °C (50 to 104 °F) Storage: –20 to 50 °C (–4 to 122 °F)
Humidity:	Operating:20 to 90 %, non-condensing Storage: 10 to 95 % (with packaging)
Atmospheric pressure:	Operating:525 to 795 mmHg (70 to 106 kPa) Storage: 375 to 795 mmHg (50 to 106 kPa)

Monitoring Accessories

$etCO_2$ Module

Physical Attributes	
Size (H x W x D):	Module: 150 x 93 x 65 mm (5.9 x 3.6 x 2.6 in) Capnostat III sensor: 33 x 42 x 22 mm (1.3 x 1.7 x 0.9 in)
Weight:	Module: 0.5 kg (1.1 lb) Capnostat™ III sensor:18 g
Connections:	Sensor connector, female luer side-stream sampling port, male luer sample exhaust port
Adult airway adapter dead space:	<5 cc
Neonatal airway adapter dead space:	< 0.5 cc
Moisture resistance:	Airway adapter can be immersed in water without damage
NOTE: Capnostat™ III sensor size and weight exclude cable.	
Electrical Specifications	
Power source:	Powered directly from monitor
Protection against electric shock:	Type CF
Mode of operation:	Continuous
Environmental Requirements	
Temperature range:	Operating:10 to 40 °C (50 to 104 °F) Storage: –20 to 50 °C (–4 to 122 °F)
Relative humidity:	Operating:20 to 90 %, non-condensing Storage: 10 to 95 % (with packaging)
Atmospheric pressure:	Operating:525 to 795 mmHg (70 to 106 kPa) Storage: 375 to 795 mmHg (50 to 106 kPa)

$etCO_2$ Pod

Physical Attributes	
Size (H x W x D):	Pod: approx. 140 x 140 x 51 mm (5.5 x 5.5 x 2 in) Capnostat™ III Sensor: 33 x 42 x 22 mm (1.3 x 1.7 x 0.9 in)
Weight:	Pod: 0.5 kg (1.1 lb) Capnostat™ III sensor: 18 g
Connections:	Sensor connector, female luer side-stream sampling port, male luer sample exhaust port
Adult airway adapter dead space:	< 5 cc
Neonatal airway adapter dead space:	< 0.5 cc
Moisture resistance:	Airway adapter can be immersed in water without damage
NOTE: Capnostat™ III sensor size and weight exclude cable.	
Electrical Specifications	
Power source:	Powered directly from monitor
Protection against electric shock:	Type CF
Mode of operation:	Continuous
Defibrillation protection:	Yes
Environmental Requirements	
Temperature range:	Operating: 10 to 40 °C (50 to 104 °F) Storage: –20 to 50 °C (–4 to 122 °F)
Relative humidity:	Operating: 20 to 90 %, non-condensing Storage: 10 to 95 % (with packaging)
Atm. pressure:	Operating: 525 to 795 mmHg (70 to 106 kPa) Storage: 375 to 795 mmHg (50 to 106 kPa)
NOTE: Reading complies to BTPS = body temperature 37 °C, ambient barometric pressure of 750 mmHg, and relative humidity of 100 %.	

$etCO_2$/Respiratory Mechanics Pod

Physical Attributes	
Size (H x W x D):	Approx. 140 x 140 x 51 mm (5.5 x 5.5 x 2 in)
Weight:	Pod: 0.54 kg (1.2 lb) Flow sensor: 59 g (0.13 lb)
Degree of protection against ingress of water:	Pod is resistant to spills only.
NOTE: For information on the Capnostat™ III sensor, see B-23. For more information about airway adapters used with the etCO2/respiratory mechanics pod, see B-51.	
Electrical Specifications	
Power source:	Powered directly from monitor
Protection against electric shock:	Type CF
Mode of operation:	Continuous
Defibrillation protection:	Yes
Environmental Requirements	
Temperature range:	Operating: 10 to 40°C (50 to 104 °F) Storage: –20 to 50 °C (–4 to 122 °F)
Relative humidity:	Operating: 20 to 90 %, non-condensing Storage: 10 to 95 % (with packaging)
Atm. pressure:	Operating: 525 to 795 mmHg (70 to 106 kPa) Storage: 375 to 795 mmHg (50 to 106 kPa)
NOTE: Reading complies to BTPS = Body temperature 37 °C, (99 F) ambient barometric pressure of 750 mmHg, and relative humidity of 100 %.	

$etCO_2$ Microstream Pod

Physical Attributes	
Size (H x W x D):	Approx. 140 x 140 x 51 mm (5.5 x 5.5 x 2 in)
Weight:	Pod: 0.476 kg (1.05 lb)
Degree of protection against ingress of water:	IPX1 (per IEC 60529)
Electrical Specifications	
Power source:	Powered directly from monitor
Protection against electric shock:	Pod electrically isolated by host device.
Degree of protection against electric shock:	Type BF
Mode of operation:	Continuous
Defibrillation protection:	Yes
Environmental requirements	
Temperature range:	Operating: 0 to 40 °C (32 to 104 °F) Storage: –20 to 70 °C (–4 to 158 °F)
Relative humidity:	Operating: 10 to 95%, non-condensing Storage: 10 to 95% (with packaging)
Atmospheric pressure:	Operating: 430 to 795 mmHg (57 to 106 kPa) Storage: 430 to 795 mmHg (57 to 106 kPa)

Hemodynamic Pods

User Interface	
User Controls:	Fixed keys (C.O. Start, IBP Zero, Wedge)
Displays:	HemoMed:No LCDs Hemo2: two 4-character LCDs. Hemo4: four 4-character LCDs. MPod – Quad Hemo: No LCDs
Connections:	Hemo2: 2 invasive pressures, C.O., 2 temperatures, single cable connecting pod to monitor Hemo4, MPod – Quad Hemo, and HemoMed: 4 invasive pressures, C.O., 2 temperatures, single cable connecting pod to monitor
Degree of protection against ingress of water:	Hemo2, Hemo4, and HemoMed: IPX0 (per IEC 60529) MPod – QuadHemo: IPX1 (protected against harmful effects of dripping water) per IEC 60529
Physical Attributes	
Size (H x W x D):	Hemo2, Hemo4, and HemoMed:140 x 205 x 60 mm (5.5 x 8.1 x 2.3 in) MPod – QuadHemo: 205 x 110 x 80 mm (8.1 x 4.3 x 3.2 in)
Weight:	Hemo2 and HemoMed:0.7 kg (1.6 lb.) Hemo4: 0.9 kg (1.9 lb.) MPod – Quad Hemo: 0.48 kg (1.1 lb) **NOTE:** Hemo2 weight includes one transducer adapter block. Hemo4 weight includes two transducer adapter blocks. Both weights exclude mounting clamp. For the MPod – Quad Hemo the weight includes four transducer cables but excludes the mounting clamp and rod.
Electrical Specifications	
Power source:	Powered directly from the monitor
Protection against electric shock:	Type CF
Mode of operation:	Continuous
Defibrillation protection:	Yes
Environmental Requirements	
Temperature range:	Operating: Hemo2, Hemo4, HemoMed:10 to 40 °C (50 to 104 °F) MPod – QuadHemo: 0°C to 45°C (32°F to 113°F) Storage: Hemo2, Hemo4, HemoMed: –20 to 50 °C (–4 to 122 °F) MPod – QuadHemo: –40°C to +70°C (–40°F to +158°F)

Relative humidity:	Operating: Hemo2, Hemo4, HemoMed: 20 to 90 %, non-condensing MPod – QuadHemo: 10 to 95% Storage: 10 to 95 % (with packaging)
Atmospheric pressure:	Operating: Hemo2, Hemo4, HemoMed: 525 to 795 mmHg (70 to 106 kPa) MPod – QuadHemo: 480 to 795 mmHg (64 to 106 kPa) Storage: 375 to 795 mmHg (50 to 106 kPa)

Invasive Blood Pressure

Measurement method:	Resistive strain gauge transducer
Display resolution:	1 mmHg
Measurement range:	–50 to +400 mmHg
Frequency ranges:	DC to 8 Hz, DC to 16 Hz, and DC to 32 Hz (user selectable)
Accuracy:	±1 mmHg or ±3 % exclusive of transducer (whichever is greater)
Zero balance range:	±200 mmHg
Transducer specifications:	Dräger provided transducers with a resistance of 200 to 3000 Ω and an equivalent pressure sensitivity of 5µV/V/mmHg ±1 %
Degree of protection against electric shock:	Type CF
Defibrillation protection:	Yes

Cardiac Output

Parameter display:	Cardiac output, blood temperature, Injectate temperature
Measurement method:	Thermodilution
Measurement range:	Cardiac output:0.5 to 20 L/min Blood temperature:25 to 43 °C (77 to 109 °F) Injectate temperature:–5 to +30 °C (23 to 86 °F)
Accuracy:	Cardiac output: ±5% (with 0° C injectate) Injectate temperature: ±0.25 °C
Degree of protection against electric shock:	Type CF
Defibrillation protection:	Yes

Infinity® PiCCO Pod – MS17441

User Interface	
User Controls:	Fixed keys (C.O. Start, IBP Zero)
Displays:	four 4-character LCDs.
Connections:	4 invasive pressures, C.O., 2 temperatures, single cable connecting pod to monitor
Degree of protection against ingress of water:	IPX0 (per IEC 60529)
Physical Attributes	
Size (H x W x D):	140 x 205 x 60 mm (5.5 x 8.1 x 2.3 in)
Weight:	0.9 kg (1.9 lb)
Note: Weight includes two transducer adapter blocks and exclude mounting clamp.	
Electrical Specifications	
Power source:	Powered directly from the monitor
Protection against electric shock:	Type CF
Mode of operation:	Continuous
Defibrillation protection:	Yes
Environmental Requirements	
Temperature range:	Operating:5 to 45 °C (41 to 113 °F) Storage: –20 to 50 °C (–4 to 122 °F)
Relative humidity:	Operating:10to 95 %, non-condensing Storage: 10 to 95 % (with packaging)
Atmospheric pressure:	Operating:485 to 795 mmHg (65 to 106 kPa) Storage: 375 to 795 mmHg (50 to 106 kPa)
Additional Technical Data	
Measurement method:	PCCI Continuous Pulse Contour Analysis PCCO Continuous Pulse Contour Analysis p-SVI Continuous Pulse Contour Analysis SVV Continuous Pulse Contour Analysis p-SVR Continuous Pulse Contour Analysis p-SVRI Continuous Pulse Contour Analysis dPmax Continuous Pulse Contour Analysis GEF Transpulmonary Thermodilution p-CO Transpulmonary Thermodilution GEDV Transpulmonary Thermodilution GEDVI Transpulmonary Thermodilution EVLW Transpulmonary Thermodilution EVLWI Transpulmonary Thermodilution PVPI Transpulmonary Thermodilution

Display resolution:	PCCI 0.01 L/min/m^2 PCCO 0.01 L/min p-SVI 1 ml/m^2 SVV 1% p-SVR 10 dyn.sec. cm^{-5} p-SVRI 10 dyn.sec. cm^{-5}/m^2 dPmax 1 mmHg/s GEF 1% p-CO 0.01 L/min GEDV 1 ml GEDVI 1 ml/m^2 EVLW 1 ml EVLWI 1 ml/kg PVPI 0.1 p-BT 0.1 ºC (1 ºF)
Measurement range:	PCCI 0.01 to 15 L/min/m^2 PCCO 0.25 to 25 l/m p-SVI 1 to 125 ml/m^2 SVV 0 to 50% p-SVR 0 to 30000 dyn.sec. cm^{-5} p-SVRI 0 to 30000 dyn.sec. cm^{-5}/m^2 dPmax 200 to 5000 mmHg/s GEF 1 to 99% p-CO 0.25 to 25 L/min GEDV 40 to 4800 ml GEDVI 80 to 2400 ml/m^2 EVLW 10 to 5000 ml EVLWI 0 to 50 ml/kg PVPI 0.1 to 10 p-BT 25 ºC to 43 ºC (77 ºF to 109 ºF)
Accuracy:	PCCI Not applicable PCCO Coefficient of variation ≤ 3% p-SVI Not applicable SVV Not applicable p-SVR Not applicable p-SVRI Not applicable dPmax Not applicable GEF Not applicable p-CO Coefficient of variation ≤ 1% GEDV Coefficient of variation ≤ 2% GEDVI Not applicable EVLW Not applicable EVLWI Not applicable PVPI Not applicable
Zero balance range:	±200mmHg
Degree of protection against electric shock:	Type CF
Defibrillation protection:	Yes

SCIO Four/SCIO Four Oxi/SCIO Four plus/SCIO Four Oxi plus Module

See the Scio Four Modules suppliment for information.

Trident (NMT) Pod

Physical Attributes	
Size (H x W x T)	36 x 132 x 140 mm (1.42 x 5.19 x 5.51 in)
Weight	595 g (21 oz.)
Connections	• PodCom: for connection to monitor • NMT Cable • EEG: for connection to an EEG pod or BISx pod.
Electric shock protection:	Type CF
Mode of operation:	Continuous
Defibrillator protection	No
Environmental Requirements	
Temperature range:	Operating:10 to 40 °C (50 to 104 °F) Storage: –20 to 40 °C (–4 to +104 °F)
Relative humidity:	Operating:20 to 90 %, non-condensing Storage: 20 to 90 %, (with packaging)
Atmospheric pressure	Operating:525 to 795.1 mmHg (70 to 106 kPa) Storage: 375 to 795.1 mmHg (50 to 106 kPa)

BISx Pod

Physical Attributes	
Size (H x W x T)	114.3 x 95.3 x 63.5 mm (4.5 x 3.75 x 2.5 in)
Weight (without PodCom cable)	227 g (8 oz.)
Connections	PodCom: for connection to monitor
Power source:	Powered directly from monitor
Protection against electric shock:	Type BF
Mode of operation:	Continuous
Defibrillator protection	No
Environmental Requirements	
Temperature range:	Operating:10 to 40 °C (50 to 104 °F) Storage: –20 to 40 °C (–4 to +104 °F)
Relative humidity:	Operating:20 to 90 %, non-condensing Storage: 20 to 90 %, (with packaging)
Atmospheric pressure:	Operating:525 to 795.1 mmHg (70 to 106 kPa) Storage: 375 to 795.1 mmHg (50 to 106 kPa)

EEG Pod

Physical Attributes	
Size (H x W x D):	36 x 132 x 140 mm (1.42 x 5.19 x 5.51 in)
Weight:	580 g (1.27 lb)
Connection to monitor:	3m PodCom interface cable
Connection to patient:	± input for each channel and universal neutral Referential mode block provides + input for each channel and neutral
Power source:	Powered directly from the monitor
Protection against electric shock:	Type BF
Mode of operation:	Continuous
Defibrillator protection	No

Environmental Requirements	
Temperature range:	Operating:15 to 40 °C (40 to 104 °F) Storage: –20 to 50 °C (–4 to 122 °F)
Relative humidity:	Operating:20 to 90 %, non-condensing Storage: 10 to 95 % (with packaging)
Atm. pressure:	Operating:525 to 795 mmHg (70 to 106 kPa) Storage: 375 to 795 mmHg (50 to 106 kPa)

tpO_2/CO_2 Pod

Physical Attributes	
Size (H x W x D):	52 x 132 x 153.4 mm (2.05 x 5.2 x 6.04 in)
Weight:	454 g (1 lb)
Connections:	Connector for tpO2/tpCO2 solid-state electrode Connector for pod-monitor interface cable
Interface Cable:	1 m (3.2 ft)
Degree of protection against ingress of water:	IPX 1 per IEC 60529
Electrical Specifications	
Mode of operation:	Continuous
Power requirements:	DC powered directly from the monitor
Protection against electric shock:	Type CF
Environmental Requirements	
Temperature range:	Operating:15 to 40 °C (55 to 104 °F) Storage: –20 to 50 °C (–-4 to 122 °F)
Relative humidity:	Operating:20 to 95 %, non-condensing Storage: 10 to 95 % (with packaging)
Atmospheric pressure:	Operating:550 to 775 mmHg (73 to 103 kPa) Storage: 375 to 795 mmHg (50 to 106 kPa)

FiO_2 Sensors

Physical Attributes	
Size (H x D):	40 x 30 mm (1.59 x 1.2 in)
Weight:	35 g (<1.2 oz)
Connections:	NeoMed Pod, interface cable
Mounting:	16 mm thread x 1 mm pitch
Sensor type:	Galvanic fuel cell (partial pressure)
Useful life:	Approximately 1 year
NOTE: This sensor contains lead and caustic material. Dispose of or recycle properly and in accordance with local regulations.	
Environmental Requirements	
Temperature range:	Operating:10 to 40 °C (50 to 104 °F) Storage: –10 to 50 °C (14 to 122 °F)
Relative humidity:	Operating:20 to 90 %, non-condensing Storage: 10 to 95 % (with packaging)
Atm. pressure:	600 to 900 mmHg (80 to 120 kPa)

Masimo SET® – SpO2 pod

Physical Attributes	
Size (H x W x T)	39 x 58 x 135 mm (1.5 x 2.3 x 5.3 in)
Weight	0.15 kg (0.33 lbs)
Connections	X8:for power and connection to monitor Cable connection: for intermediate cable to Masimo sensors
Power source:	Powered directly from monitor
Mode of operation:	Continuous
Degree of protection against electric shock:	Type CF
Protection against ingress of water:	IPX1 (per IEC 60529). This pulse oximeter is protected against harmful effects of dripping water.
Environmental Requirements	
Temperature range:	Operating: 5 to 45 °C (41to 113 °F) Storage: –20 to 60 °C (–4 to 140 °F)
Relative humidity:	Operating:10 to 95 %, non-condensing Storage: 10 to 95 %, (with packaging)
Atmospheric pressure	Operating:485 to 795 mmHg (64.7 to 106 kPa) Storage: 375 to 795 mmHg (50 to 106 kPa)

Nellcor Oximax® – SpO2 pod

Physical Attributes	
Size (H x W x T)	37 x 58 x 118 mm (1.5 x 2.3 x 4.6 in)
Weight	166 g (0.075 lbs)
Connections	X8:for power and connection to monitor Cable connection: for intermediate cable to Nellcor sensors
Power source:	Powered directly from monitor
Mode of operation:	Continuous
Degree of protection against electric shock:	Type CF
Protection against ingress of water:	IPX1 (per IEC 60529). This pulse oximeter is protected against harmful effects of dripping water.
Environmental Requirements	
Temperature range:	Operating: 0 to 45 °C (32 to 113 °F) Storage: –40 to 70 °C (–40 to 158 °F)
Relative humidity:	Operating:10 to 95 %, non-condensing Storage: 10 to 95 %, (with packaging)
Atmospheric pressure	Operating:485 to 795 mmHg (64 to 106 kPa) Storage: 375 to 795 mmHg (50 to 106 kPa)

Continuous Non-Invasive Arterial Blood Pressure (CNAP) Pod

Physical Attributes	
Size (H x W x D)	47.72 x 132.37 x 137.32 mm (1.87 x 5.21 x 5.40 in.)
Weight (without cuff controller, sensor cuff and cable)	0.35 kg (0.78 lb)
Connections • PodCom • Cable connection	 For power and connection to monitor For cuff controller cable and sensor cuff connections **NOTE:** Pneumatic connection between the sensor cuff and pod includes terminations which prevent the accidental separation of the sensor cuff assembly for reprocessing.
Power source	Powered directly from the monitor
Degree of protection against electric shock	Type BF
Defibrillation protection	Yes
Vibration/bump • IEC 60068.2-27*:* • IEC 60068.2-29*:*	 0.040 double amplitude displacement (5-32 Hz) 2G Peak (32 to 500 Hz) 20 to 500 Hz, ASD = 0.02 G2/Hz, low reproducibility, 9 min
Mode of operation	Continuous
Environmental Requirements	
In operation • Temperature • Relative humidity • Atmospheric pressure	 05 °C to 45 °C (1 °F to 113 °F) 10 to 95 %, non-condensing 485 to 795 mmHg (64.7 to 106 kPa)
In storage • Temperature • Relative humidity • Atmospheric pressure	 –20 °C to 50 °C (–4 °F to 122 °F) 10 to 95 % (with packaging) 375 to 795 mmHg (50 to 106 kPa)

Monitoring Specifications

WARNING: The following parameters are not monitored in neonatal mode: arrhythmia, sidestream etCO2, cardiac output, ST, and all MultiGas parameters.

ECG

Display:	Up to 12 leads
Available leads:	
Adult and pediatric (regular) with TruST off:	I, II, III, aVR, aVL, aVF, V, V+, V1-V6 (aVR/aVL/aVF/V only with 5-lead set; V+ only with 6-lead set; all leads only with 12-lead set)
Adult and pediatric with TruST on:	I, II, III, aVR, aVL, aVF, V2, V5, dV1, dV3, dV4, dV6 **NOTE:** TruST leads are indicated by a prefix “d” before the V lead.
Neonatal:	I, II, III, aVR, aVL, aVF, V, V+ (aVR/aVL/aVF/V only with 5-lead set; V+ only with 6-lead set)
Measurement range:	15 to 300 1 b/min
Accuracy:	±2 bpm or ±1 % (whichever is greater)
Display update period:	2 s.
QRS detection:	Amplitude:0.4 to 5.0 mV (0.2 to 5.0 mV for scale settings of 0.5 mV/cm and lower) Duration:70 to 120 ms (adult and pediatric) 40 to 120 ms (neonatal)
Frequency ranges:	filter = Monitor:0.5 to 40 Hz filter = ESU:0.5 to 16 Hz filter = OFF:0.05 to 40 Hz **NOTE:** Printed ST and Rest-ECG reports conform to EC-11 diagnostic bandwidth requirements.
Degree of protection against electric shock:	Type CF
Defibrillation protection:	Yes
Arrhythmia detection:	Adult and Pediatric:Yes Neonatal:No
Pacer detection:	Adult and pediatric:Yes, on leads I, II, or III Neonatal:No
Detects pacemaker pulses with the following characteristics:	
Amplitude	±2 to ±700 mV
Width (dp)	0.2 to 2.0 ms
Rise/Fall times (min.)	0.1 d_p, 100 ms
Overshoot (min.)	0.025 a_p, 2 mV

Recharge time constant	4 to 100 ms

ECG/Arrhythmia/ST Supplemental information	
Respiration excitation waveform	Square wave signal, 50 µA, 39.896 KHz
Noise suppression	Not Applicable
Time to alarm for tachycardia	Vent tachycardia 1mVpp, 206 bpm Gain 0.5, range 3.0 to 3.5 seconds, average 3.3 seconds Gain 1.0, range 2.9 to 3.3 seconds, average 3.2 seconds Gain 2.0, range 2.8 to 3.5 seconds, average 3.0 seconds
	Vent tachycardia 2 mVpp, 195 bpm Gain 0.5, range 2.2 to 4.0 seconds, average 3.0 seconds Gain 1.0, range 1.9 to 2.5 seconds, average 2.3 seconds Gain 2.0, range 2.0 to 2.9 seconds, average 2.5 seconds
Tall T-wave rejection capability per IEC 60601-2-27:2011 Section 201.12.1.101.17	Neonatal category = 1.75 mV T-wave amplitude Adult category = 1.40 mV T-wave amplitude
Heart rate averaging method	Heart Rate is normally based on the average R-R interval calculated over the last 10 seconds, however it updates more quickly to reflect changes to the patient's underlying rate.
Response time of heart rate meter to change in heart rate	HR change from 80 to 120 bpm: Range: [3.4 to 7.1 seconds] Average: 5.3 seconds HR change from 80 to 40 bpm: Range: [6.3 to 8.6 sec] Average: 7.4 seconds
Heart rate meter accuracy and response to irregular rhythm	Ventricular bigeminy: 80bpm Slow alternating ventricular bigeminy: 60 bpm Rapid alternating ventricular bigeminy: 120 bpm Bidirectional systoles: 90 bpm
Accuracy of input signal reproduction	Methods A, B, C and D from AAMI EC11 were used to establish overall system error and frequency response.

ST-Segment Analysis

Sensed leads:	3 lead cable:I, II, or III (user-selectable) 5 lead cable:(choice of 3 leads) I, II, III, aVR, aVL, aVF, or V 6 lead cable:(choice of 3 leads) I, II, III, aVR, aVL, (w/ TruST Off)aVF, V, V+ 6 lead cable:(choice of 3 leads) I, II, III, aVR, aVL, (w/ TruST On) aVF, V1-V6, dV1, dV3, dV4, dV6 **NOTE:** TruST leads are indicated by a prefix “d” before the V lead. 12 lead cable: (choice of 3 leads) I, II, III, aVR, aVL, (Optional) aVF, V1-V6
ISO point:	Adjustment range:Complex start to fiducial point Default: QRS onset to 28 msec
ST measurement point:	Adjustment range:Fiducial point to complex end Point default:QRS offset +80 msec
ST complex:	Length: 892 msec (225 samples) Frequency response:0.05 to 40 Hz
Update interval:	15 seconds, 1 normal beat required
Trend intervals:	1, 2, 4, 8, 12, 24 hours
Trend resolution:	One data point every 30 seconds
ST level alarm adjustment range:	1 to 15 mm
ST event alarm duration:	OFF, 15, 30, 45, 60 seconds
Alarm priority:	Medium
Alarm auto set:	Current value ±2 mm

EEG

Parameter display:	Median frequency; Spectral Edge Frequency (SEF); Beta, Alpha, Theta, and Delta powers; Burst Suppression Ratio (BSR)
Channels:	Up to 4 analog waveforms and parameter boxes, 4 channel plot of power vs. frequency
Measurement range -- Median frequency:	Range: 0.5-30 Hz Resolution:0.1 Hz Accuracy:±10%
Measurement range -- Spectral Edge Frequency-SEF:	SEF Frequencies: 85, 90, 95, 97, 98% Range: 0.5 - 30 Hz Resolution:0.1 Hz Accuracy:±10 %
Measurement range -- Total Power:	Range: 44 to100 dB Resolution:1 dB Accuracy:±10 %

Measurement range -- Beta, Alpha, Theta, Delta Power:	Percentage of total power Range: 0 - 100% Resolution:1% Accuracy:±10%
Measurement range -- burst suppression ratio (BSR):	Percentage of time waveform is isoelectric over last 60s Range: 0 to100 % Resolution:1 % Accuracy:±10 %
Input signal range:	±1.125 mV
Bandwidth:	0.5 to 30 Hz
Baseline recovery time:	≤5 sec
DC offset:	±200 mV DC
Sampling rate:	8000/sec
EEG scales:	5-500 uV/div
EEG lead labels:	None, Left, Right, Front, Back, Right Front, Right Back, Left Front, Left Back, Fp, Fp1, Fp2, Fz, F3, F4, F7, F8, Cz, C3, C4, T7, T8, Pz, P3, P4, P7, P8, O, O1, O2
Trending:	24 hours Each EEG channel for the following parameters: Median frequency, spectral edge frequency, total Power, beta, alpha, theta, and delta powers, BSR
Recordings:	R50 recorder:Analog EEG waveforms Laser printer:Analog EEG waveforms, Power spectrum

Respiration

Sensing leads:	I or II (user-selectable)
Measurement method:	Impedance pneumography
Detection threshold:	0.15Ω to 4.0Ω in manual mode (user adjustment) Adult and Pediatric: 0.20Ω - 10.5Ω in auto mode (automatic adjustment) Neonatal: 0.20Ω - 1.5Ω in auto mode (automatic adjustment)
Measurement range:	0 - 155 breaths per min
Measurement accuracy:	±1 1/breath/min or 2% of rate (whichever is greater)
Apnea Detection?	Adult: No Pediatric: Yes Neonatal: Yes

Non-Invasive Blood Pressure (NBP)

Parameter display:	Systolic, Diastolic, Mean
Measurement method:	Oscillometric technique
Modes of operation:	Manual (single measurement), Continuous (5 minutes), or Interval
Interval times:	1, 2, 2.5, 3, 5, 10, 15, 20, 25, 30, 45, 60, 120, and 240 min
Measurement range (heart rate)	30 to 240 bpm
Pressure measurement range (Adult - 270 mmHg):	Systolic NBP: 30 to 250 mmHg Mean NBP: 20 to 230 mmHg Diastolic NBP: 10 to 210 mmHg
Pressure measurement range (Pediatric - 180 mmHg):	Systolic NBP: 30 to 170 mmHg Mean NBP: 20 to 150 mmHg Diastolic NBP: 10 to 130 mmHg
Pressure measurement range (Neonatal - 140 mmHg):	Systolic NBP: 30 to 130 mmHg Mean NBP: 20 to 110 mmHg Diastolic NBP: 10 to 100 mmHg
Connections:	Quick-release hose connector with single airway
Default inflation pressure:	Adult (270): 160 mmHg ±10mmHg Pediatric (180): 120 mmHg ±10 mmHg Neonatal (140): 110 mmHg ±10 mmHg
Inflation pressure after a valid measurement (±10 mmHg):	Adult (270): Previous NBP_{SYS} + 25 mmHg Pediatric (180): Previous NBP_{SYS} + 25 mmHg Neonatal (140): Previous NBP_{SYS} + 30 mmHg
Inflation pressure after an alarm:	Adult (270): 160 mmHg ±10 mmHg Pediatric (180): 120 mmHg ±10 mmHg Neonatal (140): 110 mmHg ±10 mmHg
Maximum inflation pressure:	Adult (270): 265 mmHg ±5 mmHg Pediatric (180): 180 mmHg ±10 mmHg Neonatal (140): 142 mmHg ±10 mmHg
Minimum inflation pressure:	Adult (270): 110 mmHg ±10 mmHg Pediatric (180): 90 mmHg ±10 mmHg Neonatal (140): 70 mmHg ±10 mmHg
Maximum measurement time:	Adult (270): 2 min ±1 sec Pediatric (180): 2 min ±1 sec Neonatal (140): 90 sec ±1 sec
Maximum measurement time including a retry:	Adult (270): 3 min ±1 sec Pediatric (180): 3 min ±1 sec Neonatal (140): 90 sec ±1 sec
Software safety cut-off:	Adult (270): 273 ±3 mmHg Pediatric (180): 215 ±3 mmHg Neonatal (140): 153 ±3 mmHg
Hardware safety cut-off:	Adult (270): 300 ±30 mmHg Pediatric (180): 300 ±30 mmHg Neonatal (140): 157 ±8 mmHg
Static cuff accuracy:	±3 mmHg
Calibration range:	Adult and Pediatric: 10 to 260 mmHg ±3 mmHg Neonatal: 10 to 150 mmHg ±3 mmHg

Degree of protection against electric shock:	Type CF
Defibrillation protection:	Yes

Invasive Blood Pressure (IBP)

Measurement method:	Resistive strain gauge transducer
Display resolution:	1 mmHg
Measurement range:	–50 to +400 mmHg
Frequency ranges:	DC to 8 Hz, DC to 16 Hz, and DC to 32 Hz (user selectable)
Accuracy:	±1 mmHg or ±3 % exclusive of transducer (whichever is greater)
Zero balance range:	±200 mmHg
Transducer specifications:	Dräger provided transducers with a resistance of 200 to 3000 Ω and an equivalent pressure sensitivity of 5µV/V/mmHg ±1 %
Degree of protection against electric shock:	Type CF
Defibrillation protection:	Yes

Pulse Oximetry OxiSure SpO_2 via MultiMed

Parameter display:	Saturation (%SpO_2), pulse rate
Measurement method:	Transmission spectrophotometry
Measurement range:	SpO_2: 1 to 100 % Pulse rate:30 to 250 1/bpm
Resolution:	SpO_2: 1 % Pulse rate:1 b/min
Calibration range:	70 to 100 %
Display range:	0 to 100 %
Display update period:	2 seconds
Maximum hold from previous update:	30 seconds (in the event of artifact or other error)

Measurement accuracy, adult mode[1, 2, 3, 5]:

Saturation (%SpO_2):
0 to 69% not specified
70 to 100% sensor-specific as follows:

Dräger :	
OxiSure sensor - D	±2
Nellcor : [4]	
D-25/D-25L, D-20, I-20, N-25, OxiMAX MAX-A, OxiMAX MAX-AL, OxiMAX MAX-P, OxiMAX MAX-N, OxiMAX MAX-I	±2
Nellcor :	
DS100A	±3
Masimo: [4]	
LNOPADT, LNOPPED, LNOPNEO, LNOPNEO SS,LNOP-YI	±2
Masimo:	
LNOP-DCI, LNOP-DCIP, NR125	±2
EAR	±3.5
Pulse rate:	±3 beats/min or ±3% (whichever is greater)

Measurement accuracy and notes continued on next page.

Measurement accuracy, Neonatal mode[1, 2, 3, 4, 5]:

Saturation (%SpO_2):
0 to 69% not specified
70 to 100% sensor-specific as follows:

Nellcor:
N-25, OxiMAX MAX-N ±3

Masimo:
LNOPNEO, LNOPNEO SS, LNOP-YI ±3

Pulse Rate: ±3 beats/min or ±3% (whichever is greater)

NOTES:

1) Since pulse oximeter measurements are statistically distributed, only about two-thirds of those measurements can be expected to fall within ±1 A_{rms} of the value measured by a co-oximeter.
2) These accuracies have been validated using blood samples obtained from healthy adult volunteers during induced hypoxia studies in the range of 70-100% SpO2 against a laboratory co-oximeter and ECG monitor.
3) SpO_2 accuracies are expressed as ± "X" digits between indicated saturation levels. Accuracy of the SpO_2measurement is specified within 1 A_{rms} of the value measured by a co-oximeter.
4) Accuracy of saturation measurements on neonates is decreased by ±1 digit as compared to accuracy on adult patients to account for the theoretical effect on oximeter measurements of fetal hemoglobin in neonatal blood.
5) The pulse rate accuracy has been validated on healthy adult volunteers during induced hypoxia studies in the range of 70-100% SpO2 against a laboratory co-oximeter and ECG monitor. This variation equals ±1 A_{rms} of the pulse rate value measured by the ECG monitor.
6) A functional tester cannot be used to assess the accuracy of a Pulse Oximeter Probe or a Pulse Oximeter monitor

Interfering Substances:	Carboxyhemoglobin may erroneously increase readings. The level of increase is approximately equal to the amount of carboxyhemoglobin present. Dyes, nail polishes and other substances, may absorb an abnormal amount of red light, which can effect the accuracy of the measurement. Be sure to apply the sensor to a site free of any artificial pigments.
SpO_2 alarms:	High:adjustable, 21 to 100 % Low: adjustable, 20 to 99 %
Nominal wavelength:	Dräger: Red: 660 nm IR: 905 nm Masimo: Red: 660 nm IR: 905 nm Nellcor: Red: 660 nm IR: 910 nm
Power:	Dräger: Red: 1.8 mW(max.) IR: 2.0 mW(max.) Masimo: Red: 0.9 mW(max.) IR: 0.9 mW(max.) Nellcor: Red: 3 mW(max.) IR: 4 mW(max.) **Note**: LED drive is current limited by hardware mechanisms.
Degree of protection against electric shock:	Type CF
Defibrillation protection:	No

Pulse Oximetry *(Masimo SET SpO_2 via Pod)*

Intendeduse	The Infinity Masimo SET® pod and accessories are indicated for use during both motion and non-motion conditions and for patients who are well or poorly perfused.
Parameter display:	Saturation (%SpO_2), pulse rate, perfusion
Measurement range:	%SpO_2: 1 to100 % Pulse rate:25 to 240 /min Perfusion:0.02 to 20 %

Measurement accuracy(1, 5)**:**

The following are for all Masimo LNCS and LNOP sensors.

Saturation (%SpO2) - During No Motion Conditions:(2)	
0 to 69% not specified	
70 to 100%:	
Adults, Pediatrics	±2
Neonates	±3
Saturation (%SpO2) - During Motion Conditions:(3, 4)	
0 to 69% not specified	
70 to 100%:	
Adults, Pediatrics(3)	±3
Neonates(4)	±3
Pulse Rate (bpm) - During No Motion Conditions:(2)	
Adults, Pediatrics, Neonates	25 - 240 bpm ±3
Pulse Rate (bpm) - During Motion Conditions:(3, 4)	
Adults, Pediatrics, Neonates	25 - 240 bpm ±5

NOTES:

1) Since pulse oximeter measurements are statistically distributed, only about two-thirds of those measurements can be expected to fall within ±1 A_{rms} of the value measured by a co-oximeter.
2) The Infinity® Masimo SET® SpO2 SmartPod™ pulse oximeter with LNOPAdt sensors has been validated for no motion accuracy in human blood studies on healthy adult volunteers in induced hypoxia studies in the range of 70-100% SpO2 against a laboratory co-oximeter and ECG monitor. This variation equals ±1 A_{rms} of the value measured by a co-oximeter.
3) The Masimo SET® pod with LNOP-Adt 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 a 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 - 100% SpO2 against a laboratory co-oximeter and ECG monitor. This variation equals ±1 A_{rms} of the value measured by a co-oximeter.
4) The Masimo SET® pod with LNOP-Neo and Neo Pt sensors has been validated for motion and no 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 a 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 - 100% SpO2 against a laboratory co-oximeter and ECG monitor. 1% has been added to the results to account for the effects of fetal hemoglobin.
5) The pulse rate accuracy has been validated on healthy adult volunteers during induced hypoxia studies in the range of 70-100% SpO2 against a laboratory co-oximeter and ECG monitor. This variation equals ±1 A_{rms} of the pulse rate value measured by the ECG monitor.

Nominal wavelength:	Red:	660 nm
	IR:	905 nm
Radiant power at 50 mW pulsed:	Min:	0.13 mW
	Max:	0.79 mW

Low perfusion performance:(6)	Pulse amplitude:>0.02 % Saturation (%SpO_2):±2 and %transmission >5 % Pulse rate:±3

(6)The Masimo SET® pod 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.

7) A functional tester cannot be used to assess the accuracy of a Pulse Oximeter Probe or a Pulse Oximeter monitor

Pulse Oximetry *(Nellcor Oximax SpO_2 via Pod)*

Parameter display:	Saturation (%SpO_2), pulse rate
Measurement range:	%SpO_2: 1 - 100% Pulse rate:25 - 250 /min

Measurement accuracy, Adult mode (1, 2):

Saturation (%SpO2):

0 to 60% not specified

60 to 80% sensor-specific as follows:

Nellcor : OxiMAX MAX-A, OxiMAX MAX-AL, OxiMAX MAX-P, OxiMAX MAX-N, OxiMAX MAX-I, OxiMAX MAX-FAST	±3
Nellcor : SC-A, MAX-R, OxiCliq A, OxiCliq P, OxiCliq N, OxiCliq I, D-YS, DS-100A, OXI-A/N, OXI-P/I	not specified

70 to 100% sensor-specific as follows:

Nellcor : OxiMAX MAX-A, OxiMAX MAX-AL, OxiMAX MAX-P, OxiMAX MAX-N, OxiMAX MAX-I, OxiMAX MAX-FAST SC-A	±2
Nellcor : OxiCliq A, OxiCliq P, OxiCliq N, OxiCliq I	±2.5
Nellcor : D-YS, DS-100A, OXI-A/N, OXI-P/I	±3
Nellcor : D-YS with D-YSE Ear Clip, D-YS with D-YSPD Spot Clip	±3.5

80 to 100% sensor-specific as follows:

Nellcor : MAX-R	±3.5

Pulse Rate (3) : 25 - 250 bpm ±3 beats/min or ±3% (whichever is greater)

NOTES:
1) Since pulse oximeter measurements are statistically distributed, only about two-thirds of those measurements can be expected to fall within ±1 A_{rms} of the value measured by a co-oximeter.
2) The Infinity® Nellcor Oximax® SpO2 SmartPod™ pulse oximeter with Adult sensors has been validated in human blood studies on healthy adult volunteers in induced hypoxia studies in the range of 70-100% SpO2 against a laboratory co-oximeter and ECG monitor. This variation equals ±1 A_{rms} of the value measured by a co-oximeter.
3) The pulse rate accuracy has been validated on healthy adult volunteers during induced hypoxia studies in the range of 70-100% SpO2 against a laboratory co-oximeter and ECG monitor. This variation equals ±1 A_{rms} of the pulse rate value measured by the ECG monitor.
4) A functional tester cannot be used to assess the accuracy of a Pulse Oximeter Probe or a Pulse Oximeter monitor

Measurement accuracy, Neonatal mode (1, 2):	
Saturation (%SpO2):	
0 to 60% not specified	
60 to 80% sensor-specific as follows:	
Nellcor :	
OxiMAX MAX-N	±3
Nellcor :	
SC-PR, SC-NEO, OxiCliq N, D-YS, OXI-A/N	not specified
70 to 100% sensor-specific as follows:	
Nellcor:	
Nellcor :	
OxiMAX MAX-N, SC-PR, SC-NEO	±2
Nellcor :	
OxiCliq N	±3.5
Nellcor :	
D-YS, OXI-A/N	±4
Pulse Rate(3):	±3 beats/min or ±3% (whichever is greater)

NOTES:
1) Since pulse oximeter measurements are statistically distributed, only about two-thirds of those measurements can be expected to fall within ±1 A_{rms} of the value measured by a co-oximeter.
2) The Infinity® Nellcor Oximax® SpO2 SmartPod™ pulse oximeter with Adult sensors has been validated in human blood studies on healthy adult volunteers in induced hypoxia studies in the range of 70-100% SpO2 against a laboratory co-oximeter and ECG monitor. This variation equals ±1 A_{rms} of the value measured by a co-oximeter.
3) The pulse rate accuracy has been validated on healthy adult volunteers during induced hypoxia studies in the range of 70-100% SpO2 against a laboratory co-oximeter and ECG monitor. This variation equals ±1 A_{rms} of the pulse rate value measured by the ECG monitor.

Nominal wavelength:	Red: 660 nm IR: 910 nm

tpO_2/CO_2

Parameter display:	tpO2, tpCO2 parameter values; plus selectable on oxy-cardirespirogram
Sensing element:	tpO2/tpCO2 solid-state, dual-thermistor electrode
Measurement range:	tpO2: 0 to 800 mmHg tpCO2: 0 to 200 mmHg
Resolution:	1 mmHg
Reporting interval:	once every 1.2 s

Accuracy:	tpO2: 40 to100 mmHg ±1 mmHg <40 or >100 mmHg ±2 % or ±5 mmHg, whichever is greater tpCO2: 30 to 80 mmHg: ±1 mmHg <30 or >80 mmHg ±3 mmHg
Drift:	O2: ±5 % over recommended calibration interval CO2: ±10 % over recommended calibration interval
Non-linearity:	±5 mmHg
Hysteresis:	±5 mmHg
Response time:	10 to 90 % response to a step change of O2: 20 s 10 to 90 % response to a step change of CO2: 20 s
Site timer:	0 to 8 hours or OFF (selectable)
Temperature setting:	37 to 45 °C, selectable
Sensor calibration:	One-point calibration with CAL1 gas (fixed gas concentration of 20.9 % O2 and 5.0 % CO2)
Barometric pressure:	500 to 800 mmHg, selectable
Heating power:	Measurement range:0 to 660 mW Resolution:0.1 °C Accuracy:±10 %

End-Tidal CO_2 ($etCO_2$) *via $etCO_2$ module or pod*

Parameter display:	etCO2, iCO2, Respiration Rate (RRc)
Measurement method:	Dual wavelength, non-dispersive infrared absorption
Measurement modes:	Adult and Pediatric:Mainstream and Sidestream Neonatal:Mainstream only
Warm up:	≤5 min (at 25 °C)
Measurement range:	0 to 99 mmHg CO2 partial pressure
Accuracy:	0 to 40 mmHg:±2 mmHg 41 to 70 mmHg:±5 % of reading 71 to 99 mmHg:±8 % of reading Stable over 24 hours, over full range of readings at atmospheric pressure
Drift of measurement accuracy:	≤1.6 mmHg over 8 hours
Quantitative effects of humidity and condensate on accuracy	Full accuracy specifications are maintained for all non-condensing humidity levels.
Adverse effects on performance of cyclical pressures up to 10 kPa (100 cmH2O)	No effect on accuracy
Effect of barometric pressure on accuracy	No effect on accuracy

Calibration:	Verify once a day Calibrate when moving the sensor from one module to another Calibration time:< 20 s
Compensation:	Balance: User-selectable Atm. pressure:Automatic or user-selectable (540 to 800 mmHg)
Sampling flow rate:	180 ±12 mL/min (sidestream measurement mode)
Gas leakage:	<1.6 ml/min
Alarm limit resolution:	$etCO_2$, iCO_2: 0.1 mmHg (0.01 kPa) RRc: 1 breath/min
Apnea detection?	Adult: Yes Pediatric: Yes Neonatal:Yes
RRc range (pod):	Mainstream:0-149 breaths/min Sidestream:0-69 breaths/min Accuracy:±1 breath/min
Rise time:	Mainstream:<100 ms Sidestream:<200 ms
Delay time:	Mainstream:<100 ms Sidestream:<450 ms
Total system response time:	Rise time plus delay time

Cross-sensitivity Compensation Error: Gas measurement accuracy was tested at the gas levels listed in the following table. The additional worst case error when compensation is correctly selected (for barometric pressure, O2, and N2O) for the actual fractional gas constituents that are present is:
0 to 40 mmHg: ± 2 mmHg additional error
41 to 70 mmHg: ± 3 % additional error
71 to 99 mmHg: ± 5 % additional error

Additional notes regarding cross-sensitivity compensation errors:
Xenon and Helium: Constantly bias etCO2 values >= 38 mmHg by up to –5 mmHg
Desflurane: At concentrations > 5%, constantly biases etCO2 values >= 38 mmHg by up to +4 mmHg

Quantitative Effects Measured At	
Gas or Vapor	**Gas Level *(Gas levels in % volume fraction)***
Nitrous oxide	60
Halothane	4
Enflurane	5
Isoflurane	5
Sevoflurane	5
Xenon	80

Helium	50
Metered dose inhaler propellants	Not specified for use
Desflurane	15
Ethanol	0.1
Isopropanol	0.1
Acetone	0.1
Methane	1.0

End-Tidal CO_2 ($etCO_2$) *via INFINITY $etCO_2$ Microstream™ pod*

Parameter display:	$etCO_2$, iCO_2, Respiration Rate (RRc)
Measurement method:	Dual wavelength, non-dispersive infrared absorption
Measurement modes:	Adult, Pediatric and Neonatal: Sidestream only
Measurement range:	0-99 mmHg CO2 partial pressure
Accuracy (full accuracy from the time the first value appears on the screen):	0 to 38 mmHg:±2 mmHg 39 to 99 mmHg:±5 % of reading +0.08 % for every 1 mmHg (above 38 mmHg)
Drift of measurement accuracy:	None
Quantitative effects of humidity and condensate on accuracy	Full accuracy specifications are maintained for all non-condensing humidity levels.
Adverse effects on performance of cyclical pressures up to 10 kPa (100 cmH2O)	No effect on accuracy
Effect of barometric pressure on accuracy	No effect on accuracy
Sampling flow rate:	50 +15 mL/min. or –7.5 mL/min.
Gas leakage:	Not applicable
Alarm limit resolution:	$etCO_2$, iCO2: 0.1 mmHg (0.01 kPa) RRc: 1 breath/min
RRc range (pod):	0-150 breaths/min
RRc accuracy	0 to 70 bpm:±1 bpm 71 to 120 bpm:±2 bpm 121 to 150 bpm:±3 bpm **NOTE:** A breath simulator system combined with CO2 and N2 gases was used to simulate respiration rates covering the specified range. The resulting end tidal CO2 values were compared to the expected value. Differences between actual and expected end tidal CO2 values were within the limits of the specified accuracy for the respective respiration rate, i.e. there was no effect of the respiration rate on the end tidal CO2 values beyond those limits.

Rise time (10 to 90%):	≤190 ms
Delay time:	2.7 sec. maximum @ flow 50 mL/min with standard FilterLine™
Total system response time:	Typical 4 s
Compensation:	BTPS (standard correction used by Microstream capnography during all measurement procedures for body temperature, pressure, and saturation)
Calibration interval:	Initially calibrate after 1,200 operating hours, then once a year or after 4,000 operating hours, whichever comes first. The initial calibration should not occur before 720 hours of use.

Cross-sensitivity Compensation Error: Gas measurement accuracy is unaffected at the gas levels listed in the following table:

Quantitative Effects Measured At	
Gas or Vapor	**Gas Level *(Gas levels in % volume fraction)***
Nitrous oxide	80
Halothane	6.5
Enflurane	6.5
Isoflurane	6.5
Sevoflurane	9
Xenon	80
Helium	80
Metered dose inhaler propellants	Not specified for use
Desflurane	24
Ethanol	0.1
Isopropanol	0.1
Acetone	0.1
Methane	1.0

$etCO_2$/Respiratory Mechanics

Pressure Parameters		
Measurement range, Adult	PIP PEEP tPEEP MAP Pause	0 to 120 cmH2O 0 to 98 cmH2O 0 to 98 cmH2O 0 to 120 cmH2O 0 to 120 cmH2O
Measurement range, Pediatric	PIP PEEP tPEEP MAP Pause	0 to 120 cmH2O 0 to 98 cmH2O 0 to 98 cmH2O 0 to 120 cmH2O 0 to 120 cmH2O
Measurement range, Neonatal	PIP PEEP tPEEP MAP Pause	0 to 120 cmH2O 0 to 98 cmH2O 0 to 98 cmH2O 0 to 120 cmH2O 0 to 120 cmH2O
Flow/volume parameters		
Measurement range, Adult	PIF PEF TVi TVe RRv MVe TV Ik	0 to 180 L/min 0 to 180 L/min 0, 100 to 3000 mL 0, 100 to 3000 mL 0 to 150 1/min 0 to 60 L/min 0 to 100 %
Measurement range, Pediatric	PIF PEF TVi TVe RRv MVe TV Ik	0 to 120 L/min 0 to 120 L/min 0, 10 to 3000 mL 0, 10 to 3000 mL 0 to 150 1/min 0 to 60 L/min 0 to 100 %
Measurement range, Neonatal	PIF PEF TVi TVe RRv MVe TV Ik	0 to 28 L/min (etCO2/flow), 0 to 40 (flow only) (PIF& PEF) 0, 100 to 500 mL 0, 100 to 500 mL 0 to 150 1/min 0 to 10 L/min 0 to 100 %
Measurement range, Adult/Pediatric	TVi s, TVi m, TVe s, TVe m MVe s, MVe m RRs, RRm	0, 100 to 3000 mL 0 to 60 L/min 0 to150 1/min
Measurement range, Neonatal	TVi s, TVi m, TVe s, TVe m MVe s, MVe m RRs, RRm	0, 2 to 500 mL 0 to 10 L/min 0 to 150 1/min

Flow/Volume Parameters (Derived)		
Measurement range, Adult/Pediatric	Raw i, Raw e Cdyn C20/Cdyn RSBI I:E Ti, Te InspT% WOBimp	0 to 100tocmH2O/L/s 0 to 500tomL/cmH2O Not applicable 0 to 1000tobpm/L 6:1, 1:6 0 to 15tosec 0 to 100 0 to 8 J/L/s
Measurement range, Neonatal	Raw i, Raw e Cdyn C20/Cdyn RSBI I:E Ti, Te InspT% WOBimp	0 to 500 cmH2O/L/s 0 to 500 mL/cmH2O 0 to 1 Not applicable 6:1, 1:6 0 to 15 sec 0 to 100 Not applicable
Flow/Volume/CO2 Parameters (Derived)		
Measurement range Adult	VCO2 TVCO2 TValv s, TValv m, TValv MValv s, MValv m,MValv PeCO2 TVd aw TVd/TVaw	0 to 400 mL 0 to 120 mL 0, 100 to 3000 mL 0 to 60 L/min 0 to 50 mmHg 0 to 500 mL 0 to 0.75
Measurement range Pediatric	VCO2 TVCO2 TValv s, TValv m, TValv MValv s, MValv m,MValv PeCO2 TVd aw TVd/TVaw	0 to 400 mL 0 to 120 mL 0, 10 to 400 mL 0 to 30 L/min 0 to 50 mmHg 0 to 500 mL 0 to 0.75
Measurement range Neonatal	VCO2 TVCO2 TValv s, TValv m, TValv MValv s, MValv m,MValv PeCO2 TVd aw TVd/TVaw	0 to 400 mL 0 to 120 cmL 0, 2 to 250 mL 0 to 8 L/min 0 to 50 mmHg 0 to 250 mL Not applicable

Airway Adapter and sensor dimensions			
Type	Deadspace	Inner diameter	Weight without tubing
Flow Neonatal	<1 mL	5 mm	<7 g
Flow Adult/Pediatric	6.5 mL	15 mm	<9 g
CO2/Flow Neonatal	<1 mL	5 mm	<11 g
CO2/Flow Pediatric	<4 mL	10 mm	<11 g

CO2/Flow Adult/Pediatric	8 mL	15 mm	<11 g

Flow Performance		
Adapter/Sensor Type	**Flow Range**	**Flow Accuracy**
Flow neonatal	±40	Greater of ±3 % reading or 0.125 L/min
Flow adult/pediatric	±180	Greater of ±3 % reading or 0.5 L/min
CO2/Flow neonatal	±25	Greater of ±3 % reading or 0.125 L/min
CO2/Flow pediatric	±120	Greater of ±3 % reading or 0.25 L/min
CO2/Flow adult/pediatric	±180	Greater of ±3 % reading or 0.5 L/min
Note: Static flow testing with standard, known temperature, gas composition and straight inlet conditions		
Pressure Performance		
Adapter/Sensor Type	**Airway Pressure Range**	**Pressure Accuracy**
Flow neonatal or adult/pediatric	±120 cmH2O	Greater of ±2 % or 0.5 cmH2O
CO2/Flow neonatal, pediatric or adult/pediatric	±120 cmH2O	Greater of ±2 % or 0.5 cmH2O
Note: Static testing with standard, known pressure condition		
CO2 Performance		
Adapter/sensor type/size	**CO2 Range**	**CO2 Accuracy**
Flow (all sizes)	0 to 40	±2 mmHg
	41 to 70	±5 % of reading
	71 to 99	±8 % of reading
CO2/Flow (all sizes)	0 to 40	±2 mmHg
	41 to 70	±5 % of reading
	71 to 99	±8 % of reading
NOTE: Accuracy obtained under specified test conditions		
CO2 alarm limit resolution:	0.1 mmHg (0.01 kPa)	
Quantitative effects of humidity and condensate on accuracy	Full accuracy specifications are maintained for all non-condensing humidity levels.	
Adverse effects on performance of cyclical pressures up to 10 kPa (100 cmH2O)	No effect on accuracy	
Effect of barometric pressure on accuracy	No effect on accuracy	
Gas leakage:	<1.6 ml/min	

Cross-sensitivity Compensation Error: Gas measurement accuracy was tested at the gas levels listed in the following table. The additional worst case error when compensation is correctly selected (for barometric pressure, O2, and N2O) for the actual fractional gas constituents that are present is: 0 to 40 mmHg: ±2 mmHg additional error 41 to 70 mmHg: ±3 % additional error 71 to 99 mmHg: ±5 % additional error
Additional notes regarding cross-sensitivity compensation errors: Xenon and Helium: Constantly bias etCO2 values >= 38 mmHg by up to –5 mmHg Desflurane: At concentrations > 5%, constantly biases etCO2 values >= 38 mmHg by up to +4tommHg

Quantitative Effects Measured At	
Gas or Vapor	**Gas Level *(Gas levels in % volume fraction)***
Nitrous oxide	60
Halothane	4
Enflurane	5
Isoflurane	5
Sevoflurane	5
Xenon	80
Helium	50
Metered dose inhaler propellants	Not specified for use
Desflurane	15
Ethanol	0.1
Isopropanol	0.1
Acetone	0.1
Methane	1.0

FiO_2

Oxygen measurement range:	5-100% O2
Accuracy:	One point calibration:≤14.2 % FS (at RTP) Two point calibration:≤3 % FS (at RTP)
Warm up:	Value available immediately after calibration
Nominal response time:	97 % in 30 seconds (flow rate = 2L/min at RTP)

Alarm limit range:	18 to100 %
Stability of accuracy:	±3 % over an 8-hour interval
Protection against electric shock:	Type CF
Note: RTP = Room temperature / pressure 23 °C ±3 and ambient barometric pressure	

MultiGas Monitoring

Parameter display:	etCO2*, iCO2*, RRc*, et O2, iO2, O2, N2O, etHAL, iHAL, etISO, iISO, etENF, iENF, etSEV, iSEV, etDES, iDES **NOTE:** Asterisks distinguish gas analyzer parameter labels from those of the etCO_2 module.
Display values:	Agents: CO2, O2:Inspired and expired concentrations (%), plus trend, and waveform N2O: Inspired and expired concentrations (%)
Alarm limit resolution:	CO2: 0.1 % O2, N2O: 1 % Agents: 0.1 %

NMT *Via Trident Pod*

Stimulation current:	Auto mode: read-only; displayed value is based on reference measurement at startup (max. 60 mA into impedances of 0 to 6.6 k Ohms) Manual mode: 5 mA (default) to 60 mA, in incr. of 5mA
Pulse width:	100, 200 (default) or 300 µs (Monophasic)
Measurement range:	NMT-Temp:20 to 40 °C Single: 0 to 200 % (of reference twitch) TOF-Ratio:4 to 150 % TOF-Count:0 to 4 (number of twitches) (if TOF-Ratio <4 % or number of twitches <4) PTC: 0 to 20 (number of twitches)
Measurement interval:	None, 1s, 10s, 20s (default), 1min, 5min, 15min, 30min
Accuracy:	NMT-Temp:±1 °C Single: ±10 % TOF-Ratio:±10 %
Display resolution:	NMT-Temp:1 °C Single/TOF-Ratio:1% TOF-Count/PTC:1

Trend scale range:	NMT-Temp:20 to 40° C (incr. of 1 °C) Single: 0 to 200 % (incr. of 5 %) TOF-Ratio:0 to 150 % (incr. of 5 %) TOF-Count:0 to 4 (incr. of 1) PTC: 0 to 20 (incr. of 1)

BIS Parameters *Via BISx Pod*

BIS index:	Parameter Label:BIS Measurement Range:0 to 100 Display Resolution:1
Signal quality index:	Parameter Label:SQI Measurement Range:0 to 100% Display Resolution:1
Suppression ratio:	Parameter Label:BSR Measurement Range:0 to 100% Display Resolution:1%
EMG:	Parameter Label:EMG Measurement Range:0 to 100 dB (in the frequency range from 70-110 Hz) Display Resolution:1 dB
Total power:	Parameter Label:PWR Measurement Range:40 to 100 dB (frequency range 0.5-30 Hz) Display Resolution:1 dB
Spectral edge frequency:	Parameter Label:SEF Measurement Range:0.5 to 30 Hz Display Resolution:0.1 Hz
Burst Count:	Parameter Label:BCT Measurement Range:0 to 30 Display Resolution:1

Temperature

Parameter display:	Absolute temperature, delta temperature (with hemodynamic pods)
Measurement range:	Absolute:–5 to 50 °C (23 to 122 °F) Delta: 0 to 55 °C (32 to 131 °F)
Resolution:	0.1 °C
Accuracy:	Absolute:±0.1 °C Delta: ±0.2 °C
Average response time:	<2.5 seconds
Probe accuracy:	±0.2 °C 0 to 25 °C ±0.1 °C25 to 45 °C
Degree of protection against electric shock:	Type CF
Defibrillation protection:	Yes
NOTE: Range and accuracy values are also applicable to hemodynamic pods.	

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C Approved Options and Accessories

WARNING: Disposable accessories (such as disposable electrodes, transducers, etc.) are for single use only. Do not reuse disposable accessories.

NOTE: Part numbers are subject to change. Contact your Sales representative for the most current part numbers and accessories.

Power Supply

Power Cords

Power cord Cont. Europe, CEE 7, 2.5 m	4321712
Power cord North America, 5-15P, 2.25 m (7.4 ft)	4321720
Power cord Australia and New Zealand AS 3112, 3 m	1851705
Power cord Great Britain, BS 1363, 3 m	1851713
Power cord Switzerland, SEV 1011, 3 m	4321613
Power cord China, GB1002, 3 m	1859714
Power cord Denmark, 3 m	1868950
Power cord Brazil, NBR 14136, 3 m	1875523
Power cord, 3 m	1869833
Power cord Thailand, NEMA 515P 250V, 3 m	1868160

Power Adapters

Power adapter (IDS power supply) *Including: 2.5 m connection cable to IDS. Mains power inlet cable must be ordered separately.*	MS18284

Power adapter *Mains power inlet cable must be ordered separately.*	5955393

NOTE: Power adapters greater than or equal to revision 6 can be used to connect to Delta and Delta XL monitors and all Infinity Docking Stations (IDS). Any power adapters prior to revision 6 are only to be used to connect to Delta and Delta XL directly.

NOTE: This power adapter is no longer commercially available and has been replaced by MS18284.

AC power adapter, universal *Mains power inlet cable must be ordered separately.*	5188607

NOTE: This power adapter is not for use with any Infinity Docking Station.

NOTE: This power adapter is no longer commercially available and has been replaced by MS18284.

Grounding Cable

Grounding cable, 5 m *Connects monitor chassis to earth ground; has two spring catches*	2171767

Infinity Docking Station (IDS)

Infinity Docking Station (IDS)	5206110
Infinity Docking Station (IDS), interface and power	5732388
Infinity Docking Station (IDS), integrated MIB	7489375
Infinity Docking Station — basic *Provides mechanical mounting for Delta or Delta XL devices. Can be used with Docking Station Bed Mount (5188813) during patient transport.*	4715319
Option MIB II, 4 channel for IDS *Supports connection of up to 4 MIB devices*	7261246

Wireless Card

WLAN client adapter 802.11 b/g *Consists of a wireless card (MS24694) and adapter (MS24595)*	MS25009

Mounting

Shelf mount, Docking Station *Shelf mount for Docking Station or interface plate, allows for tilt and swivel*	4720087
Wall mount, Docking Station *Universal mount for Docking Station or interface plate, 23 cm extending arm on vertical track*	4720111
Bed mount, Docking Station *Mount for securing Docking Station to a bed rail*	5188813
Rolling stand, Docking Station *Mobile rolling stand for attaching IDS or interface plate (with basket)*	4722240
Pick and Go EasiArm mount kit *Includes mount, mount plate (PGEA) and GCX and Westbrook wall track*	7498913
Wall mount adapter for IDS *Adapter to mount IDS to the vertical track of IDS wall mount 4720111*	4720061
Rail mount for IDS power supply *Plate for mounting IDS power supply on horizontal rails*	4720095
Wall bracket for IDS *Wall-mountable bracket for holding IDS*	4720129
Rolling-stand bracket for IDS *Bracket to mount IDS power supply on pole of a rolling stand*	4720103
Mount adapter, monitor + R50 recorder *Bracket to mount an R50 recorder next to bedside monitor*	4720145
R50 countertop plate *Plate to stabilize R50 recorder on a countertop* *For use with interface plate 3376493*	5197384
Interface plate *Provides alarm output, recorder, and remote display connections and data export RS-232* *Can be connected to bottom of monitor or R50 recorder* *Not for use with IDS*	3376493

Cable management bracket *Mounts under IDS*	7267037
Clamp mount docking station *Clamp to mount Docking Station or interface plate to vertical poles (1.3 to 3.8 cm diameter) or horizontal bars (10 x 25 mm)*	MS17338

External Connection Accessories

RS232 diagnostic UART cable, 3 m *For interface between a monitor and a PC for diagnostic applications*	4714346
QRS sync cable, 3 m *One end unterminated*	4314667
Analog output cable, 5 m *One end unterminated*	4314618
Alarm output cable, 5 m *For connecting an IDS to a nurse-call system* *5 m cable with one end unterminated*	5194928
Alarm output cable, interface plate, 5 m *For connecting to a nurse-call system* *5 m cable with one end unterminated*	4314626
Y-cable, recorder and alarm output *For simultaneous recorder and alarm output connection from an interface plate*	4313578
Y-cable, IDS to remote keypad	5596288
Transmitter analog ECG cable *Connects transmitter to MultiMed cable, to display lead II. For use with Infinity Telemetry or TruST Telemetry transmitter*	4316621
Vital connection cable *Connects Infinity Telemetry transmitter to monitor via the X8 connector for NBP and SpO_2 measurements*	MS15421
SDC to IDS cable, 25 m	5194910
Export protocol cable, IDS 3 m *For technical details regarding export protocol and cable termination, refer to Infinity RS232 Export Protocol handbook*	5206441

Network Patch Cables

NOTE: The Infinity network patch cables are not recommended for connecting the MIB II protocol converter to the IDS or the Infinity Kappa monitor. The recommended patch cables can be found under the section entitled "External Device Interface" on page C-6.

Patch cable, 1.2 m *Shielded cable to connect the IDS or a monitor to a network wallplate*	4726373
Patch cable, 2.4 m *Shielded cable to connect the IDS or a monitorto a network wallplate*	4726381
Patch cable, 4.9 m *Shielded cable to connect the IDS or a monitor to a network wallplate*	4726399
Patch cable, 20 m *Shielded cable to connect the IDS or a monitor to a network wallplate; comes with extra connector for field termination*	4725557

R50 Recorders and Recorder Cables

R50 recorder (includes paper)	5952630
R50-N recorder (includes paper and a mounting plate)	5740068
Recording paper, 10 rolls	4711201
R50 recorder cables, IDS-interface plate, 1.5 m *Cable to connect an R50 Recorder to the IDS (requires interface plate)*	4721770
Recorder cable, IDS-R50, 3 m *Cable to connect an R50 recorder to a IDS (interface plate not required)*	4313560
Recorder cable, 0.6 m *Cable to connect an R50 recorder to a monitor equipped with an interface plate*	4313586

External Device Interface

MIB II protocol converter	7256931
MIB connection cable, 3 m *Cable to connect the MIB protocol converter to an IDS*	5589093
MIB cable, Abbott Oximetrix [3]	5742981
MIB cable, Abbott Q2/Q2+ Continuous Cardiac Output/SvO_2	7493344
MIB cable, AVL Opti CCA	5742999

MIB cable, Aspect A-2000 BIS monitor	5950220
MIB cable, Edwards/Baxter Vigilance/Vigilance II	5198929
NOTE: Due to corporate mergers, Baxter accessories may be labelled as being from Edwards. Contact Edwards if there is any doubt as to the identity of the accessories.	
MIB cable, Dräger Evita 2, Evita 4/Evita XL/Savina/Fabius CE, Babylog ventilators	5198952
MIB cable, Evita Infinity V500 [1, 4]	5189829
This cable requires an adapter	
MIB cable, Dräger Cato, Cicero B, Cicero EM (B/W)	5736355
MIB cable, Dräger Julian, Cicero C (flow support), Cicero EM (Color), Fabius GS[2], Tiro[2], Primus, Apollo (flow)	5736348
MIB cable, Dräger Julian/Apollo/Primus (CO_2 support)	7493690
MIB cable, Dräger Narkomed 2/4, 6000, 6400	5944074
Radiometer MIB cable, Hamilton Galileo ventilator	7493310
MIB cable, Radiometer MicroGas 7650 monitor	7493351
MIB cable, BD/Ohmeda CD	5944082
NOTE: Due to corporate mergers, Ohmeda accessories may be labelled as being from Becton Dickinson (BD). Contact BD if there is any doubt as to the identity of the accessories.	
MIB cable, Puritan Bennett 840 ventilator	7493336
MIB cable, Puritan Bennett 7200	5198937
MIB cable, Siemens Servo[i]	5954537
MIB cable, Siemens Servo Ventilator 300/300A	5198911
MIB cable, Siemens Servo Ventilator 900	5198945
MIB cable, Taema Horus ventilator	7493328
MIB cable, Viasys BEAR 1000/BEAR cub Ventilator	MS16476
MIB cable, VIA V-ABG[1]	5743872
MIB cable, Dräger Zeus	MS16991
MIB cable, Dräger Fabius GS[3], Tiro[3]	MS16186
MIB cable, Dräger Caleo, C2000/C2000E incubators and Babytherm warmer	MS18805
MIB cable, Somanetics INVOS 5100C[1]	MS24505
MIB cable, DatexOhmeda/GE Aestiva/Aespire 7900/7100[1]	MS24506
Double shielded patch cable, 1.5 m	MS26957
Shielded cable to connect the IDS to the MIB II Protocol Converter	
Double shielded patch cable, 2.4 m	MS26955
Shielded cable to connect the IDS to the MIB II Protocol Converter	
Double shielded patch cable, 5 m	MS26956
Shielded cable to connect the IDS to the MIB II Protocol Converter	

Double shielded patch cable, 15.2 m *Shielded cable to connect the IDS to the MIB II Protocol Converter*	MS27314

[1] Requires VF8 or higher software
[2] For devices built since September 2004 (SN>ARUK0001)
[3] For devices built prior to September 2004 (SN<ARUK0001) flow not supported
[4] Requires MIB software VF8.1 or higher and monitor software VF8.0 or higher

Displays and Display Components

Surgical Display Controller

Surgical Display Controller (ISD), (includes 5191213)	5193110
Adapter cable, 25 m *Cable to connect the ISD to a IDS*	5194910
Remote display cable, 25 m	5191213

Monitor Options

5 to 6 channel option *Expands display to six channels*	5597914
6 to 8 channel option *Expands display to eight channels*	5597922
4 to 5 channel option for Kappa monitor *Not required when ordering the 5 to 6 channel option*	5597211
ACE full arrhythmia option *Adds calls for run, bigeminy, couplet, PVC, and accelerated ventricular rhythm*	4322967
ARIES 12 lead ST option *Provides 12 lead ST analysis with the MultiMed 12 pod and 8 lead ST analysis with the MultiMed 6 pod*	5597328
3-Lead ST analysis option *Not required if ARIES option is installed*	5201988
Physiological calculation option	5201996
PodCom option *Adds a second pod communication channel*	5597203

Handle Hook mount, Delta/Delta XL	MS15202
Wireless option	7498087
ARIES/PhysioCalcs/arrhythmia package	5943910
OR mode (stored in monitor)	MS17653
OR mode (stored in IDS)	MS17034

ECG

MultiMed and NeoMed Pods

WARNING: The NeoMed and the MultiMed 12 pods are not intended for use during electrosurgery. To protect patients from burns, do not use these pods in an ESU environment.

Multiparameter cable MultiMed® plus, for ECG, resp., SpO2, and temp., 2.5 m	MS20093
Multiparameter cable MultiMed® plus OR, for ECG, resp., SpO2 and temp., 2.5 m	MS20094
Multiparameter cable MultiMed® 5 Pod, for ECG, resp., SpO2, and temp., 2.5 m	3368391
Multiparameter cable MultiMed® 5 Pod, for ECG, resp., SpO2, and temp., 1.5 m	5950196
Multiparameter cable MultiMed® 6 Pod, for ECG, resp., SpO2, and temp., 2.5 m	5191221
MultiMed 12 pod, accommodates: *ECG 12-lead patient cables* *1 SpO_2 extension cable*	5589663
Multiparameter cable NeoMed Pod, for ECG, resp., SpO2, temp., and FiO2, 2.5 m	5590539
ECG intermediate cable, 3-lead, for NeoMed Pod, 1.5 m	5592162
ECG neonatal 3-lead adapter cable, 2 m *Connects the MultiMed plus pods (single-pin connector style) to disposable neonatal ECG electrodes (5195024)* Do not use the ECG neonatal 3-lead adapter cable with the ECG extension cable (MS16256) during electrosurgery (ESU)	MS25951
ECG ESU block, for OR use of 3- or 5-lead ECG cables with MultiMed® 5 *Only for use during electrosurgery (can use with 3- or 5-lead ECG lead sets)*	5947226
ECG ESU block, for OR use of 3-, 5-, or 6-lead ECG cables with MultiMed® 6 *Only for use during electrosurgery (can use with 3-, 5- or 6-lead ECG lead sets)*	7486140

ECG electrodes, single-patient use, adult/child, 50 pcs.	4527750
Electrode adapter, to connect neonatal electrodes to MultiMed® pod, 10 pcs. *For connection of neonatal electrodes to the MULTIMED pods and ECG intermediate cables*	5194779
ECG electrodes, single-patient use, neonate, 300 pcs.	5195024

ECG Leads

IEC Color Code 1 (IEC1) is the European color scheme:

3-lead	RA red, LL green, LA yellow
5-lead	RA red, LL green, LA yellow, RL black, V white
6-lead	RA red, LL green, LA yellow, RL black, V white, V+ gray & white
12-lead	RA red, LL green, LA yellow, RL black, V1 white & red, V2 white & yellow, V3 white & green, V4 white & brown, V5 white & black, V6 white & violet

IEC Color Code 2 (IEC2) is the AHA/US color scheme:

3-lead	RA white, LL red, LA black
5-lead	RA white, LL red, LA black, RL green, V brown
6-lead	RA white, LL red, LA black, RL green, V brown, V+ gray & brown
12-lead	RA white, LL red, LA black, RL green, V1 brown & red, V2 brown & yellow, V3 brown & green, V4 brown & blue, V5 brown & orange, V6 brown & violet

NOTE: Unless otherwise specified all lead-set lengths are 1 meter (1 m).

ECG Leads for Single-Patient Use (Single pin version - for direct connection to MultiMed Plus and MultiMed Plus OR)

ECG cable, 3-lead, single-pin connector, single-pat. use, IEC1 (European color code), 1 m	MP00875
ECG cable, 3-lead, single-pin conn., single-pat. use, IEC2 (AHA/US color code), 1 m	MP00877
ECG cable, 5-lead, single-pin conn., single-pat. use, IEC1 (European color code), 1/1.5 m	MP00879
ECG cable, 5-lead, single-pin conn., single-pat. use, IEC2 (AHA/US color code), 1/1.5m	MP00881
ECG cable, 6-lead, single-pin connector, single-patient use, IEC1 (European color code), 1/1.5 m	MP03122
ECG cable, 6-lead, single-pin connector, single-patient use, IEC2 (AHA/US color code), 1/1.5 m	MP03123
ECG extension cable, single-pin connector, 2 m	MS16256

Standard ECG Lead Sets (Single pin version - for direct connection to MultiMed Plus and MultiMed Plus OR)

ECG cable, 6-lead, single-pin connector, IEC1 (Euro) 1 m	MS16157
ECG cable, 6-lead, single-pin connector, IEC2 (AHA/US color code)	MS16547
ECG cable, 3-lead, single-pin connector, IEC1 (European color code), 1 m	MS16159
ECG cable, 5-lead, single-pin connector, IEC1 (Eur. color code), 1 m	MS16158
ECG cable, 3-lead, single-pin connector, IEC2 (AHA/US color code), 1 m	MS16231
ECG cable, 5-lead, single-pin connector, IEC2 (AHA/US color code), 1 m	MS16546
ECG extension cable, single-pin connector, 2 m	MS16256

MonoLead - (single pin version - for direct connection to MultiMed Plus and MultiMed Plus OR)

ECG cable, 3-lead, single-pin connector MonoLead® 3, IEC1 (Euro) 2m	MS14555
ECG MonoLead 3, IEC1 (EURO), 4.1m*	MS28561
ECG cable, 5-lead, single-pin connector MonoLead® 5, IEC1 (Euro) 2.5m	MS14559
ECG MonoLead 5, IEC1 (EURO), 5.3m*	MS28559
ECG MonoLead 6, IEC1 (EURO), 5.7m*	MS17185
ECG cable, 6-lead, single-pin connector MonoLead® 6, IEC1 (Euro) 3.1 m	MS14683
ECG cable, 3-lead, single-pin connector MonoLead® 3, IEC2 (AHA/US) 2m	MS14556
ECG MonoLead 3, IEC2 (AHA/US), 4.1m*	MS28557
ECG cable, 5-lead, single-pin connector MonoLead® 5, IEC2 (AHA/US) 2.5 m	MS14560
ECG MonoLead 5, IEC2 (AHA/US), 5.3m*	MS28558
ECG cable, 6-lead, single-pin connector MonoLead® 6, IEC2 (AHA/US) 3.1m	MS14682
ECG MonoLead 6, IEC2 (AHA/US), 5.7m*	MS28560
ECG extension cable, single-pin connector, 2 m	MS16256

NOTE: *Must not be used in combination with extension cable MS16256.

Standard ECG Lead Sets (Dual pin version - for direct connection to MultiMed 3/5/6/12)

ECG cable, 3-lead, dual-pin connector, IEC1 (Euro) 1 m	5956433
ECG cable, 3-lead, dual-pin connector, IEC2 (AHA/US) 1 m	5956441
ECG cable, 5-lead, dual-pin connector, IEC1 (Euro) 1 m	5956466
ECG cable, 5-lead, dual-pin connector, IEC2 (AHA/US) 1 m	5956458
ECG cable, 6-lead, dual-pin connector, IEC1 (Euro) 1 m	5956482
ECG cable, 6-lead, dual-pin connector, IEC2 (AHA/US) 1 m	5956474
ECG cable for C lead, IEC1 (Euro) 1.5 m	5956508
ECG cable for V lead, IEC2 (AHA/US) 1.5 m	5956490

NOTE: Chest leads for use with MultiMed12 pod. Not for OR use.

ECG extension cable, dual-pin connector, 2 m	MS16492

Single Pin to Dual Pin Adapter

ECG adapter for single-pin ECG cable to MultiMed® 5	MS14679

Required to connect a single-pin ECG cable (3- or 5-lead) to the MultiMed 5 pod.

NOTE: The ESU 5-lead block is compatible with this adapter. This adapter does not replace the ESU block.

ECG adapter for single-pin ECG cable to MultiMed® 6	MS14680

Required to connect a single-pin ECG cable (3-, 5- or 6-lead) to the MultiMed 6 pod.

NOTE: The ESU 6-lead block is compatible with this adapter. This adapter does not replace the ESU block.

MonoLead, dual pin version (for direct connection to MultiMed 3/5/6/12)

ECG cable, 3-lead, dual-pin connector MonoLead® 3, IEC1 (Euro) 2 m	MS16160
ECG cable, 5-lead, dual-pin connector MonoLead® 5, IEC1 (Euro) 2.5m	MS16161
ECG cable for C lead MonoLead® 5, IEC1 (Euro) 2.5 m	MS16232
ECG cable, 3-lead, dual-pin connector MonoLead® 3, IEC2 (AHA/US) 2m	MS16233
ECG cable, 5-lead, dual-pin connector MonoLead® 5, IEC2 (AHA/US) 2.5m	MS16229
ECG cable for C lead MonoLead® 5, IEC2 (AHA/US) 2.5 m	MS16230

Pulse Oximetry (SpO_2)

NOTE: The selection for choosing the SpO_2 technology type is password-protected. Contact your hospital's technical personnel for more information.

Dräger Sensors

Reusable

SpO2 finger sensor Dräger, reusable *Adult sensor for finger application* *patient weight > 40 kg (88 lb.)* **NOTE:** Not for use with MicrO2+, Masimo SET, or Nellcor OxiMax pods.	MS13235

Adhesive single-patient use

SpO2 adhesive sensor Dräger, vinyl, disposable, adult, 24 pcs.	MS16449
SpO2 adhesive sensor Dräger, foam, disposable, adult, 24 pcs.	MS16445
SpO2 adhesive sensor Dräger, vinyl, disposable, child, 24 pcs.	MS16448
SpO2 adhesive sensor Dräger, foam, disposable, child, 24 pcs.	MS16444
SpO2 adhesive sensor Dräger, cloth, disposable, baby, 24 pcs.	MS16447
SpO2 adhesive sensor Dräger, cloth, disposable, neonate, 24 pcs.	MS16446

Masimo LNCS Sensors

Reusable

SpO2 finger sensor Masimo LNCS DCI, reusable, adult *Adult sensor for finger application* *Patient weight > 30 kg (66 lb.)*	MP00796
SpO2 finger sensor Masimo LNCS DCIP, reusable, child *Pediatric/adult sensor for finger application* *Patient weight > 10 - < 50 kg (> 22 - < 110 lb.)*	MP00795
SpO2 Masimo sensor LNCS-TC-I Ear, reusable, pediatric/adult	MP00788
SpO2 Masimo sensor LNCS-TF-I, reusable, pediatric/adult	MP00799
SpO2 Masimo sensor LNCS-YI Multisite, reusable, neonate/pediatric/adult	MP00789

Adhesive Single-Patient Use

SpO2 adhesive sensor Masimo LNCS Adt, disposable, adult, 20 pcs. *Patient weight > 30 kg (66 lb.)*	MP00790
SpO2 adhesive sensor Masimo LNCS Inf, disposable, baby, 20 pcs. *Patient weight 3-20 kg (7-44 lb.)*	MP00791

SpO2 adhesive sensor Masimo LNCS Neo, disposable, neonate, 20 pcs. *Patient weight < 10 kg (22 lb.)*	MP00792
SpO2 adhesive sensor Masimo LNCS Pt, disposable, child, 20 pcs. *Patient weight 10-50 kg (22-110 lb.)*	MP00793
SpO2 adhesive sensor Masimo LNCS NeoPt, disposable, premature baby, 20 pcs. *Patient weight < 1 kg (2 lb.)*	MP00794

Masimo LNOP Sensors

Reusable

SpO2 finger sensor Masimo LNOP DCI, reusable, adult *Adult sensor for finger application* *Patient weight > 30 kg (66 lb.)*	7270312
SpO2 finger sensor Masimo LNOP DCIP, reusable, child *Pediatric/adult sensor for finger application* *Patient weight > 10 - < 50 kg (> 22 - < 110 lb.)*	7270304
SpO2 multisite sensor Masimo LNOP YI, reusable *Finger - patient weight > 10 kg (22 lb.)* *Great toe - patient weight > 3 - <10 kg (> 6.6 - < 22 lb.)* *Across foot or palm and back of hand - patient weight < 3 kg (6.6 lb.)*	7497014
SpO2 ear sensor Masimo LNOP TI, reusable *On earlobe or pinna - patient weight > 30 kg (66 lb.)*	7497006

Adhesive Single-Patient Use

SpO2 adhesive sensor Masimo LNOP Adt, disposable, adult, 20 pcs. *Patient weight > 30 kg (66 lb.)*	7496990
SpO2 adhesive sensor Masimo LNOP Pt, disposable, child, 20 pcs. *Patient weight 10-50 kg (22 to 110 lb.)*	7496982
SpO2 adhesive sensor Masimo LNOP Neo, disposable, neonate, 20 pcs. *Patient weight < 10 kg (22 lb.)*	7496974
SpO2 adhesive sensor Masimo LNOP NeoPt, disposable, premature baby, 20 pcs. *Patient weight < 10 kg (22 lb.)*	7496966

Nellcor Sensors

Reusable Sensors

Nellcor Durasensor DS-100A, SpO2 Sensor, adult *SpO2 adult sensor for finger application Patient weight > 40 kg (88 lb.)*	72 62 764

Disposable Sensors (Adhesive Single-Patient Use)

Nellcor OxiMAX MAX-A, adult, 24 pcs *SpO2 adult sensor for finger or toe application Patient weight > 30 kg (66 lb.)*	MX50065
Nellcor OxiMAX MAX-AL, adult, 24 pcs *SpO2 adult sensor for finger or toe application Patient weight > 30 kg (66 lb.)*	MX50071
Nellcor OxiMAX MAX-I, infant, 24 pcs *SpO2 infant sensor for finger or toe application Patient weight 3-20 kg (6.7-44 lb.)*	MX50067
Nellcor OxiMAX MAX-N, neonatal/adult, 24 pcs *SpO2 neonatal sensor for foot application Patient weight < 3 kg or >40 kg (<6.7 lb. or >88 lb.)*	MX50068
Nellcor OxiMAX MAX-P, pediatric, 24 pcs *SpO2 pediatric sensor for finger or toe application Patient weight 10-50 kg (22-110 lb.)*	MX50066

Pods

Various pod kits are available, contact your local sales representative for details.

Masimo SET SpO_2 pod kit Delta (MS16356) *1 MASIMO SET SpO_2 pod with Delta/Delta XL Mount* *1 MASIMO Extension cable*	MS16901
Masimo SET SpO_2 pod kit Kappa (MS16356) *1 MASIMO SET SpO_2 pod with Kappa Mount* *1 MASIMO Extension cable*	MS16902
Infinity Nellcor OxiMax pod *Connects to monitor via X8 fixed cable*	MS23997

SpO_2 Cables

SpO2 intermediate cable Masimo LNOP, 3 m	MS17041
SpO2 intermediate cable Masimo LNOP, 1.2 m	MS18680
SpO2 intermediate cable Masimo LNCS, 3 m	MS17522
SpO2 intermediate cable Masimo LNCS, 1.2 m	MS24303
SpO2 extension cable Dräger/Nellcor, for Multimed 5/6 and NeoMed pods, 1m	3368433
SpO2 extension cable Dräger/Nellcor, for Multimed 5/6 and NeoMed pods, 2 m	3375834

SpO2 sensor cable Masimo ProCal, for Multimed 5/6 and NeoMed pods, 2 m	7492601
SpO2 sensor cable Masimo ProCal, for Multimed 5/6 and NeoMed pods, 1.5 m	MS13926
Extension cable Masimo, LNCS, SpO2 sensors for MultiMed Plus/MultiMed Plus OR	MS20163
SpO2 intermediate cable Dräger/Nellcor®, for Multimed Plus/ Plus OR, 1.2 m	MS18683
SpO2 intermediate cable Dräger/Nellcor®, for Multimed Plus/ Plus OR, 3 m	MS17330

Temperature

Adapter cable, 7-pin connector for temperature probe with 1/4" connector	5198333
Y-cable, reusable, 7-pin connector, for 2 temperature probes	5592154

Reusable Temperature Probes

Core Probes

For use in electrosurgery, esophageal and rectal applications

General-purpose temperature probe, reusable, adult, 7-pin connector, 1.5 m	4329889
General-purpose temperature probe, reusable, adult, 7-pin connector, 3 m	5204644
General-purpose temperature probe, reusable, child, 7-pin connector, 1.5 m	4329848
General-purpose temperature probe, reusable, child, 7-pin connector, 3 m	5204651
General-purpose temperature probe, reusable, adult, 1/4" connector, 3 m	5201327
General-purpose temperature probe, reusable, adult, 1/4" connector, 5 m	5201319
General-purpose temperature probe, reusable, child, 1/4" connector, 3 m	5201343
Protective cover for general-purpose temperature probe, contains latex, 10 pcs.	7014616

WARNING: Covers contain latex. Do not use with skin probes.

Skin Probes

Not for use in electrosurgery

Skin temperature probe, reusable, with 7-pin connector, 1.5 m	4329822
Skin temperature probe, reusable, with 7-pin connector, 3 m	5204669
Skin temperature probe, reusable, with 1/4" connector, 3 m	5201335

Single-Patient Use Temperature Probes

General Purpose Probes (single-patient use)

General-purpose temperature probe, single-pat. use, adult, 7-pin connector, 1.6m	MP00991
General-purpose temperature probe, single-pat. use, adult, 7-pin connector, 3 m	MP00992
General-purpose temperature probe, single-pat. use, child, 7-pin connector, 1.6m	MP00993
General-purpose temperature probe, single-pat. use, child, 7-pin connector, 3 m	MP00994

Skin Probles (single-patient use)

Skin temperature probe, single-patient use, adult, 7-pin connector, 1.6 m	MP00995
Skin temperature probe, single-patient use, adult, 7-pin connector, 3 m	MP00996
Skin temperature probe, single-patient use, child, 7-pin connector, 1.6 m	MP00997
Skin temperature probe, single-patient use, child, 7-pin connector, 3 m	MP00998

Non-Invasive Blood Pressure (NBP)

NBP Cuffs

Reusable	
NIBP cuff XXS, reusable, infant, 8-13 cm/13 cm	MP00911
NIBP cuff XS, reusable, child, 12-19 cm/19 cm	MP00912
NIBP cuff S, reusable, small adult, 17-25 cm/29 cm	MP00913
NIBP cuff M, reusable, adult, 23-33 cm/33 cm	MP00915
NIBP cuff M+, reusable, adult, long, 23-33 cm/43 cm	MP00916
NIBP cuff M++, reusable, adult, extra long, 23-33 cm/53 cm	MP00917
NIBP cuff L, reusable, large adult, 31-40 cm/40 cm	MP00918
NIBP cuff L+, reusable, large adult, long, 31-40 cm/55 cm	MP00919
NIBP cuff XL, reusable, thigh, 38-50 cm/50 cm	MP00921
Single-Patient Use Cuffs	
NIBP cuff XXS, single-patient use, infant, 8-13 cm/13 cm, 10 pcs.	MP00924
NIBP cuff XS, single-patient use, child, 12-19 cm/19 cm, 10 pcs.	MP00925
NIBP cuff S, single-patient use, small adult, 17-25 cm/29 cm, 10 pcs.	MP00926
NIBP cuff M, single-patient use, adult, 23-33 cm/33 cm, 10 pcs.	MP00928
NIBP cuff M+, single-patient use, adult long, 23-33 cm/43 cm, 10 pcs.	MP00929
NIBP cuff M++, single-patient use, adult extra long, 23-33 cm/53 cm, 10 pcs.	MP00930
NIBP cuff L, single-patient use, large adult, 31-40 cm/40 cm, 10 pcs.	MP00931
NIBP cuff L+, single-patient use, large adult long, 31-40 cm/55 cm, 10 pcs.	MP00932
NIBP cuff XL, single-patient use, thigh, 38-50 cm/50 cm, 10 pcs.	MP00934
Single-Patient Use Cuffs Neonatal	
NIBP cuff, disposable, neonate, size 1, 3.1-5.7 cm, 10 pcs.	2870181
NIBP cuff, disposable, neonate, size 2, 4.3-8.0 cm, 10 pcs.	2870199

NIBP cuff, disposable, neonate, size 3, 5.8-10.9 cm, 10 pcs.	2870207
NIBP cuff, disposable, neonate, size 4, 7.1-13.1 cm, 10 pcs.	2870215
NIBP cuff, disposable, neonate, size 5, 8.3-15 cm, 10 pcs.	2870173

NBP Connecting Hoses

NIBP connection tube, adult, 3.7 m, for Infinity® monitors	MP00953
NBP connection hose, neonatal, 2.4 m	28 70 298

Continuous Non-Invasive Arterial Blood Pressure (CNAP) Pod

Infinity CNAP SmartPod starter kit	MS17075
Includes	
Infinity CNAP SmartPod	MS16905
NOTE: Requires VF7 software or higher.	
CNAP Cuff Controller and Cradle	MS26125
CNAP connection cable	MS15893
Cuff controller forearm strap	MS26122
1 sensor cuff – large [1]	MS15896
1 sensor cuff – medium [1]	MS15895
1 sensor cuff – small [1]	MS15894
Port communication cable, 3 m	3368425
Universal pole mount	MS19705

[1] The cuffs are designed to last for approximately 12 months of cumulative operation depending on usage, which is monitored with a chip inside each cuff. The cuff usage is a measure of the inflate-deflate cycles which is monitored through each detected pressure pulse as the cuff is typically inflated and deflated between systolic and diastolic pressure within heart beat. When the cuff deteriorates to a point below which proper function cannot be maintained, a message is indicated on the Dräger monitor to replace.

Pulse Contour Cardiac Output (PiCCO)

PiCCO Pod

PiCCO Pod Kit — MS16734

Includes:

1 PiCCO pod
1 Hemo pod adapter - 10 pin
1 adapter block to connect PULSION disposable pressure transducers to the hemo pod adapter
1 PULSION pressure transducer to PiCCO pod interface cable, 20 cm
1 PiCCO pod CO injectate thermistor cable
1 PiCCO pod CO catheter cable
1 PiCCO pod CO intermediate cable, 1.5 m

PiCCO Pod — MS17441

Includes 3m PodCom cable to monitor 3368425 &
universal pole mount 7485621

NOTE: All disposables are delivered by PULSION directly.

PiCCO Pod Connecting Cables

Hemo pod adapter - 10 pin *Adapter block to connect PULSION disposable pressure transducers to the Hemo pod adapter*	3375958
PULSION pressure transducer to PiCCO Pod interface cable *20podcm cable to connect PULSION disposable pressure transducers to the Hemo pod adapter*	MS16920
PiCCO pod CO injectate thermistor cable *Connects the PiCCO PV4046 injectate sensor housing to the CO intermediate cable*	MS16919
PiCCO pod CO catheter cable *Connects the PiCCO arterial thermodilution catheter to the CO intermediate cable*	MS16918
PiCCO pod CO intermediate cable, 1.5 m *Connects the PiCCO CO catheter cable and CO thermistor cable to PiCCO pod*	MS16916

NOTE: All disposables are delivered by PULSION directly.

Invasive Blood Pressure (IBP)

Hemodynamic Pods (includes 3 m cable and universal pole mount)

Hemo2 pod	4319435
Hemo4 pod	4315961
HemoMed pod	5588822
MPod – QuadHemo (includes a universal pole mount and transducer mounting plate pole)	MS20725

Note: Transducers and transducer mounting plates are available from the applicable manufacturer; purchase locally or contact your Dräger representative for information.

Hemodynamic Pod Connecting Cables

PodCom cable, 3 m *Cable to connect Hemo2 or Hemo4 pod to monitor*	3368425
HemoMed intermediate cable, 3 m *Cable to connect HemoMed to monitor*	5591925
HemoMed intermediate cable, 5 m *Cable to connect HemoMed to monitor*	5591933
IBP Y-cable, 7 pin, 0.3 m *Cable for monitoring 2 pressures without hemopods Requires specific intermediate cable for each IBP transducer*	5592147
IBP Y-cable, 10 pin, 0.3m *Cable for monitoring 2 pressures without hemopods Requires specific intermediate cable for each IBP transducer*	5731281
IBP adapter, 10 pin to 7 pin *Connects pressure transducer cables to the monitor with 7 pin connectors*	3368383

IBP Accessories

Hemo pod adapter, Abbott/Medex/ICU Medical *(One for each Hemo2 and two for each Hemo4/HemoMed pod)*	5196998
Hemo pod adapter, Edwards/Baxter *(One for each Hemo2 and two for each Hemo4/HemoMed pod)*	5196980
Hemo Pod Adapter, Argon/Merit Medical® *(One for each Hemo2 and two for each Hemo4/HemoMed pod)*	3375941
NOTE: Argon accessories may be labelled as a Merit Medical® product.	
Pod adapter SensoNor, for connecting pressure transducer cables, 7-pin *(One for each Hemo2 and two for each Hemo4/HemoMed pod)*	4329160
Pod adapter, 10-pin, for pressure transducer *(One for each Hemo2 and two for each Hemo4/HemoMed pod)*	3375958

IBP SensoNor/Memscap Cables and Transducers

IBP pressure transducer cable for Memscap (Capto/SensoNor), 3.7 m	4321563
Dome for SensoNor 840, 50 pieces	4529954
IBP-set disp. SensoNor 840, 10 pieces *Sterile, disposable monitoring kit for SensoNor 840 pressure transducers*	4530226

IBP Transducer Plates

IBP pressure transducer plate, for Hemo2 Pod, universal, 5 pcs.	4721408
IBP press. transducer plate, for Hemo4 Pod, universal, 5 pcs.	4721424
IBP pressure transducer plate, f.Hemo2 Pod, f.Memscap (Capto/SensoNor), 5 pcs.	4721614
IBP press. transducer plate, for Hemo4 Pod, for Memscap (Capto/SensoNor), 5pcs.	4721416
IBP press. transducer plate, f.Hemo2/4 Pods,f.Abbott TranspacII/III/Braun,5pcs	5192112
IBP press. transducer plate, for Hemo2/4 Pods, for Abbott Transpac IV, 5pcs.	7270460

Transducer Adapter Cables for Infinity MPod – Quad Hemo

NOTE: One cable is required per invasive pressure.

Abbott/Medex/ICU Medical, transducer adaptor cable	MS22535
Baxter/Edwards, transducer adaptor cable	MS22147
Argon/Merit Medical®, transducer adaptor cable	MS22148
Utah Medical, transducer adaptor cable	MS22534
Dräger 7-pin, transducer adaptor cable	MS22533
Dräger 10-pin, transducer adaptor cable	MS22532

Cardiac Output

C.O. connection cable, 1 m *Connects C.O. accessories to Hemo2/Hemo4/HemoMed pods*	3368458

C.O. catheter cable *Connects catheter to intermediate cable*	8419160
C.O. thermistor cable, Argon/Merit Medical® *Use with thermistor T-piece 5741975*	8420077
C.O. thermistor T-piece Argon/Merit Medical® *Argon/Merit Medical® Becton Dickinson disposable in-line injectate sensor for measurement of injectate temperatures* *For use with cable 8420077*	5741975
C.O. thermistor cable Baxter/Edwards	8539983

Transcutaneous Blood Gas

tpO_2/CO_2 pod *Includes 1 m pod connecting cable 5599076*	5592535
tpO2/tpCO2 solid-state electrode	4529988
Fixation set for tpO2 and tpCO2 electrodes *Box of 100 disposable adhesive rings and four 20 ml bottles contact fluid*	MP00716
Membrane replacement set for tcpO2/tcpCO2 electrodes *Contains 10 ml electrolytic solution, 12 tpO_2 and $tpCO_2$ membrane kits, O-ring remover, and cleaning paper*	MP00715
Calibration gas, for tpO2/tcCO2, 20,9% O2 and 5% CO2, 12 pcs. *12 gas cylinders, each containing dry gas with 5% CO_2 and 20.9% O_2 concentrations*	MP00717
Electrode holder set, Electrode holder, screw, and O-ring	MP00718
TCC calibration unit	MP00722

End-Tidal CO_2 ($etCO_2$)

$etCO_2$ Module and Pods

$etCO_2$ module	4319310
$etCO_2$ pod	5740738
$etCO_2$ Microstream pod	7870947

Sensors

$etCO_2$ CAPNOSTAT™ III sensor *Reusable $etCO_2$ sensor with 2.4 m cable. Suitable for adults, children, and neonates* *Includes calibration and reference cell, adult airway adapter and 5 cable clips.*	4322975

Main Stream Accessories

$etCO_2$ airway adapter, adult, dead space < 5cc	4721796
etCO2 airway adapter, neonatal, dead space < 0.5cc	4721788

Side Stream Accessories

etCO2 sidestream airway adapter, including tubing, 10 pcs. *Not for use with neonates*	4714437
Dehumidification tubing for etCO2 sidestream sampling, Nafion®, 10 pcs.	4714429
etCO2 nasal cannula, adult, 10 pcs.	4714395
etCO2 nasal cannula, child, 10 pcs	4714387

Microstream Accessories

For use with intubated patients:	
etCO2 airway adapter Microstream®, adult/child, max. 12 h, 25 pcs.	7869535
etCO2 airway adapter Microstream®, adult/child, max. 72 h, 25 pcs.	7869543
etCO2 airway adapter Microstream, neonate/child, max. 72 h, 25 pcs.	7869550
For use with non-intubated patients:	
etCO2 nasal/mouth cannula Microstream, child, max. 12 h, 25 pcs.	7869501
etCO2 nasal/mouth cannula Microstream, + O2, child, max. 12 h, 25 pcs.	7869584
etCO2 nasal cannula Microstream, adult, max. 12 h, 25 pcs.	7869477
etCO2 nasal cannula Microstream, child, max. 12 h, 25 pcs.	7869469
etCO2 nasal cannula Microstream, adult, max. 24 h, 25 pcs.	7869592
etCO2 nasal cannula Microstream, neonate/child, max. 24 h, 25 pcs.	7869618
etCO2 nasal cannula Microstream, + O2, adult, max. 24 h, 25 pcs.	7869493

etCO2 nasal cannula Microstream, + O2, child, max. 24 h, 25 pcs.	7869485
Smart Capnoline® Plus, adult/intermediate (pack of 25)	MS26187
Smart Capnoline® Plus O2, adult/intermediate (pack of 25)	MS26188

$etCO_2$/Respiratory Mechanics

$etCO_2$/respiratory mechanics pod	5740704

Adapters/Sensors

Respiratory mechanics adapter, disposable, 10 pieces *CO_2 + Flow Pediatric*	5957142
Respiratory mechanics adapter, disposable, 10 pieces *flow neonatal*	5957100
Sensor for respiratory mechanics, flow, and CO2, disp., adult/child, 10 pcs.	5957126
Sensor for respiratory mechanics, flow, and CO2, disposable, neonate, 10 pcs.	5957118
Sensor for respiratory mechanics and flow, disposable, adult/child, 10 pcs.	5957134

FiO_2

FiO_2 sensor cable, 1.5 m	5597898

MultiGas Monitoring

Modules

Scio Four Oxi plus	6871801
Scio Four Oxi	6871803
Scio Four plus	6871802
Scio Four	6871804
Power supply	MS18508

NOTE: See the Scio Four Modules suppliment for accessories and cables.

NMT Monitoring

Patient parameter unit set Infinity Trident NMT SmartPod *Includes the following:*	MS15007
Trident pod *includes 3 m PodCom cable to monitor 3368425 & universal pole mount 7485621*	7876910
NMT intermediate cable for Infinity Trident (NMT) SmartPod, 1.9 m	7872174
Bed clip for cables	MS15087
NMT thumb adapter for Infinity Trident (NMT) SmartPod, disposable, 50 pcs. *Houses accelerometer when the hand adapter is not being used*	MS15084
NMT hand adapter Trident *Houses accelerometer and temperature sensor; connects to NMT accessory cable*	MS15086
NMT accelerometer Trident *Measures thumb acceleration during NMT measurements*	MS15085
NMT thermistor Trident	MS15053
NMT electrode cable Trident, 2-lead, 0.3 m	MS13218

BISx Monitoring

BISx Pod *Pod to measure level of consciousness* *Includes PodCom cable and Sensor cable.*	MS14796
BIS Pediatric Sensor (box of 25)	MP00003
BIS 4 Electrode Sensor (box of 25)	MP00005

EEG

EEG pod *Includes podcomm cable to monitor (3m), Universal pole mount, referential lead block converter, set of 9 reusable lead wires (0.6m), and sample electrodes*	5736744
EEG electrode cable, color-coded, 9 pcs.	5947804

EEG Electrodes Disposable, 25 Pieces	MS29468
Block for EEG referential lead conversion	5954859

Pod Communication

Pod connection cable, 3 m *Cable used to connect Hemo2, Hemo4, MPod – Quad Hemo, MultiMed12, EEG, NMT, and etCO$_2$ pods to Delta/Delta XL/ Kappa*	3368425
Pod connection cable, 5 m *Cable used to connect Hemo2, Hemo4, MPod – Quad Hemo, MultiMed12, EEG, NMT, and etCO$_2$ pods to Delta/Delta XL/ Kappa*	5195198
Pod connection cable, 30 cm *Cable used to connect Hemo2, Hemo4, MPod – Quad Hemo, MultiMed12, EEG, NMT, and etCO$_2$ pods to Delta/Delta XL/ Kappa*	7257988

These Instructions for Use only apply to
Infinity Delta Series VF9
with the Serial No.:
If no Serial No. has been filled in by Dräger, these Instructions for Use are provided for general information only and are not intended for use with any specific machine or unit.
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concerning Medical Devices

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