

Specificație Tehnică Completată

Anexa 1 Mașină de anestezie (caracteristici medii 110120)

Model: Carestation 750 Reg. SDM: DM000271225

Monitor pacient B 155M SDM: DM000620292

Producător: DATEX-OHMEDA, INC./GE Healthcare

Țara: SUA

Digitally signed by Chicu Natalia

Date: 2026.04.03 09:08:14 EEST

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Location: Moldova

MOLDOVA EUROPEANĂ



Specificarea tehnică deplină solicitată, Standarde de referință	Specificația tehnică propusă de ofertant
Mașina de anestezie este destinată să livreze, să monitorizeze gazele anestezice și să asigure respirația artificială a pacientului în timpul actului chirurgical	Mașina de anestezie este destinată să livreze, să monitorizeze gazele anestezice și să asigure respirația artificială a pacientului în timpul actului chirurgical DA, Carestation 750 pag.1 din Carestation_750_Spec_sheet
Parametru	Parametru
Specificația	Specificația
Prize de gaz	Prize de gaz
O2, Aer	O2, Aer DA, Carestation 750 pag.1 din Carestation_750_Spec_sheet
Display mașina de anestezie $\geq 12"$, color TFT sau LCD touch screen	Display mașina de anestezie 15 inch, color LCD touch screen 1024x768 DA, pag.4 Carestation_750_Spec_sheet
Debitmetre	touch screen DA, pag.1 Carestation_750_Spec_sheet
tipul electronice sau mecanic	Debitmetre tipul electronice DA, pag.1 Carestation_750_Spec_sheet
gaz O2, Air	gaz O2, Air DA, CS700-ADITIONAL INFORMATION
gama, L/min	gama, L/min diapazon min. 1 - 15 DA, pag.6 Carestation_750_Spec_sheet
diapazon min. 1 - 15	Vaporizator tip vaporizator acceptate
Vaporizator tip vaporizator acceptate	Izofluran obligatoriu DA, pag.4 Carestation_750_Spec_sheet, pag.1 Vaporizer_820_Spec_sheet
Izofluran obligatoriu	Sevofluran obligatoriu DA, pag.4 Carestation_750_Spec_sheet, pag.1 Vaporizer_820_Spec_sheet
Sevofluran obligatoriu	Halothan obligatoriu DA, pag.4 Carestation_750_Spec_sheet, pag.1 din Vaporizer_Tec7_Spec_sheet
Halothan obligatoriu	număr de vaporizatoare instalate la dispozitiv 2 unități DA, pag.1 Carestation_750_Spec_sheet
număr de vaporizatoare instalate la dispozitiv ≥ 2 unități obligatoriu Izofluran	

Anexa 1

obligatoriu Sevofluran obligatoriu interlock obligatoriu sistem de absorbție obligatoriu Mecanisme de siguranță siguranța O2 acustică, vizuală siguranță de amestec hipoxic obligatoriu Ventilator automat tip pacient Adult, Pediatric, Neonatal moduri de ventilație Manual/spontan, VCV, PCV, PS, SIMV-V, SIMV-P volumul Tidal, ml diapazon min. 10-1500 frecvența respirației/minut diapazon min. 5 - 100 Volum minutar (MV), L/min diapazon min. 3-40 raportul I:E minim 2:1 la 1:4 pauză de inspirație obligatoriu control presiune, cmH2O diapazon min. 10-70	obligatoriu Izofluran DA pag.1 Carestation_750_Spec_sheet obligatoriu Sevofluran pag.1 Carestation_750_Spec_sheet obligatoriu interlock DA pag.4 Carestation_750_Spec_sheet obligatoriu sistem de absorbție DA, pag.7 Carestation_750_Spec_sheet obligatoriu Mecanisme de siguranță siguranța O2 acustică, vizuală DA, pag.27 din Carestation 750-clinical_guide, pag.6 Carestation_750_Spec_sheet siguranță de amestec hipoxic obligatoriu DA, pag.5 Carestation_750_Spec_sheet Ventilator automat tip pacient Adult, Pediatric, Neonatal DA, pag.1 Carestation_750_Spec_sheet moduri de ventilație Manual/spontan, VCV, PCV, PS, SIMV-V, SIMV-P DA, pag.2 Carestation_750_Spec_sheet volumul Tidal, ml diapazon 5-1500 DA pag.2 Carestation_750_Spec_sheet frecvența respirației/minut diapazon min.5 - 100 DA pag.3 Carestation_750_Spec_sheet Volum minutar (MV), L/min diapazon 0.1-99.9 L/min DA pag.3 Carestation_750_Spec_sheet raportul I:E minim 2:1 la 1:8 DA pag.3 Carestation_750_Spec_sheet pauză de inspirație obligatoriu DA, pag.3 Carestation_750_Spec_sheet control presiune, cmH2O diapazon min. 10-70 DA, Carestation_750_Spec_sheet, pag.7. În ventilație mecanică Limita de presiune este compusă din limita de presiune a parametrului PEEP (Off, 4- 30 cmH2O) și a parametrului P inspired (5-60 cmH2O) de asupra presiunii PEEP conform Carestation_750_Spec_sheet, pag.3 . Astfel limita inferioară este de 5 cmH2O (suma dintre PEEP Off si P inspired 5 cmH2O), iar limita superioară este de 100 cmH2O conform parametrului Pmax care este mai mare decât suma dintre PEEP maxim si P inspired

PEEP cmH2O diapazon min. 4-20	maxim fiindcă există și parametrul P support. Cerința solicitată este astfel îndeplinită fiindcă limita de presiune este 5-100 cmH2O.
Trigger flux diapazon min. 1-10 L/min	PEEP, cmH2O diapazon Off, 4-30 DA, pag.3 Carestation_750_Spec_sheet
Trigger presiune diapazon min. 20 - 1 cmH20	Trigger flux diapazon 02.-10 L/min DA, pag.3 Carestation_750_Spec_sheet
Monitorizare complianța, rezistivitate obligatoriu	Trigger presiune diapazon 40-2 cmH20 DA, pag.3 Carestation_750_Spec_sheet
Sistem de autodiagnostic	Monitorizare complianța, rezistivitate obligatoriu DA, pag.40 din Carestation 750- clinical_guide
testare la scurgeri, testarea circuitelor respiratorii, complianța, alimentarea cu gaz, verificarea tuturor sistemelor	Sistem de autodiagnostic testare la scurgeri, testarea circuitelor respiratorii, complianța, alimentarea cu gaz, verificarea tuturor sistemelor DA, pag.20 din Carestation 750- clinical_guide
AGSS (sistem de evacuare a gazelor anestezice) obligatoriu	AGSS (sistem de evacuare a gazelor anestezice) obligatoriu DA, pag.3 Carestation_750_Spec_sheet
Sistem de management al consumului de agent anestezic opțional	Sistem de management al consumului de agent anestezic opțional DA, pag.35 din Carestation 750- clinical_guide
Circuitul pneumatic de ventilare a pacinetului cu funcție de încălzire a amestecului gazos obligatoriu	Circuitul pneumatic de ventilare a pacinetului cu funcție de încălzire a amestecului gazos obligatoriu DA, CS700-ADITIONAL INFORMATION, senzorii de flux pe inspir si pe expir au circuit de incalzire
port auxiliar ieșire a amestecului gazos obligatoriu	port auxiliar ieșire a amestecului gazos obligatoriu DA, pag.3 Carestation_750_Spec_sheet
Parametri monitorizați și afișați pe display	Parametri monitorizați și afișați pe display
Presiunea de aer	Presiunea de aer DA, pag.11 din Carestation 750- clinical_guide
Alarmă de înaltă presiune obligatoriu	Alarmă de înaltă presiune obligatoriu DA, pag.3 Carestation_750_Spec_sheet
Alarma presiune subatmosferică obligatoriu	Alarma presiune subatmosferică obligatoriu DA, pag.3 Carestation_750_Spec_sheet, pag.2 din CS700-ADITIONAL INFORMATION
Continuarea alarma presiune obligatoriu	Continuarea alarma presiune obligatoriu DA, pag.3 Carestation_750_Spec_sheet, pag.2 din CS700-ADITIONAL INFORMATION
Presiune scăzută / apnee obligatoriu	Presiune scăzută / apnee obligatoriu DA, pag.3 Carestation_750_Spec_sheet

Anexa 1

Alte alarme de presiune obligatoriu	Alte alarme de presiune obligatoriu DA, pag.3 Carestation_750_Spec_sheet
Volumul expirator / flux obligatoriu	Volumul expirator / flux obligatoriu DA, pag.3 Carestation_750_Spec_sheet
Volumul minut, l/min obligatoriu	Volumul minut, l/min obligatoriu DA, pag.3 Carestation_750_Spec_sheet
Concentrația de O2	Concentrația de O2 DA, pag.3 Carestation_750_Spec_sheet
Timp de răspuns, sec <30	Timp de răspuns, sec <30 DA, pag.3 din CS700-ADDITIONAL INFORMATION
Concentrația de CO2	Concentrația de CO2 DA, pag.4-5 din CS700-ADDITIONAL INFORMATION
Alarmă apnee obligatoriu	Alarmă apnee obligatoriu DA, pag.4-5 din CS700-ADDITIONAL INFORMATION
Monitorizare agent	Monitorizare agent DA, pag.5 Carestation_750_Spec_sheet
Tipul de agenți	Tipul de agenți
Halothan, isofluran, sevofluran	Halothan, isofluran, sevofluran DA, pag.5 Carestation_750_Spec_sheet, DA, E-sCAiOV pag 31
Auto indentificarea gazelor anestezice obligatoriu	Auto indentificarea gazelor anestezice obligatoriu DA, pag.5 Carestation_750_Spec_sheet
Alarmă concentrare agent obligatoriu	Alarmă concentrare agent obligatoriu DA, pag.5 Carestation_750_Spec_sheet
Determinarea și afișarea valorii MAC obligatoriu	Determinarea și afișarea valorii MAC obligatoriu DA, pag.5 Carestation_750_Spec_sheet
Modulul de gaze încorporat la mașina de anestezie obligatoriu determină concentrațiile de gaze: O2, CO2, agenți anestezici obligatoriu	Modulul de gaze încorporat la mașina de anestezie obligatoriu determină concentrațiile de gaze: O2, CO2, agenți anestezici obligatoriu DA, pag.7-8 din CS700-ADDITIONAL INFORMATION
Celulă determinare O2 tip paramagnetică/ galvanică obligatoriu	Celulă determinare O2 tip paramagnetică DA, pag.4 Carestation_750_Spec_sheet
Monitorul pentru afișarea funcțiilor vitale display ≥ 15 inch, color TFT sau LCD obligatoriu	Monitorul pentru afișarea funcțiilor vitale DA, B155M pag.1 din B 155M_Spec_sheet
touch screen obligatoriu	display 15inch, color TFT sau LCD obligatoriu DA, pag.2 din B 155M_Spec_sheet touch screen obligatoriu DA, pag.2 din B155M_Spec_sheet

Anexa 1

monitor dedicat vizualizării funcțiilor vitale obligatoriu	monitor dedicat vizualizării funcțiilor vitale obligatoriu DA, pag.1 din B 155M_Spec_sheet
fixarea monitorului de/ pe masina de anestezie obligatoriu	fixarea monitorului de/ pe masina de anestezie obligatoriu DA
imprimantă termică încorporată obligatoriu	imprimantă termică încorporată obligatoriu DA, pag.1 B1x5_User_manual
conexiuni WiFi/LAN/HDMI/USB obligatoriu	conexiuni WiFi/LAN/HDMI/USB obligatoriu DA, pag.4 din B 155M_Spec_sheet
Protecti la defibrilare 360J obligatoriu	Protecti la defibrilare 360J obligatoriu DA, pag.53 din B1x5_Suplimental_user manual
Protectia contra dispozitivelor de electrochirurgie cu frecventa inalta obligatoriu	Protectia contra dispozitivelor de electrochirurgie cu frecventa inalta obligatoriu DA, pag.244 din B1x5_User manual
Compensarea automata a driftului isoliniei obligatoriu	Compensarea automata a driftului isoliniei obligatoriu DA, pag.52 din B1x5_User manual
Detectarea automata a tipului de manjeta obligatoriu	Detectarea automata a tipului de manjeta obligatoriu DA, pag.60-61 din B1x5_Suplimental_user manual
baterie internă reîncărcabilă obligatoriu	Baterie internă reîncărcabilă obligatoriu DA, pag.5 din B 155M_Spec_sheet
Modulele hemodinamice incluse	Modulele hemodinamice incluse DA, pag.5 din B 155M_Spec_sheet
Electro-cardio-grama (ECG)	Electro-cardio-grama (ECG) DA, pag.5 din B 155M_Spec_sheet
frecvența cardiacă obligatoriu	frecvența cardiacă obligatoriu DA, pag.2 din B 155M_Spec_sheet
traseul ECG obligatoriu	traseul ECG obligatoriu DA, pag.120 din B1x5_User manual
analiza și măsurarea segmentui ST obligatoriu	analiza și măsurarea segmentui ST obligatoriu DA, pag.130, 136 din B1x5_User manual
determinarea cel puțin 20 de aritmii obligatoriu	determinarea 21 de aritmii obligatoriu DA, pag.2 din 155M_Spec_sheet, pag.134-136 din B1x5_User_manual
Puls-oximetria (SpO2)	Puls-oximetria (SpO2) DA, pag.2 din 155M_Spec_sheet
fotopletismografia obligatoriu	fotopletismografia obligatoriu DA, pag.164 din 155M_Spec_sheet
valoarea SpO2 obligatoriu	valoarea SpO2 obligatoriu DA, pag.2 din 155M_Spec_sheet
indicile de perfuzie obligatoriu	indicile de perfuzie obligatoriu DA, pag.165 din B1x5_User_manual
Tensiune sanguină neinvazivă (NIBP) obligatoriu	Tensiune sanguină neinvazivă (NIBP) obligatoriu DA, pag.2 din 155M_Spec_sheet
Respirația (impedanța transtoracică) obligatoriu	Respirația (impedanța transtoracică) obligatoriu DA, pag.2 din 155M_Spec_sheet

Anexa 1

Temperatura obligatoriu Tensiune sanguină invazivă (IBP) obligatoriu Alarmer prioritare 3 Tensiune de alimentare 220 V, 50 Hz Prize auxiliare 220 V $\geq$ 3 buc obligatoriu Baterie internă reîncărcabilă obligatoriu autonomie de lucru $\geq$2h obligatoriu Sertar pentru depozitare $\geq$ 2 buc obligatoriu Frînă centralizată pentru fixarea aparatului sau sistem clasic de blocare a minim două roți obligatoriu Presiune de alimentare cu gaze 3.0 - 6 bar Accesorii Furtunul cu conector de conectare la sursa de aer comprimat 1 buc. Furtunul cu conector de conectare la sursa de oxigen 1 buc. Circuit de ventilare Adult, reutilizabil $\geq$ 2 set., să se indice codul produsului Plămîn de test Adult, reutilizabil $\geq$ 2 buc., să se indice codul produsului Senzor de flux Reutilizabil $\geq$ 2 buc., să se indice codul produsului Filtru antibacterial Adult, unică utilizare $\geq$ 200 buc., să se indice codul produsului Accesorii modul de gaz Adult $\geq$ 2 set., să se indice codul produsului Cablu ECG Adult, reutilizabil 5 fire $\geq$ 1 buc., să se indice codul produsului Cablu ECG Adult, reutilizabil 3 fire $\geq$ 1 buc., să se indice codul produsului Electrozi ECG	Temperatura obligatoriu DA, pag.2 din 155M_Spec_sheet Tensiune sanguină invazivă (IBP) obligatoriu DA, pag.2 din 155M_Spec_sheet Alarmer prioritare 3 DA, pag.8 din CS700-ADDITIONAL INFORMATION Tensiune de alimentare 220 V, 50 Hz DA, pag.5 din Carestation_750_Spec_sheet Prize auxiliare 220 V 4 buc DA, pag.6 din Carestation_750_Spec_sheet Baterie internă reîncărcabilă obligatoriu DA, pag.4 din Carestation_750_Spec_sheet autonomie de lucru 90 min obligatoriu DA, pag.4 din Carestation_750_Spec_sheet Sertar pentru depozitare 3 buc obligatoriu DA, pag.1 din Carestation_750_Spec_sheet Frînă centralizată pentru fixarea aparatului DA, pag.1 din Carestation_750_Spec_sheet Presiune de alimentare cu gaze 3.0 - 6 bar DA, pag.1 din Carestation_750_Spec_sheet Accesorii Furtunul cu conector de conectare la sursa de aer comprimat 1 buc. DA, pag.6 din Carestation_750_Spec_sheet Furtunul cu conector de conectare la sursa de oxigen 1 buc DA, pag.6 din Carestation_750_Spec_sheet Circuit de ventilare 2 set Adult, reutilizabil DA Plămîn de test Adult, reutilizabil DA, 2 buc cod: 2096536-001 din Accesorii_anestezie Senzor de flux Reutilizabil 2 buc. DA, cod: 2069358-001-S Accesorii_anestezie Filtru antibacterial Adult, unică utilizare 200 buc., să se indice codul produsului DA, cod: 2106570-007 din Accesorii_anestezie Accesorii modul de gaz Adult 2 set., să se indice codul produsului DA, cod: 73319-HEL din Accesorii_anestezie Cablu ECG Adult, reutilizabil 5 fire 1 buc., să se indice codul produsului DA, cod: 2106389-004 din Accesorii_anestezie

Anexa 1

Adult, unica utilizare ≥ 100 buc., să se indice codul produsului Senzor SpO2 Adult, reutilizabil ≥ 2 buc., să se indice codul produsului Manșete NIBP Adult, reutilizabilă ≥ 2 buc., să se indice codul produsului Adult mare, reutilizabilă ≥ 2 buc., să se indice codul produsului Senzor de temperatură Adult, reutilizabil ≥ 1 buc., să se indice codul produsului	Cablu ECG Adult, reutilizabil 3 fire 1 buc., să se indice codul produsului DA, cod: 2106390-004 din Accesorii_anestezie Electrozi ECG Adult, unica utilizare 100 buc., să se indice codul produsului DA, cod: ELT-RTABA-500 din Accesorii_anestezie Senzor SpO2 Adult, reutilizabil 2 buc., să se indice codul produsului DA, cod: TS-F-D din Accesorii_anestezie Manșete NIBP Adult, reutilizabilă 2 buc., să se indice codul produsului DA, cod: 2001589-212 din Accesorii_anestezie Adult mare, reutilizabilă 2 buc., să se indice codul produsului DA, cod: 2001589-019 din Accesorii_anestezie Senzor de temperatură Adult, reutilizabil 1 buc., să se indice codul produsului DA, cod: 2107176-031



Carestation™ 750

Anesthesia Delivery System



The Carestation 750 anesthesia machine is a modern, sophisticated and easy-to-navigate anesthesia workstation. It's built on our clinically proven platform to give you the control and accuracy you need for high-quality, attentive care.

KEY FEATURES

- Modern, premium, compact design for an optimized workspace utilization
- Simple and easy-to-use 15" touchscreen ventilator display
- Intuitive user interface, inspired by the CARESCAPE™ Monitor, makes for a seamless experience in the OR
- Integrated CARESCAPE Respiratory Module
- Advanced tools to help individualize therapy
- Scalable software and hardware features: "build your own" Carestation system
- ecoFLOW software helps support clinicians in the practice of low-flow anesthesia by predicting how much O₂ is needed within the fresh gas flow
- Electronic gas mixer

VENTILATION

- Small, Compact Breathing System (CBS) specifically designed for low-flow anesthesia
- Fast gas kinetics for rapid wash-in and wash-out
- Digitally controlled, flow valve ventilator to support all patient types from neonates to adults
- Advanced ventilation options, including synchronized PCV-VG with pressure support (SIMV PCV-VG) and minimum rate ventilation (CPAP+PSV)
- Lung Protective Ventilation tools, including single-step and multi-step Lung Recruitment maneuvers to optimize clinical outcomes, while reducing workloads for clinicians
- Continual fresh gas flow with fresh gas flow compensation during mechanical ventilation

DESIGN

- Ergonomic form factor for seamless and efficient workflow and serviceability
- Innovative cable management solution to organize power cables and gas hoses and to simplify installation, cleaning and transportability
- Easy to clean surfaces
- Extendable, tiltable, swiveling display arm for flexible positioning to stay close to the patient
- Two-vaporizer configuration
- Bi-level work surface illumination
- Absorbent canister designed for ease of use and long life
- Intelligent lighting that highlights active flow controls and auxiliary ports when in use

PHYSICAL SPECIFICATIONS

Product Description

Carestation™ 750 A1 Anesthesia Delivery System

Dimensions

Height:	144 cm/56.7 in
Width:	89.1 cm/35.1 in
Depth:	81.5 cm/32.1 in
Weight:	161 kg/355 lb*

Top shelf

Weight limit:	25 kg/55 lb
Width:	41.3 cm/16.3 in
Depth:	38.8 cm/15.3 in

Work surface

Height:	83.6 cm/32.9 in
Size:	1620 cm ² /251 in ²
Size:	2527 cm ² /392 in ² (with optional flip shelf)

Upper left Datex-Ohmeda (DO) dovetail

Dovetail length:	49 cm/19.3 in

Lower left Datex-Ohmeda (DO) dovetail

Dovetail length:	32 cm/12.6 in

Right Datex-Ohmeda (DO) dovetail

Dovetail length:	96.4 cm/38.0 in

Drawers (internal dimensions)

Height:	
Top and middle:	8.6 cm/3.4 in
Bottom:	13.3 cm/5.2 in
Width:	34 cm/13 in
Depth:	37 cm/14.6 in

Manual ventilation bag arm (optional)

Arm length:	39.8 cm/15.7 in
Bag arm height:	53 cm/20.9 in
(adjustable)	136 cm/53.5 in

Casters

Diameter:	12.5 cm/4.9 in
Brakes:	Central Brake



VENTILATOR OPERATING SPECIFICATIONS

Modes of ventilation – included

VCV (Volume Control) Mode with tidal volume compensation
PCV (Pressure Control Ventilation)
Cardiac Bypass

Modes of ventilation – optional

PCV-VG (Pressure Controlled Ventilation-Volume Guarantee)
SIMV (Synchronized Intermittent Mandatory Ventilation)
(volume and pressure)
PSVPro™ Mode (Pressure Support with Apnea backup)
CPAP+PSV (Pressure Support mode)
SIMV PCV-VG

Advanced software options

Spirometry (included)
Auto alarm limits (included)
ecoFLOW
Pause Gas
Recruitment maneuver
VCV Cardiac Bypass

Ventilator parameter ranges

Tidal volume range:	5 to 1500 mL (PCV modes 5 to 1500 mL) (Volume Control, PCV-VG and SIMV volume 20 to 1500 mL)
Incremental settings:	20 to 50 mL (increments of 1 mL) 50 to 100 mL (increments of 5 mL) 100 to 300 mL (increments of 10 mL) 300 to 1000 mL (increments of 25 mL) 1000 to 1500 mL (increments of 50 mL)

* Excludes vaporizers, airway gas module, patient monitor.

VENTILATOR OPERATING SPECIFICATIONS *(continued)*

Ventilator parameter ranges

Minute volume range:	Less than 0.1 to 99.9 L/min)
Pressure (P _{inspired}) range:	5 to 60 cmH ₂ O (increments of 1 cmH ₂ O) above set PEEP
Pressure (P _{max}) range:	12 to 100 cmH ₂ O (increments of 1 cmH ₂ O)
Pressure (P _{support}) range:	Off, 2 to 40 cmH ₂ O (increments of 1 cmH ₂ O)
Respiratory Rate:	4 to 100 breaths per minute for Volume Control and Pressure Control; 2 to 60 breaths per minute for SIMV, PSVPro mode and SIMV PCV-VG; 4 to 60 bpm for CPAP+PSV (increments of 1 breath per minute)
Inspiratory/ expiratory ratio:	2:1 to 1:8 (increments of 0.5) (VCV, PCV, PCV-VG)
Inspiratory time:	0.2 to 5.0 seconds (increments of 0.1 seconds) (SIMV, PSVPro and CPAP PSV)
Trigger window:	Off, 5 to 80% of Texp (SIMV, PSVPro) (increments of 5%)
Flow trigger:	1 to 10 L/min (increments of 0.5 L/min) 0.2 to 1 L/min (increments of 0.2 L/min)
Inspiration termination level:	5 to 75% (increments of 5%)
Inspiratory Pause range:	Off, 5-60% of T _{insp}

Positive End Expiratory Pressure (PEEP)

Type:	Integrated, electronically controlled
Range:	OFF, 4 to 30 cmH ₂ O (increments of 1 cmH ₂ O)

Ventilator performance

Peak gas flow:	120 L/min + fresh gas flow
Flow valve range:	1 to 120 L/min
Flow compensation range:	150 mL/min to 15 L/min

VENTILATOR ACCURACY

Delivery/monitoring accuracy

Volume delivery:	> 210 mL = better than 7% ≤ 210 mL = better than 15 mL < 60 mL = better than 10 mL
Pressure delivery:	±10% or ±3 cmH ₂ O (larger of)
PEEP delivery:	±1.5 cmH ₂ O
Volume monitoring:	> 210 mL = better than 9% ≤ 210 mL = better than 18 mL < 60 mL = better than 10 mL
Pressure monitoring:	±5% or ±2.4 cmH ₂ O (larger of)

Alarm settings

Tidal volume (V _{TE}):	Low: OFF, 1 to 1500 mL High: 20 to 1600 mL, OFF
Minute volume (V _E):	Low: OFF, 0.1 to 10 L/min High: 0.5 to 30 L/min, OFF
Inspired oxygen (FiO ₂):	Low: 18 to 99% High: 19 to 100%, OFF
Apnea alarm:	Mechanical ventilation ON: < 5 mL breath measured in 30 seconds Mechanical ventilation OFF: < 5 mL breath measured in 30 seconds
Low airway pressure:	4 cmH ₂ O above PEEP
High pressure:	12 to 100 cmH ₂ O (increments of 1 cmH ₂ O)

Sustained airway pressure:

Mechanical ventilation ON:	P _{max} < 30 cmH ₂ O, the sustained limit is 6 cmH ₂ O P _{max} 30 to 60 cmH ₂ O, the sustained limit is 20% of P _{max} P _{max} > 60 cmH ₂ O, the sustained limit is 12 cmH ₂ O
PEEP and mechanical ventilation ON:	Sustained limit increases by PEEP minus 2 cmH ₂ O
Mechanical ventilation OFF:	P _{max} 12 to 60 cmH ₂ O, the sustained limit is 50% of P _{max} P _{max} > 60 cmH ₂ O, the sustained limit is 30 cmH ₂ O
Subatmospheric pressure:	Paw < -10 cmH ₂ O
Audio pause countdown clock:	120 to 0 seconds

VENTILATOR COMPONENTS

Flow transducer

Type:	Variable orifice flow sensor (autoclavable)
Location:	Inspiratory outlet and expiratory inlet

Oxygen sensor

Type:	Optional galvanic fuel cell or paramagnetic with Airway Module option

Ventilator screen

Display size:	15 inch
Pixel format:	1024 x 768

Battery backup

Backup power:	Battery time is 90 minutes when fully charged, which supports full system functionality and ventilation.
Battery type:	Internal rechargeable sealed lead acid

Communication ports

RS-232C compatible serial interface
Ethernet
Datex-Ohmeda device interface solutions port
USB port
VGA Output

ANESTHETIC AGENT DELIVERY

Delivery

Vaporizers:	Tec™ 6 Plus, Tec 7, Tec 820, Tec 850
Number of positions:	2
Mounting:	Tool-free installation Selectatec™ manifold interlocks and isolates vaporizers

AIRWAY MODULES

General

Supported modules:	E-sCAiO, E-sCAiOV
Size (HxWxD), excluding water trap:	112 x 37 x 205 mm/4.4 x 1.5 x 8.1 in
Weight:	0.7 kg/1.5 lb

Sampling rate:	120 mL/min $\pm$ 20 mL

Automatic compensation for atmospheric pressure variation (495 to 795 mmHg) temperature and CO₂/N₂O and CO₂/O₂ collision broadening effect. Parameter display update interval typically breath-by-breath. Functional alarms for blocked sample line, D-fend™ Water Trap check and D-fend replacement.

Non-disturbing gases:

Ethanol, acetone, isopropanol, methane, nitrogen, nitric oxide, carbon monoxide, water vapor, freon R134A (for CO₂, O₂ and N₂O):

Maximum effect on readings:	CO ₂ < 0.2 vol% ; O ₂ , N ₂ O < 2 vol% ; AA < 0.15 vol%

Carbon dioxide (CO₂)

EtCO ₂ :	End-tidal CO ₂ concentration
FiCO ₂ :	Inspired CO ₂ concentration

CO₂ waveform

Measurement range:	0 to 15% (0 to 15 kPa, 0 to 113 mmHg)

Accuracy:	$\pm$ (0.2 vol% + 2% of reading)

Datex-Ohmeda infrared sensor

Adjustable low and high alarm limits for EtCO₂ and FiCO₂

Respiration rate (RR)

Measurement range:	4 to 100 breaths/min

Detection criteria:	1% variation in CO ₂

Adjustable low and high alarm limits for respiration rate; alarm for apnea

Patient Oxygen (O₂)

FiO ₂ :	Inspired O ₂ concentration
EtO ₂ :	End-tidal O ₂ concentration
FiO ₂ -EtO ₂ :	Inspired-expired difference

O₂ Measurement

Measurement range:	0 to 100%
Accuracy:	$\pm$ (1 vol% + 2% of reading)

Datex-Ohmeda differential paramagnetic sensor Adjustable low and high alarm limits for FiO₂ and EtO₂; alarm for FiO₂ < 18%

Nitrous Oxide (N₂O)

Measurement range:	0 to 100%
Accuracy:	$\pm$ (2 vol% + 2% of reading)

AIRWAY MODULES *(continued)*

Anesthetic Agent (AA)

Isoflurane

Measurement range:	0 to 6%
Accuracy:	±(0.15 vol% +5% of reading)

Sevoflurane

Measurement range:	0 to 8%
Accuracy:	±(0.15 vol% +5% of reading)

Desflurane

Measurement range:	0 to 20%
Accuracy:	±(0.15 vol% +5% of reading)

Waveform displayed

MAC value displayed (Airway Gas Option modules)

MACage value displayed (CARESCAPE modules)

Identification threshold: 0.15 vol%**

Agent mixture detection

Adjustable high and low alarm limits for EtAA, FiAA

Patient Spirometry

Pressure-volume loop

Pressure-flow loop

Flow-volume loop

Airway pressure and flow waveforms

Adjustable low and high alarm limits for P_{peak}, PEEP_{tot} and MV_{exp}

Alarms for MV_{exp} << MV_{insp} and for MV_{exp} low. Detection through D-lite™ Flow Sensor or Pedi-lite Flow Sensor and gas sampler with following specifications:

CARESCAPE Airway Modules

	D-lite(+)	Pedi-lite(+)
Respiration rate:	4 to 35 breaths/min	4 to 70 breaths/min

Tidal volume

Measurement range:	150 to 2000 mL	5 to 300 mL
Accuracy**:	±6% or 30 mL	±6% or 4 mL

Minute volume

Measurement range:	2 to 20 L/min	0.1 to 5 L/min

Airway pressure

Measurement range:	-20 to +100 cmH ₂ O
Accuracy**:	±1 cmH ₂ O
Display units:	cmH ₂ O, mmHg, kPa, mbar, hPa

Flow

Measurement range:	-100 to 100 L/min	-25 to 25 L/min

I:E

Measurement range:	1:4.5 to 2:1

Compliance

	D-lite(+)	Pedi-lite(+)
Measurement range:	4 to 100 mL/cmH ₂ O	1 to 100 mL/cmH ₂ O

Airway resistance

Measurement range:	0 to 200 cmH ₂ O/L/s

Sensor specifications

	D-lite/ D-lite(+)	Pedi-lite/ Pedi-lite(+)
Dead Space:	9.5 mL	2.5 mL

Resistance

at 30 L/min:	0.5 cmH ₂ O	
at 10 L/min:		1.0 cmH ₂ O

ELECTRICAL SPECIFICATIONS

Current leakage

100/120V	< 500µA
220/240V	< 500µA

Power

Power input:	100-120 Vac, 50/60 Hz
	220-240 Vac, 50/60 Hz
	120/220-240 Vac ± 10%, 50-60 Hz

Power cord:

Length:	5 m/16.4 ft
Rating:	10A @ 220-240 Vac or 15A @ 100-120 Vac 10A @ 120/220-240 Vac

Inlet modules

100/120 V:

Without outlets:	2A
With outlets:	12A

220/240 V:

Without outlets:	2A
With outlets:	8A

Outlet modules (optional)

100/120 V:

4 outlets on side, from top to bottom: 3A, 2A, 2A, 1.5A, individual breakers, isolation transformer (optional)

**Typical value

ELECTRICAL SPECIFICATIONS *(continued)*

Outlet modules (optional)

220/240 V:

4 outlets on side, from top to bottom: 1.5A, 1A, 1A, 1A, individual breakers, isolation transformer (optional)

Japan:

3 outlets on side, from top to bottom: 3A, 2A, 2A, individual breakers, isolation transformer (optional)

PNEUMATIC SPECIFICATIONS

Auxiliary O₂ (optional)

Connection: 7-10 mm hose barb port

O₂ concentration range: 100% O₂

Flow range: 0 to >10 L/min

Auxiliary O₂ +Air (optional)

Connection: 7-10 mm hose barb port

O₂ concentration range: 100% O₂ only, or 21% to 100% O₂ with Air

Flow range for O₂ and Air: 0 and 150 mL/min to 15 L/min

Auxiliary common gas outlet (optional)

Connector: ISO 22 mm OD and 15 mm ID

Gas supply

Pipeline input range: 280 kPa to 600 kPa (41 psig to 87 psig)

Pipeline connections: DISS-male, AS4059, S90-116, or NIST All fittings available for O₂, N₂O, and Air, and contain pipeline filter and check valve. Secondary O₂ pipeline inlet available.

Cylinder input: Pin indexed in accordance with CGA-V-1 or DIN-477 (nut and gland); contains input filter and check valve. Large cylinder kit available for O₂ and N₂O (with DIN-477).

Note: Maximum 3 cylinders

Primary regulator diaphragm minimum burst pressure: 2758 kPa/400 psig

Primary regulator nominal output: < 345 kPa/50 psig
Pin indexed cylinder connections
< 414 kPa/60 psig
DIN-477 cylinder connections

O₂ controls

Method: N₂O shut off with loss of O₂ pressure

Supply failure alarm: < 252 kPa (36.55 psig)

O₂ flush: Range: 25 to 75 L/min

Fresh gas

Flow range: 0 and 150 mL/min to 15 L/min
Minimum total flow O₂ and balance gas is 150 mL/min

Measurement accuracy

for O₂, Air and N₂O: ±5% of setting value, or ±20 mL/min (larger of)

O₂ concentration range: 21% to 100% when Air is available

O₂ Cell accuracy: ± 2.5% full scale plus 2.5% of reading

Compensation: Temperature and atmospheric pressure compensated to standard conditions of 20°C and 101.3 kPa

Hypoxic guard: Electric Mixer: Provides a nominal minimum 25% concentration of oxygen in O₂/N₂O mixture.
ALT O₂, 0 to 8-15 L/min

Materials

All materials in contact with patient breathing gases are not made from natural rubber latex.

ENVIRONMENTAL SPECIFICATIONS

System operation

Temperature: 10° to 40°C (50° to 104°F)

Humidity: 15 to 95% relative humidity (non-condensing)

Altitude: -440 to 3200 m (520 to 800 mmHg)

System storage

Temperature: -25° to 60°C (-13° to 140°F)

Humidity: 15 to 95% relative humidity (non-condensing)

Altitude: -440 to 4880 m (425 to 800 mmHg)

Oxygen cell storage: -15° to 50°C (5° to 122°F)
10 to 95% relative humidity
500 to 800 mmHg

ENVIRONMENTAL SPECIFICATIONS (continued)

Electromagnetic compatibility

Immunity:	Complies with all applicable requirements of EN 60601-1-2
Emissions:	CISPR 11 group 1 class A
Standard compliance:	AAMI ES60601-1, CSA C22.2 #601.1, EN/IEC 60601-1, ISO 80601-2-13
European Notified Body	
CE Mark:	CE0197

BREATHING CIRCUIT SPECIFICATIONS

Carbon dioxide absorbent canister

Absorbent capacity:	Reusable canister 1370 mL Disposable canister 1400 mL

Ports and connectors

Exhalation:	22 mm OD ISO 15 mm ID taper
Inhalation:	22 mm OD ISO 15 mm ID taper
Bag port:	22 mm OD (15 mm ID), ROW 22 mm ID, Australia

Bag-to-Ventilator switch

Type:	Bi-stable
Control:	Controls ventilator and direction of breathing gas within the circuit

Integrated Adjustable Pressure Limiting (APL) valve

Range:	0.5 to 70 cmH ₂ O
Tactile knob indication at:	30 cmH ₂ O and above
Adjustment range of rotation:	0.5 to 30 cmH ₂ O (0 to 230°) 30 to 70 cmH ₂ O (230 to 330°)

Materials

All materials in contact with exhaled patient gases are autoclavable, except O₂ cell, and Airway Modules.
All materials in contact with patient gases are not made from natural rubber latex.

Breathing circuit parameters

Compliance:

Bag mode:	1.81 mL/cmH ₂ O (filled disposable absorber canister) 1.74 mL/cmH ₂ O (filled reusable absorber canister)
Mechanical mode:	Automatically compensates for compression losses within the absorber and bellows assembly
Volume:	2006 mL Ventilator side 500 mL Bag side 1000 mL Reusable canister 1000 mL Disposable canister

Expiratory resistance in bag mode:

Flow rate	P _{exp} Absorber canister Installed	P _{exp} Absorber canister Removed
5 L/min	0.57 cmH ₂ O	0.57 cmH ₂ O
30 L/min	2.47 cmH ₂ O	2.47 cmH ₂ O
60 L/min	5.60 cmH ₂ O	5.60 cmH ₂ O

Note: Values include patient circuit tubing and wye piece (0.65 cmH₂O at 60 L/min)

Anesthetic gas scavenging

AGSS Type	Hospital extract system required	Machine connection
High vacuum, low flow:	High vacuum 36 +/- 3 L/min @ 12 inHg (305 mmHg)	SIS evac
High vacuum, low flow:	High vacuum 25-30 L/min @ 12 inHg (305 mmHg)	DISS evac
Low vacuum, high flow:	Low vacuum 50 to 80 L/min ISO 1H	BSI 30 mm threaded
Low vacuum, low flow:	Low vacuum 25 to 50 L/min ISO 1L	12.7 mm hose barb, 25 mm hose barb, or 30 mm ISO taper
Passive:	Passive system with air break	30 mm/1.2 in M ISO taper



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This document applies to Carestation 750 A1.

DOC2322002 Rev 3

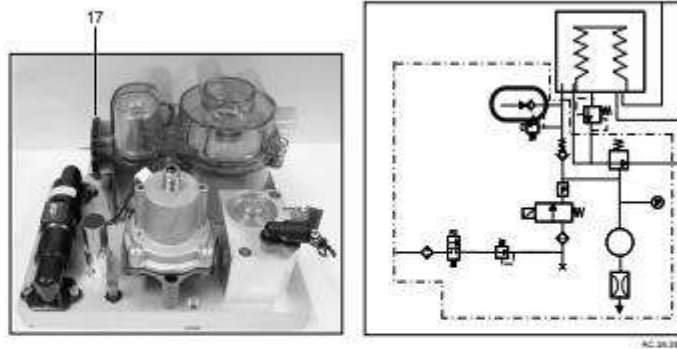


Figure 2-35 • Free breathing valve

2.13.12 Breathing circuit flow sensors

Two flow sensors (18) are used to monitor inspiratory and expiratory gas flow:

- The inspiratory flow sensor is located at the input of the breathing system inspiratory check valve.
- The expiratory flow sensor is located at the input to the breathing system expiratory check valve.

Feedback from both the inspiratory and expiratory transducers is used to:

- supply tidal volumes that make allowances for the effects of fresh gas flow and circuit compressibility.
- supply signals for expiratory tidal volume monitoring and the breath rate.

The breathing circuit flow sensors include two flex boards (one for each sensor). Each flex board contains a heating circuit and an EEPROM.

Each flex board has an I2C interface for communication with SIB. The SIB provides +12.5 VDC power with a minimum of 200 mA supply current to each flex board for flow sensor heating circuit, and provides +5 VDC with a minimum of 200 mA supply current to each flex board for EEPROM.

7 Alarms and troubleshooting

Message	Priority	Cause	Action
Inspiration stopped	Medium	High airway pressure.	Check system for blockages.
Internal failure. System may shut down.	High	Power controller software failure.	Contact an authorized service representative.
Internal failure. System may shut down.	Medium	Power controller software failure.	Contact an authorized service representative.
Low gas sample flow	Low	Sample flow is less than 80% of nominal flow for 20 seconds.	Check for blockage in the airway module sample gas line.
Memory (EEPROM) failure	Low	Software error.	Contact an authorized service representative.
Module fail. No CO ₂ , AA, O ₂ data.	Medium	Airway module hardware failure.	Replace module.
Module not compatible	Low	The monitoring module detected is not compatible with system software.	Remove the incompatible module. Use a compatible module.
Move Bag/Vent switch to Bag	Medium	Bag/Vent switch was in the Vent position when the case was changed from Aux O ₂ +Air to circle mode.	Move switch to the Bag position.
MVexp high	Medium	MVexp is greater than MVexp high alarm limit (for nine breaths and one minute has elapsed).	Set the alarm limits appropriately. Check the ventilation settings.
MVexp low	Medium	MVexp is less than MVexp low alarm limit (for nine breaths and one minute has elapsed).	Set the alarm limits appropriately. Check the ventilation settings.
N ₂ O inaccurate	Low	Airway module has fault.	Calibrate the airway module. If problem persists, contact an authorized service representative.
N ₂ O supply pressure low	Medium	N ₂ O pipeline pressure is less than 252 kPa (36 psi) and the N ₂ O cylinder pressure is less than 2633 kPa (381 psi).	Ensure the N ₂ O pipeline and cylinder are properly connected. Ensure facility gas supply pressure is within specification and the backup cylinder is full and open.
Negative airway pressure	High	Paw is less than -10 cmH ₂ O.	Check for blockages in the patient circuit.
No battery backup	Medium	Battery or charging failure.	Between cases turn the system off, then back on after 15 seconds to reset the system.
No exp flow sensor	Medium	Electrical signals show the flow sensor is not connected.	Connect the flow sensor. Replace the flow sensor if necessary.
No insp flow sensor	Medium	Electrical signals show the flow sensor is not connected.	Connect the flow sensor. Replace the flow sensor if necessary.
O ₂ flow low	Low	The O ₂ flow is less than 150 ml/min.	Adjust the O ₂ flow.
O ₂ flush stuck on?	Low	Switch detected "on" continuously for more than 30 seconds.	Check flush valve. Ensure flush valve is not sticking.

11 Specifications and theory of operation

Breath rate	4 to 100 bpm (non-spontaneous) 2 to 60 bpm (spontaneous) 1 bpm resolution
Volume sensor type	Variable flow orifice

Oxygen

Display range	5 to 110% O ₂
Display resolution	1% increments
Sensor type	Galvanic fuel cell
Measurement range	0 to 100% O ₂
Measurement accuracy	+/- (2.5% full scale plus 2.5% of reading)
Cell response time	Less than 35 seconds Note: Response time of cell and adapters is measured using the text method described in ISO 7767 (1997).
Low O ₂ alarm range	18% to 99%
High O ₂ alarm setting	19 % to 100% or Off Note: Low O ₂ limit may not be set above high O ₂ limit. High O ₂ limit may not be set below the low O ₂ limit.
Expected cell life	One year of shelf life (23°C room air) and additional two years of normal operation.
Output drift in 21% O ₂	Less than 1% over one month
Influence of humidity	- 0.03% of reading per %RH
Gas cross effect	Less than 0.3% vol% anesthetic agents and N ₂ O

Case defaults

Use the **Case Defaults** menu to set the default case types that show on the **Start Case** menu and access the **Apnea Alarm Setup** menu.

Configuring case defaults

Set the case defaults for the case types that are selectable from the **Start Case** menu. In each case type, the name, patient defaults, gas defaults, screen layout defaults, alarm defaults, and ventilator settings for each available ventilation mode can be preset.

1. From Super User mode, select **Case Defaults**.
2. Select the case name to enter the adjustment window.
3. Select an item to change. Make the change.
4. Continue to select items and make changes.
5. Select **Confirm**.
6. Repeat to set the defaults for another default case.

Setting case name

1. From Super User mode, select **Case Defaults**.
2. Select the name of the case to enter the adjustment window.
3. Select **Name**.
 - Select **Clear** to remove the existing name.
 - Select up to 10 characters from the drop-down list.
 - Select **Delete** to delete a character.
 - Select **Save** to save the name and close the drop-down list.
 - Select **Reset** to return the name to the factory default name.
 - When the 10 character maximum is reached, the name is automatically saved. The drop-down list closes.
4. Select **Confirm** when done.

Setting apnea alarm

Use the **Apnea Alarm Setup** menu to enable or disable the user's ability to turn the volume apnea alarms off during manual ventilation.

1. From **Super User** mode, select **Case Defaults**.
2. Select **Apnea Alarm Setup**.

3. Set **Volume Apnea Selection** to **Enable** or **Disable**.
Set to **Enable** to allow the user to turn the volume apnea alarm on or off from the **Start Case** menu.
Set to **Disable** to set the volume apnea alarms as always on during manual ventilation.
4. Set the **Volume Apnea** for each case default.
5. Set the **Apnea Delay** for each case default.
 - The apnea time delay range is 10 to 30 seconds.
 - CO2 apnea minimum delay is 20 seconds.
6. Select **Back** to return to the **Case Defaults** menu.

Note When the **Volume Apnea Selection** is set to **Disable**, the **Volume Apnea Alarm** menu selection does not show on the user's **Start Case** menu and the **Vol Apnea Alarm** selection does not show on the **Alarm Setup** menu.

Default case type setting

Each case has multiple settings. The default settings for the default case types are shown in the following table. An * indicates that the setting is not used for the default ventilation mode in the case type. Use the empty columns to write in facility changes.

Note **VCV ADULT** settings are used as the default if the system does not have an optional ventilation mode shown.

Page 1 Default settings for default case types							
Settings	ADULT		PEDIATRIC		LOCAL		CUSTOM 1
Name	ADULT		PEDIATRIC		LOCAL		CUSTOM 1
Patient and Sensor	Adult		Pedi		Adult		Adult
Ideal Weight	70		18		70		70
Age	40		5		40		40
Other Gas	Air		Air		Air		Air
Data Source	Vent		Vent		Vent		Vent
O2%	100		100		100		100
Total Flow	6.00		6.00		0.20		6.00
Auto MV Limits	Off		Off		Off		Off
Alarm Volume	3		3		1		3

Airway module specifications

Use only airway modules that have anesthetic agent monitoring and O₂ monitoring on this system. The following modules can be used on this system:

CARESCAPE™ series: E-sCAiO and E-sCAiOV

Gas specifications for airway modules

Airway humidity (patient spirometry)	10% RH to 100% RH
Sampling delay	3.0 seconds typical with a 3 m sampling line
Total system response time	Less than 3.8 seconds with a 3 m sampling line
Warm-up time	1 minute for operation with CO ₂ , O ₂ , and N ₂ O 5 minutes for operation of anesthetic agents 20 minutes for full specifications
Respiration rate	4 to 100 breaths/min
Diversion flow	120 +/- 20 ml/min
Airway pressure	-20 cmH ₂ O to 100 cmH ₂ O

Accuracy during stable conditions	
Ambient temperature: 10 to 40°C	
Ambient pressure: 495 to 795 mmHg	
Ambient humidity: 10 to 98% RH, non-condensing	
Automatic compensation for ambient pressure	
Full module accuracy for Respiration rate of 4 to 70 breaths/min	
CO ₂	+/- (0.2 vol% + 2% of reading)
O ₂	+/- (1 vol% + 2% of reading)
N ₂ O	+/- (2 vol% + 2% of reading) between 0 and 85 vol% +/- (2 vol% + 8% of reading for N ₂ O between 85 and 100 vol%)
Iso, Sev, Des	+/- (0.15 vol% + 5% of reading)

Typical performance	
CO ₂	Measurement range 0 to 15 vol% (0 to 15 kPa, 0 to 113 mmHg). Measurement rise time less than 260 ms typical. Accuracy +/- (0.2 vol% + 2% of reading). 6 hour drift less than 0.1 vol% Gas cross effects less than 0.2 vol% (O ₂ , N ₂ O, anesthetic agents).

Carestation™ 750/750c (A1)

Typical performance	
O ₂	Measurement range 0 to 100 vol%. Measurement rise time less than 260 ms typical. Accuracy +/- (1 vol% + 2% of reading). 6 hour drift less than 0.3 vol% Gas cross effects less than 1 vol% anesthetic agents, less than 2 vol% N₂O.
N ₂ O	Measurement range 0 to 100 vol%. Measurement rise time less than 320 ms typical. Accuracy +/- (2 vol% + 2% of reading). 6 hour drift less than 0.3 vol% Gas cross effects less than 2 vol% anesthetic agents.
Anesthetic agents	Measurement range Iso 0 to 6% vol%. Measurement range Sev 0 to 8 vol%. Measurement range Des 0 to 20 vol%. Measurement rise time Des, Iso, Sev less than 420 ms typical. Accuracy +/- (0.15 vol% + 5% of reading). 6 hour drift for Iso, Sev less than 0.1 vol% 6 hour drift for Des less than 0.3 vol% Gas cross effects less than 0.15 vol% N₂O.

Note The effects caused by N₂O to the measurement of CO₂, O₂, and anesthetic agents are automatically compensated for when using the airway module. The effects caused by anesthetic agents to the measurement of CO₂ and N₂O are automatically compensated for when using the airway module.

Alarms

Alarms may be high priority, medium priority, or low priority. When an alarm occurs during a case, an alarm tone sounds and the alarm message is displayed in the alarm message field. The system checks for alarm conditions at 1 second intervals. The alarm tone is from 47 to 70 dB (A) depending on the alarm volume setting.

CAUTION No repair should ever be attempted by anyone not having experience in the repair of devices of this nature. See the "Repair policy" in the "User maintenance" section.

WARNING If an alarm occurs, safeguard the patient first before performing troubleshooting or doing repair procedures.

Alarm priorities

Alarm priority is indicated by the color of the alarm message and the audio sequence.

- High-priority alarm messages appear in white text on a red background.
- Medium-priority alarm messages appear in black text on a yellow background.
- Low-priority alarms appear in black text on a blue background.

Pausing alarms

Selecting **Audio Pause** for an active alarm stops the audible tone for 120 seconds. The alarm message shows in the alarm message field. Selecting **Audio Pause** when no medium or high priority alarms are active prevents the audible alarm tones (audio off) for 90 seconds.

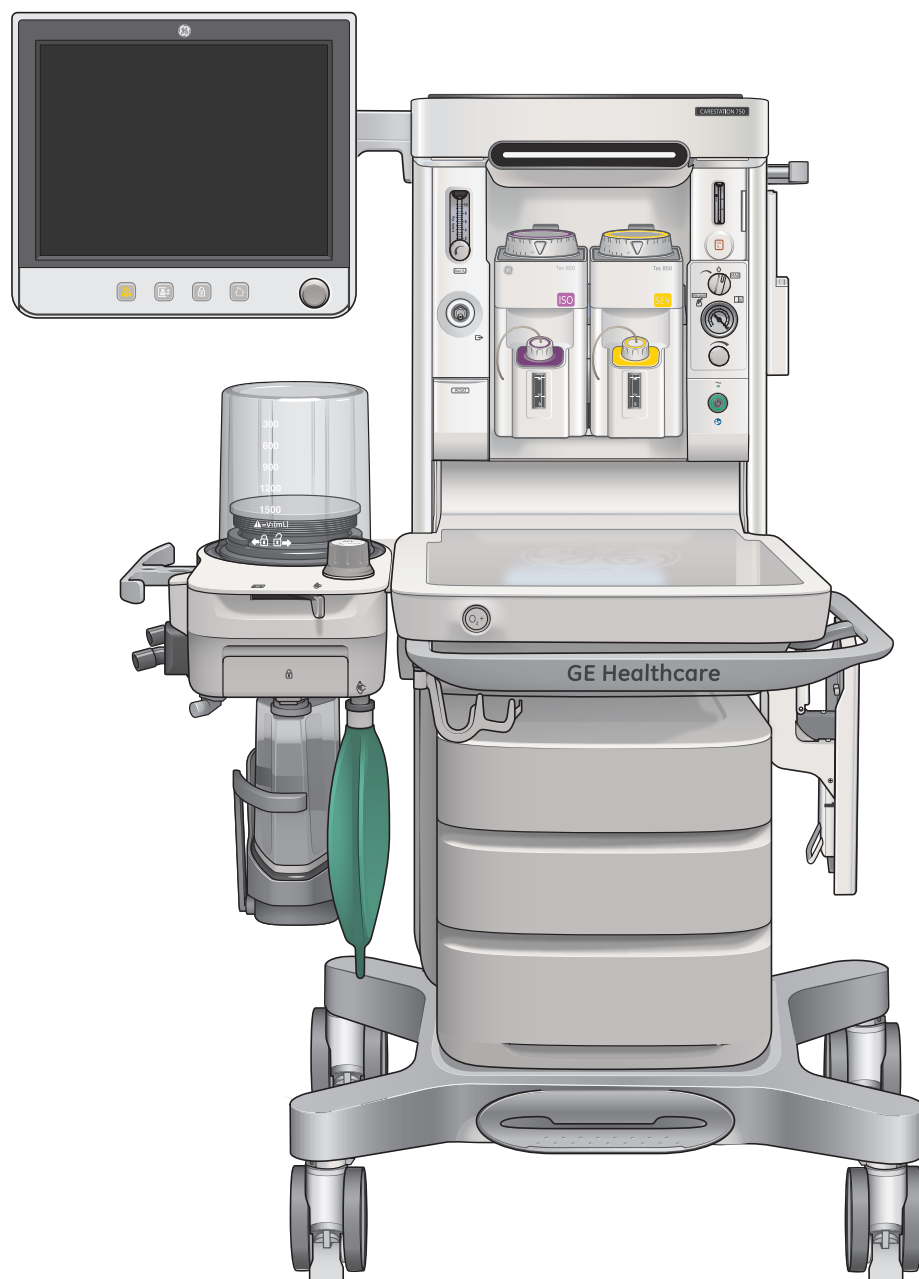
Alarms in the apnea alarm family have special silence behavior to reduce apnea nuisance alarms. Apnea family alarms include 'Apnea', 'EtCO2 low', 'MVexp low', 'RR low', and 'TVexp low'.

When pausing an apnea family alarm, the audio tone for the active alarm is paused for 120 seconds. The audible tone for any additional apnea family alarm that occurs during the audio paused period is silenced for the remaining time shown on the audio pause countdown. Only the audible alarm tone is silenced. The alarm messages still show in the alarm message fields. 'APN' shows above the audio pause countdown when the audible tone silence is in effect for the apnea family alarms.



Carestation™ 750 Anesthesia Delivery System

Clinical Reference Guide
Version 1.0







Carestation™ 750

Anesthesia Delivery System

Clinical Reference Guide
Version 1.0

Notice

Configurations available for this product depend on local market and standards requirements. Illustrations in this course may not represent all configurations of the product. This guide does not cover the operation of every accessory. Screens displayed in this training are examples only and may vary from your system due to software, options, and database. Always refer to your application for exact screen representation.

The materials contained in this guide are intended for educational purposes only. This guide does not establish specifications, operating procedures, or maintenance methods for any of the products referenced. Always refer to the official written materials (labeling) provided with the product for specifications, operating procedures, and maintenance requirements.

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No diagnostic statements are inferred or included in these materials. All clinical diagnosis should be made by a trained physician or clinician. All patient names or other protected health information or data contained in any image within this material is fictitious. Any similarity to actual persons is coincidental.

Contents

01 System overview	1	
Introduction	1	
Front view components	2	
Breathing system components	3	
Right side view components	4	
Rear view components	5	
Left side view components	6	
Central and caster brakes	7	
Using the bag support arm	8	
02 Navigation	9	
Display Controls	9	
Touch points	10	
Anesthesia system display	11	
Using menus	12	
Using the ComWheel	13	
Using quick keys	14	
03 Operation overview	15	
Turning on the system	15	
Changing gas settings	16	
Using the O ₂ flush button	16	
Using the APL valve	17	
Using the Bag/Vent switch	17	
Using the vaporizer	18	
Using the ACGO	18	
Aux O ₂ +Air	19	
04 Checkout	20	
Checkout overview	20	
Checkout full test	21	
05 Starting a case	22	
Start Case menu overview	22	
Starting a case using default settings	23	
Starting a case using custom settings	24	
		Starting manual ventilation
		Starting mechanical ventilation
		Changing a ventilator mode and settings
06 Alarms and Trends	27	
Setting alarm limits	27	
Additional alarm settings	28	
Setting Auto Limits	29	
Viewing Trends	29	
07 Ventilation modes	30	
Volume control mode (VCV)	30	
Pressure control mode (PCV)	30	
PCV-VG mode	31	
SIMV VCV mode	31	
SIMV PCV mode	32	
SIMV PCV-VG mode	33	
PSVPro™ Ventilation Mode	34	
CPAP + PSV mode	34	
08 Special features	35	
ecoFLOW overview	35	
ecoFLOW menu components	36	
Activating the ecoFLOW split screen	37	
Recruitment Maneuver	37	
Pause Gas Flow	38	
Spirometry overview	39	
Spirometry loop components	40	
Saving, viewing and deleting spirometry loops	40	
Spirometry setup	41	
Cardiac Bypass	42	
09 End of Case and Standby	43	
End Case	43	
Standby	44	
Turning off the system	45	

01 System overview

Introduction

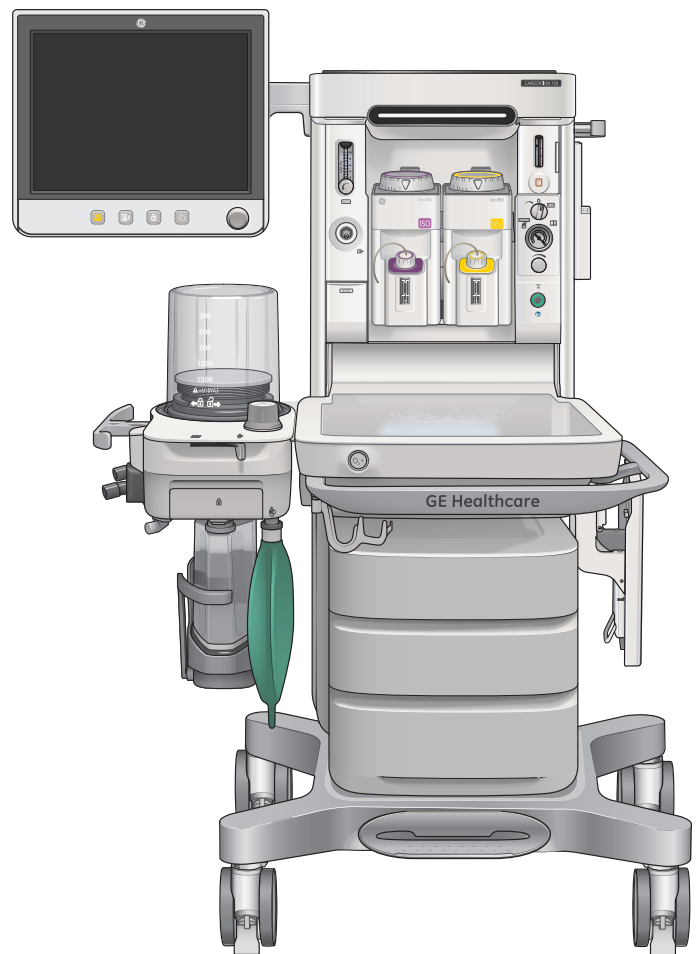
The Carestation 750/750c anesthesia systems combine advanced anesthesia delivery, patient monitoring, and care information management. Optional integrated features include auxiliary common gas outlet, auxiliary O₂ outlet, auxiliary O₂+Air outlet, suction control and respiratory gas monitoring.

Intended use

The Carestation 750/750c anesthesia systems are intended to provide monitored anesthesia care, general inhalation anesthesia and/or ventilatory support to a wide range of patients (neonatal, pediatric, and adult). The anesthesia systems are suitable for use in a patient environment, such as hospitals, surgical centers, or clinics.

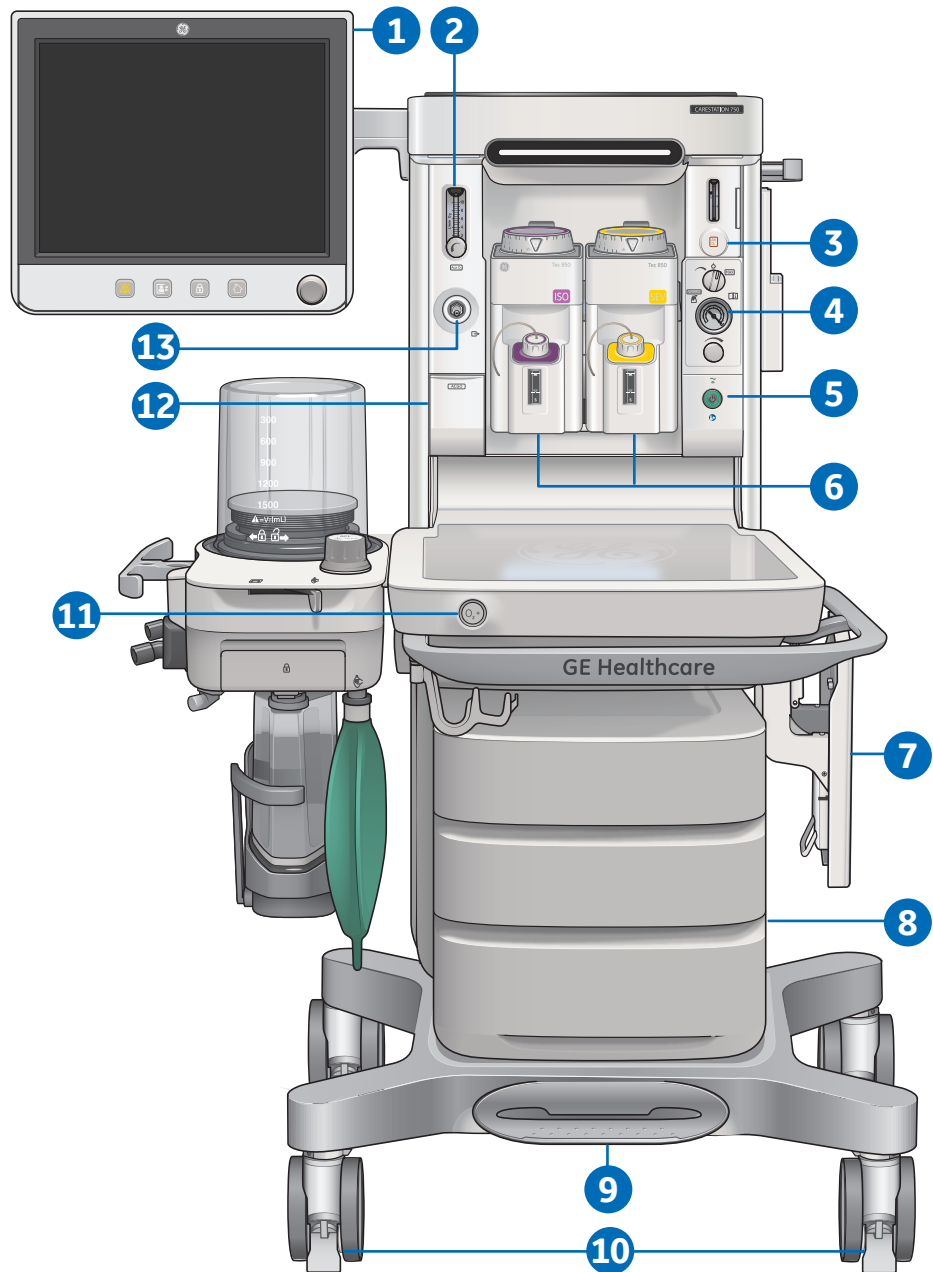
The systems are intended to be operated by a clinician qualified in the administration of general anesthesia.

Note: *The Carestation 750 system is the standard trolley system, while the Carestation 750c system is the pendant system. This clinical reference guide will focus on the standard trolley system and use the term “Carestation 750” instead of “Carestation 750/750c”. The operation of both systems is identical.*



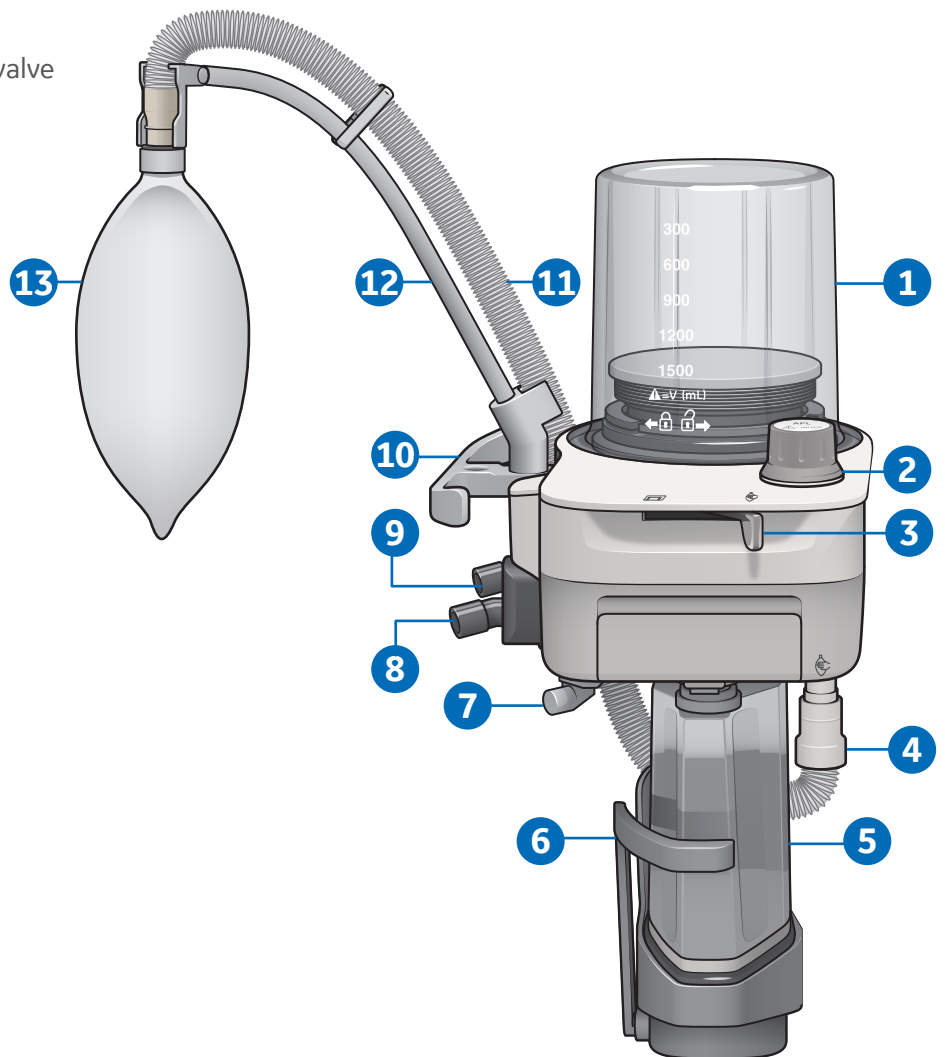
Front view components

1. Anesthesia display
2. Auxiliary O₂ flow control (optional)
3. Alt O₂ flow control
4. Suction regulator and control (optional)
5. On/Standby switch
6. Vaporizer
7. Flip-up shelf (optional)
8. Drawers
9. Central brake
10. Caster brakes and cable sweeper
11. O₂ flush
12. Auxiliary Common Gas Outlet (ACGO) or Auxiliary O₂+Air switch and port (optional)
13. Auxiliary O₂ outlet (optional)



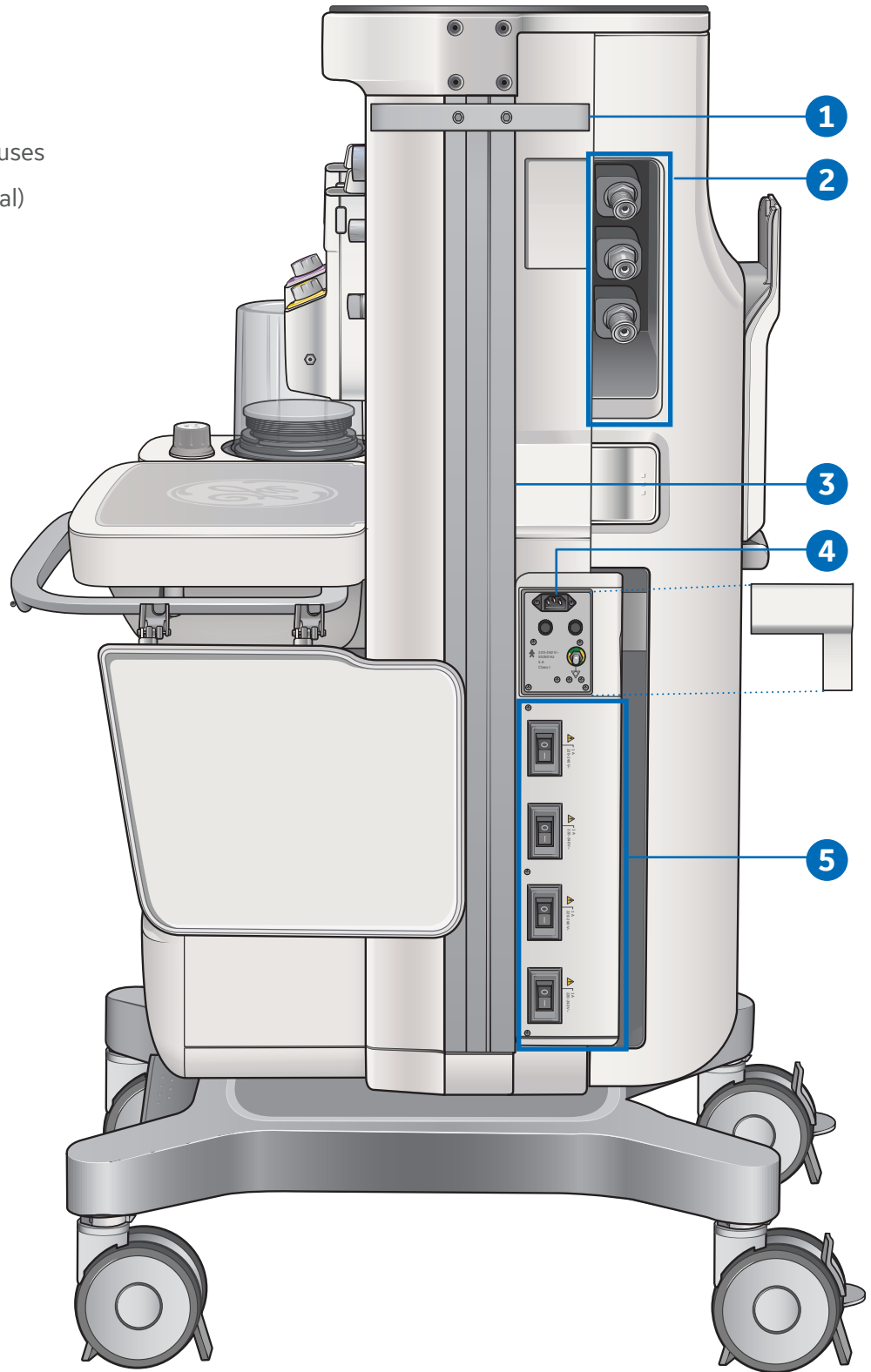
Breathing system components

1. Bellows assembly
2. Adjustable pressure-limiting (APL) valve
3. Bag/Vent switch
4. Bag hose connection
5. Absorber canister
6. Absorber canister lifter handle
7. Leak test plug
8. Inspiratory port
9. Expiratory port
10. Breathing system guard
11. Bag hose
12. Bag support arm (optional)
13. Breathing bag



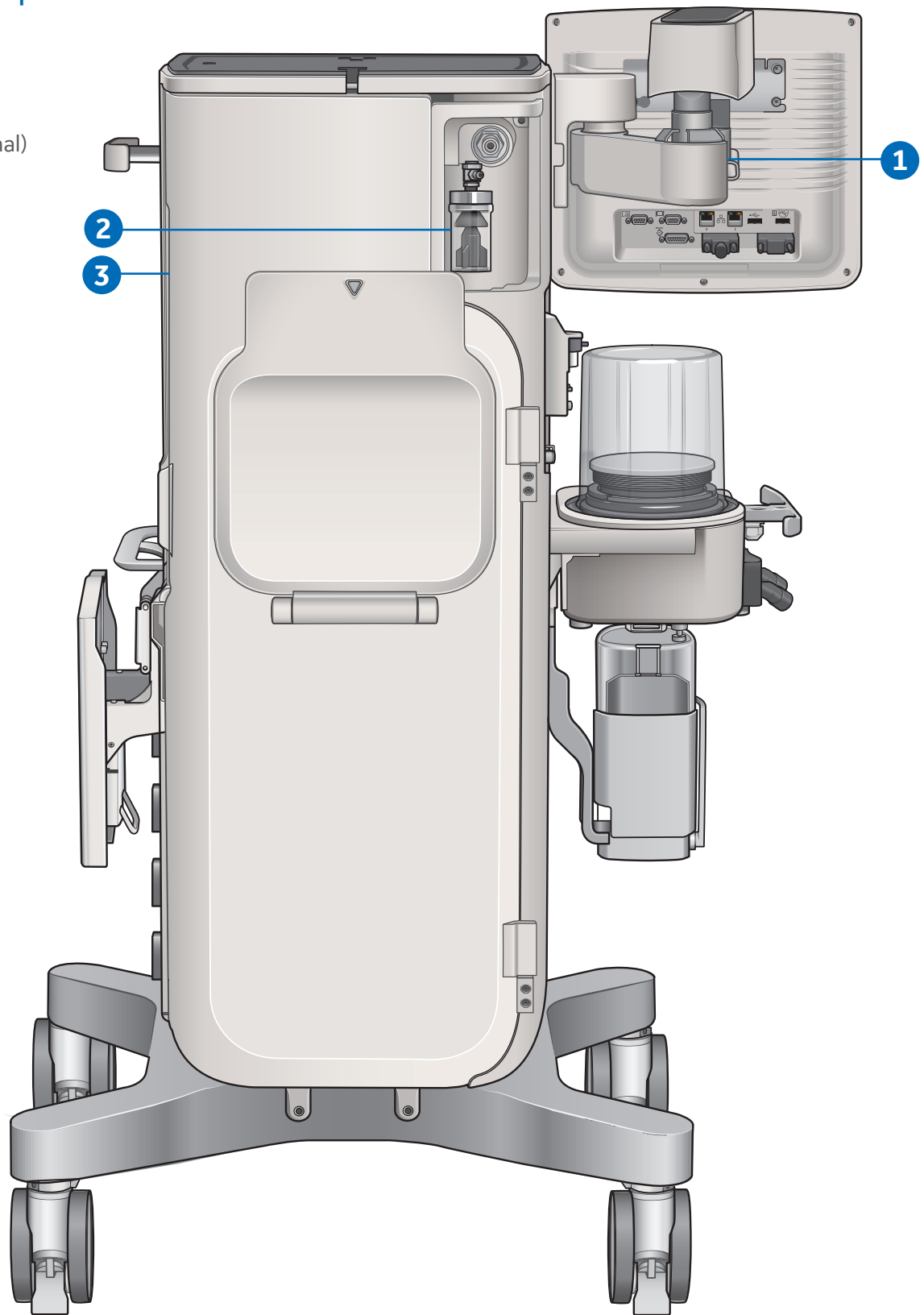
Right side view components

1. Side rail
2. Pipeline connections
3. Right dovetail
4. Mains inlet and Mains power fuses
5. Outlet circuit breakers (optional)



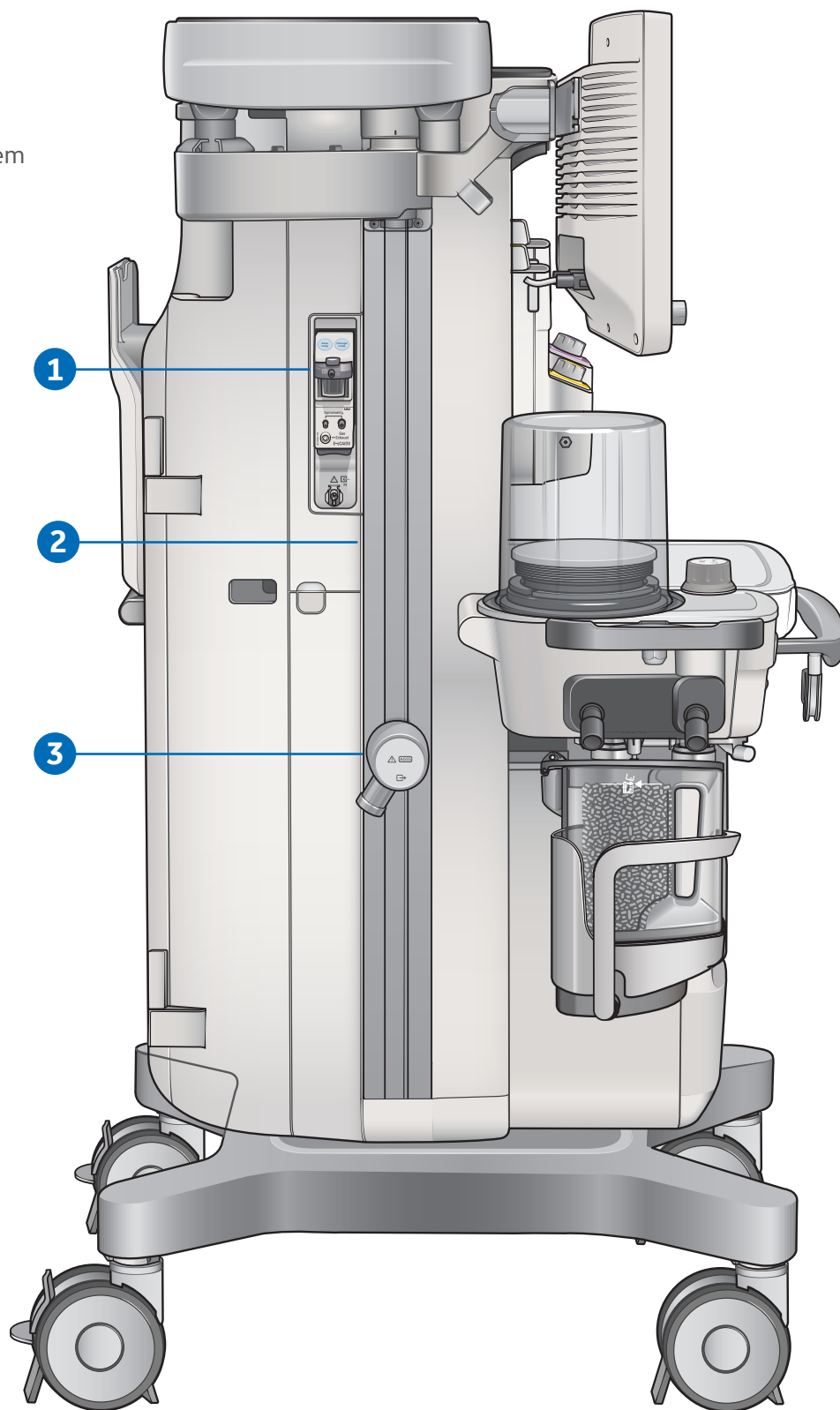
Rear view components

1. Display arm
2. Suction trap
3. Back cover (optional)



Left side view components

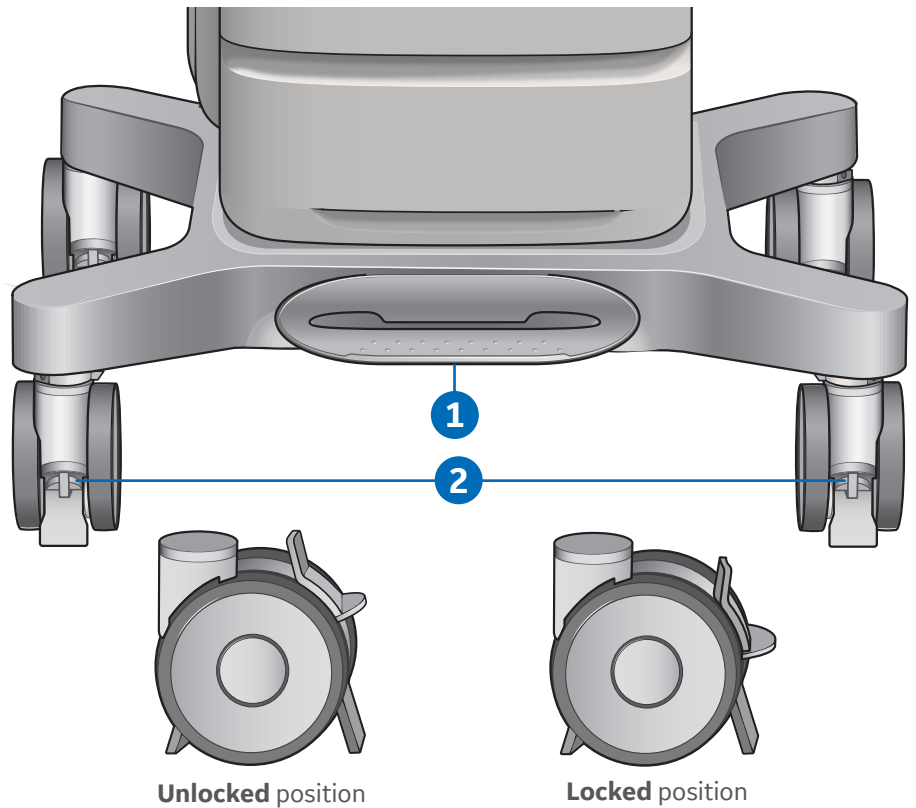
1. Airway module (optional) and sample gas return port
2. Left dovetail
3. Anesthesia Gas Scavenging System (AGSS) connection



Central and caster brakes

The Carestation 750 system has one central brake with two brakes on the rear casters that hold the system in place.

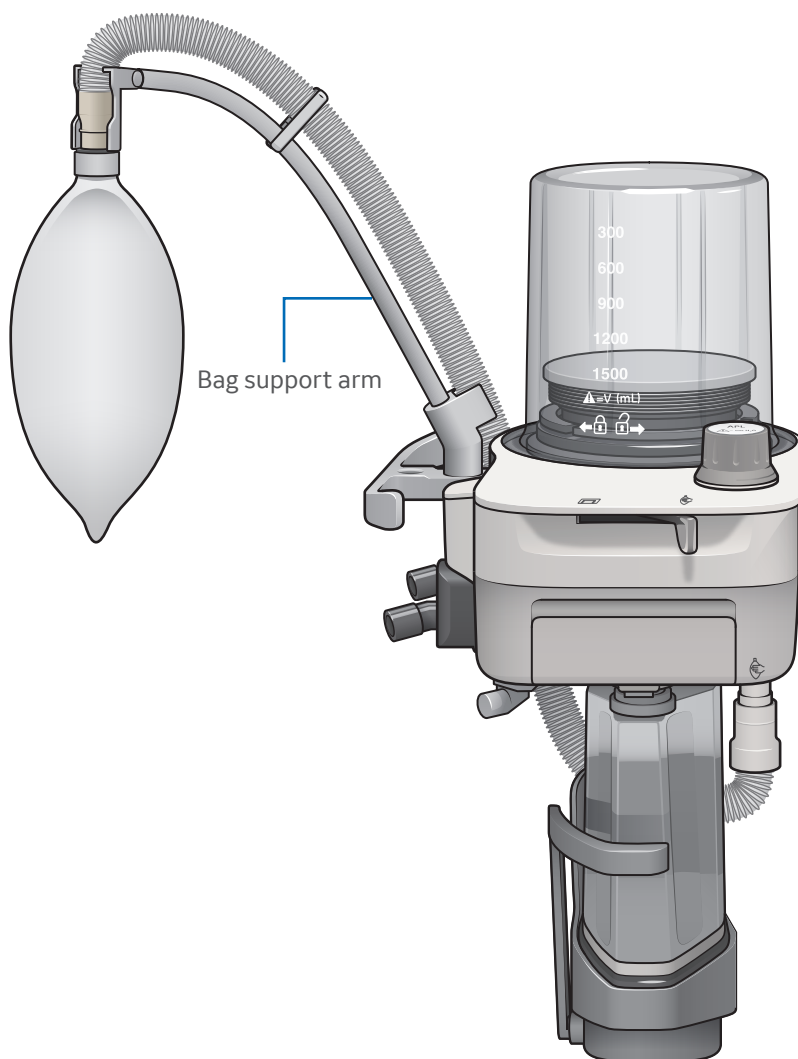
- 1. Central brake:** Push down on the central brake to lock the system in place. Lift up on the central brake to release the brake.
- 2. Caster brakes:** Push down on the lower portion of the brake pedal to lock the system in place. Push down on the upper portion of the brake to release the brake.



Using the bag support arm

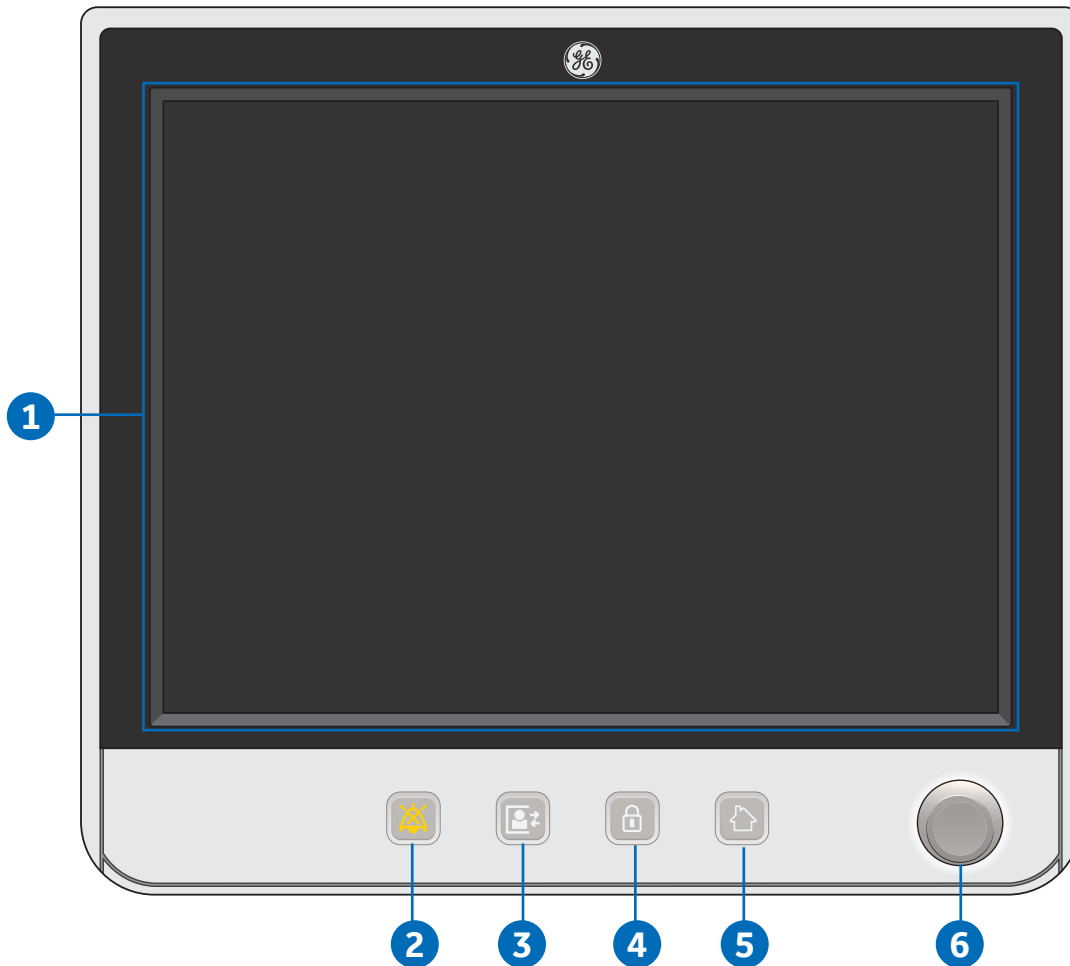
Use the optional bag support arm to hold the breathing circuit bag.

The bag support arm can be moved up or down and left or right.



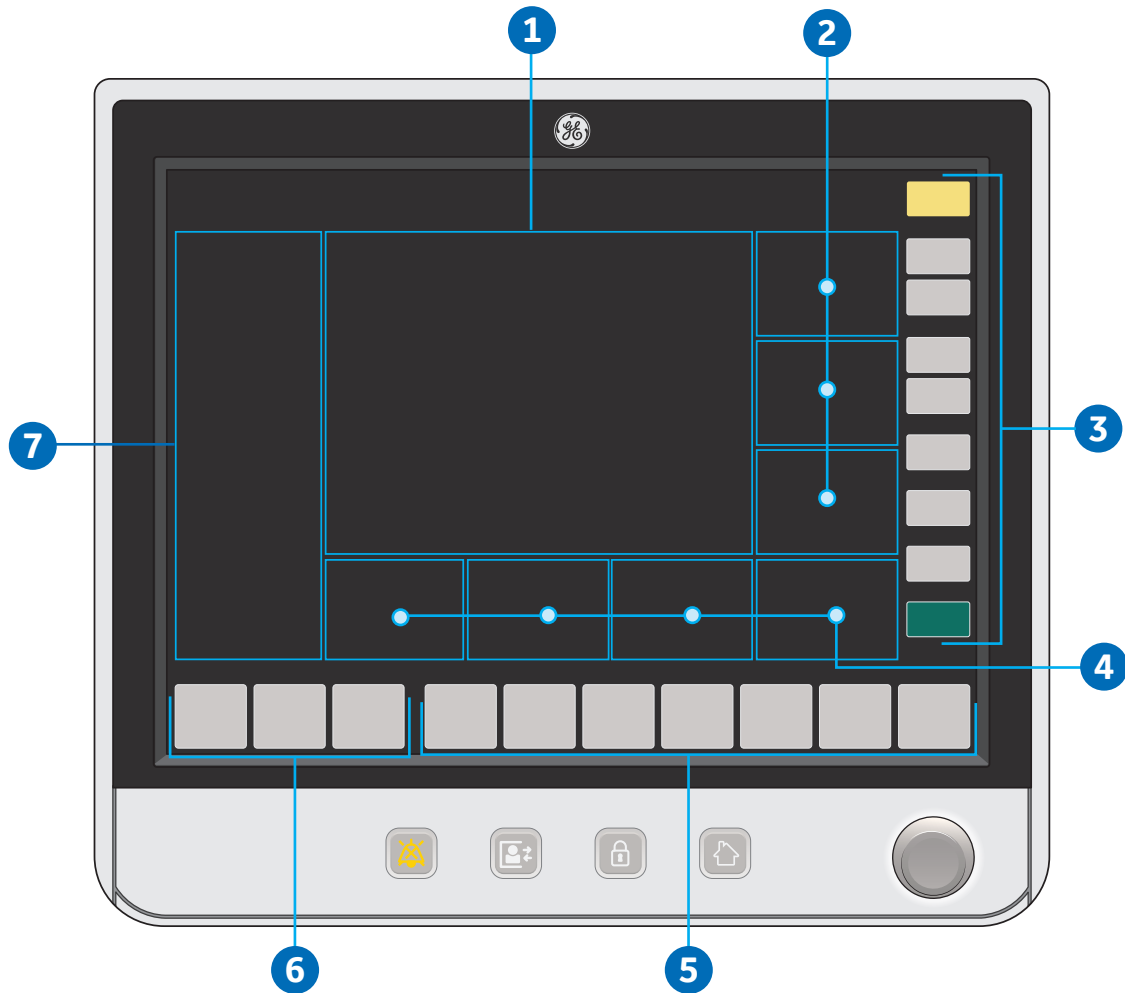
02 Navigation

Display Controls



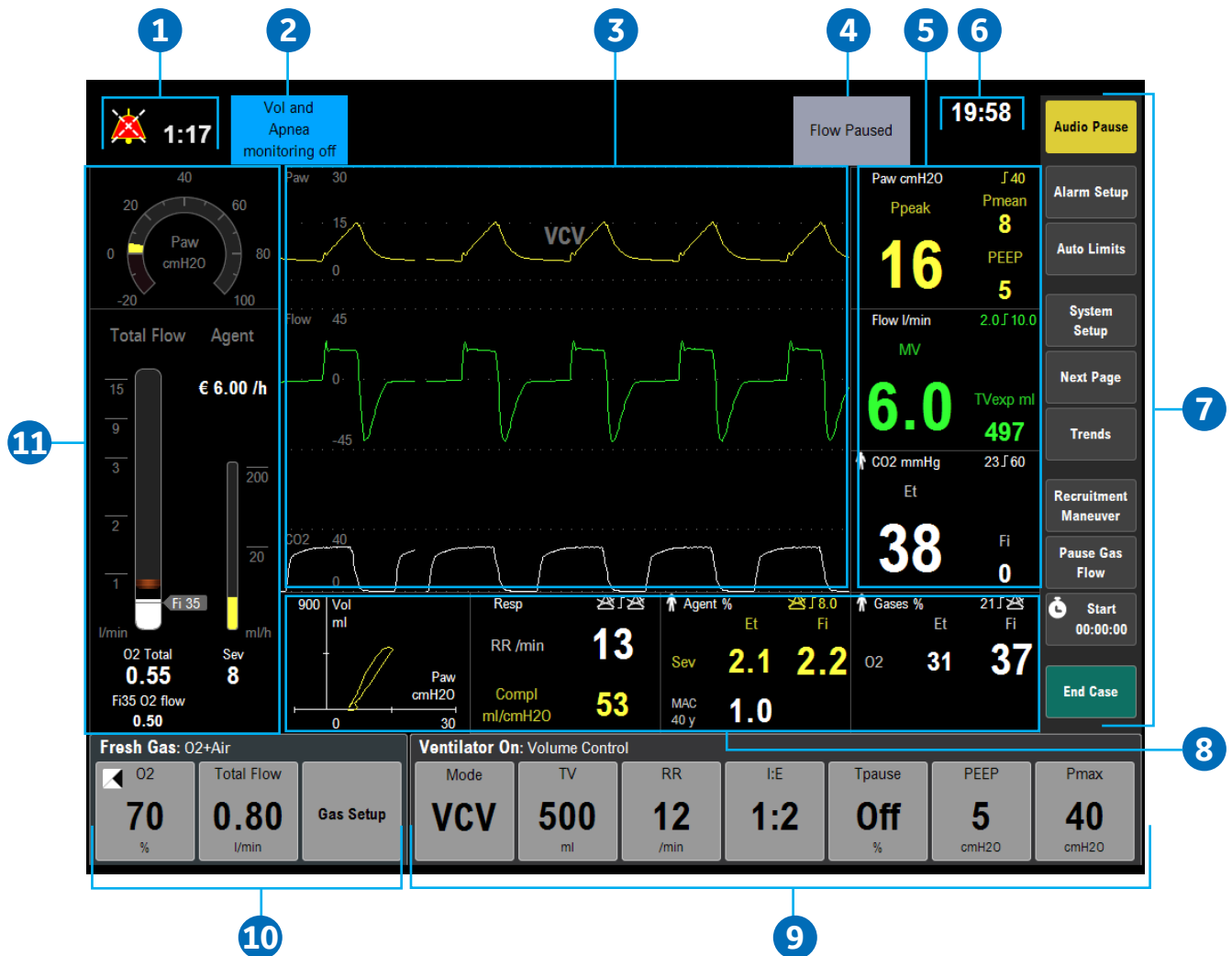
1. **Touchscreen:** Activates functions when touch areas on the screen are selected.
2. **Audio Pause key:** Stops audio for 120 seconds for any active, eligible high and medium priority alarms. Prevents audio (audio off) for 90 seconds when no medium or high priority alarms are active.
3. **Start/End Case key:** Initiates Start or End Case function.
4. **Screen Lock/Unlock key:** Locks the touchscreen. Toggles between lock and unlock functions.
5. **Home key:** Removes all menus from the screen.
6. **ComWheel:** Selects a menu item or confirms a setting. Turn clockwise or counterclockwise to scroll through menu items or change settings.

Touch points



1. Wave fields
2. Measured values
3. Function keys
4. Digit fields
5. Ventilator quick keys
6. Gas quick keys
7. Split screen values

Anesthesia system display



- 1. Audio pause symbol and countdown clock:** Indicates when alarm audio is paused and the countdown clock until audio is on.
- 2. Alarm message fields:** Displays the active alarms.
- 3. Waveform fields:** Displays the waveforms of measured values.
- 4. General message fields or lock touchscreen indicator:** Displays general messages and the touchscreen lock indicator.
- 5. Measured values fields:** Displays the measured values.
- 6. Clock:** Displays the current time.
- 7. Function keys:** Select functions such as Audio Pause, Trends, etc.
- 8. Digit fields:** Contains information for Spirometry, Resp, Agent, and Gases.
- 9. Ventilator quick keys:** Displays Mode, associated ventilation parameters, and More Settings. The selected ventilation mode will be displayed directly above the quick keys.
- 10. Gas quick keys:** Displays O₂, Total Flow, and Gas Setup.
- 11. Split screen:** Contains airway pressure, gas flow values, compliance, trends, and optional ecoFLOW information.

Using menus

1. **Menu:** Displays the title of the open menu. For example: Start Case.
2. **Menu items:** The menu items will vary depending on the selected menu.
3. **Instructions or help information:** This shows any additional instructions or help messages.

The screenshot shows a 'Start Case' menu interface. Callout 1 points to the 'Start Case' title. Callout 2 points to the 'Volume Apnea Alarm' and 'CO2 Alarms' items. Callout 3 points to the empty box at the bottom left.

1 Start Case

Case Defaults ADULT ▼

Volume Apnea Alarm On ▼

CO2 Alarms On ▼

Age y 40

Ideal Weight kg 70

Start Case Now

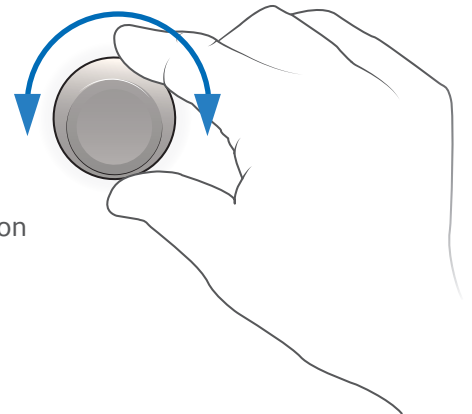
Using the ComWheel

Use the ComWheel to scroll through the quick key settings and function keys, make selections, change settings, and confirm settings.



Turn the ComWheel to the right:

- For menu items, the highlight moves down
- For quick keys, the highlight moves to the next key on the right
- For settings, the value changes to the next available setting
- For pull-down selections, the highlight moves to the next available selection
- Push the ComWheel to confirm a setting



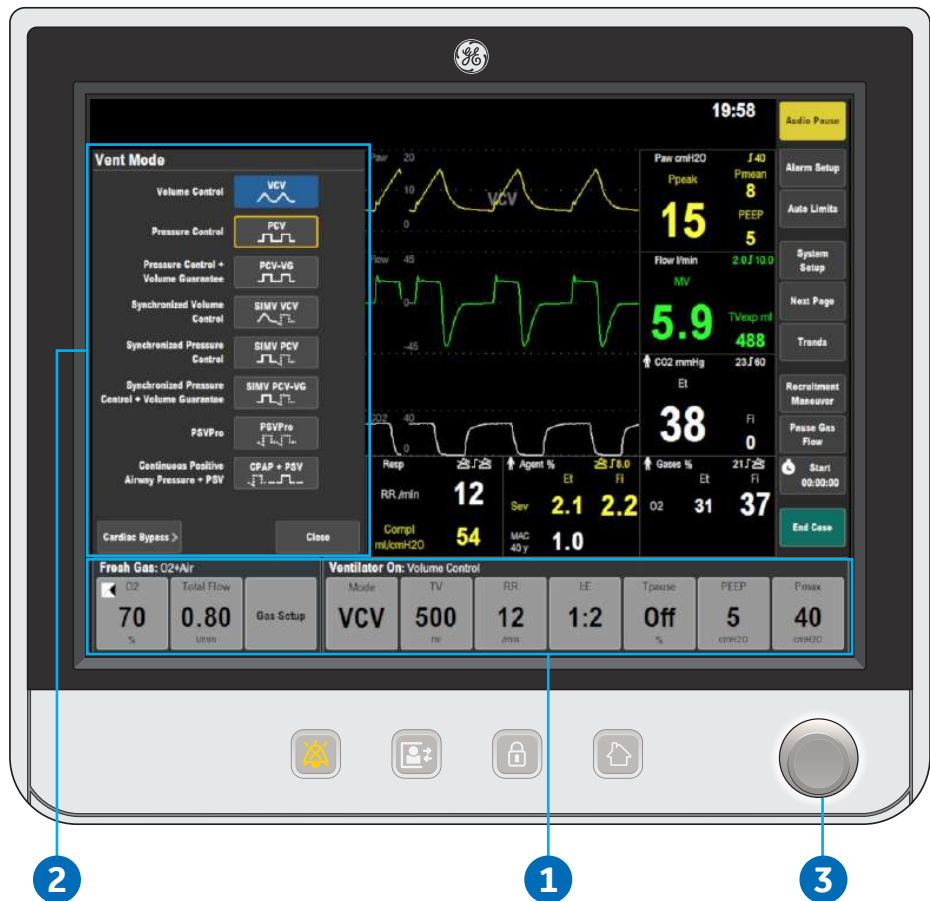
Turn the ComWheel to the left:

- For menu items, the highlight moves up
- For quick keys, the highlight moves to the next key on the left
- For settings, the value changes to the previous available setting
- For pull-down selections, the highlight moves to the previous available selection
- Push the ComWheel to confirm a setting

Using quick keys

The gas settings and the main ventilator settings for each ventilation mode can be changed using the quick keys.

1. Select a quick key to open the menu or select a parameter.
2. If **O₂**, **Total Flow**, **Gas Setup**, **Mode** or **More Settings** is selected, a menu displays. Select the desired value on the menu by touching the value. If any other quick key is selected, the value displays with a highlight. Turn the ComWheel left or right to set the desired value.
3. Push the ComWheel or select the quick key to confirm the change.

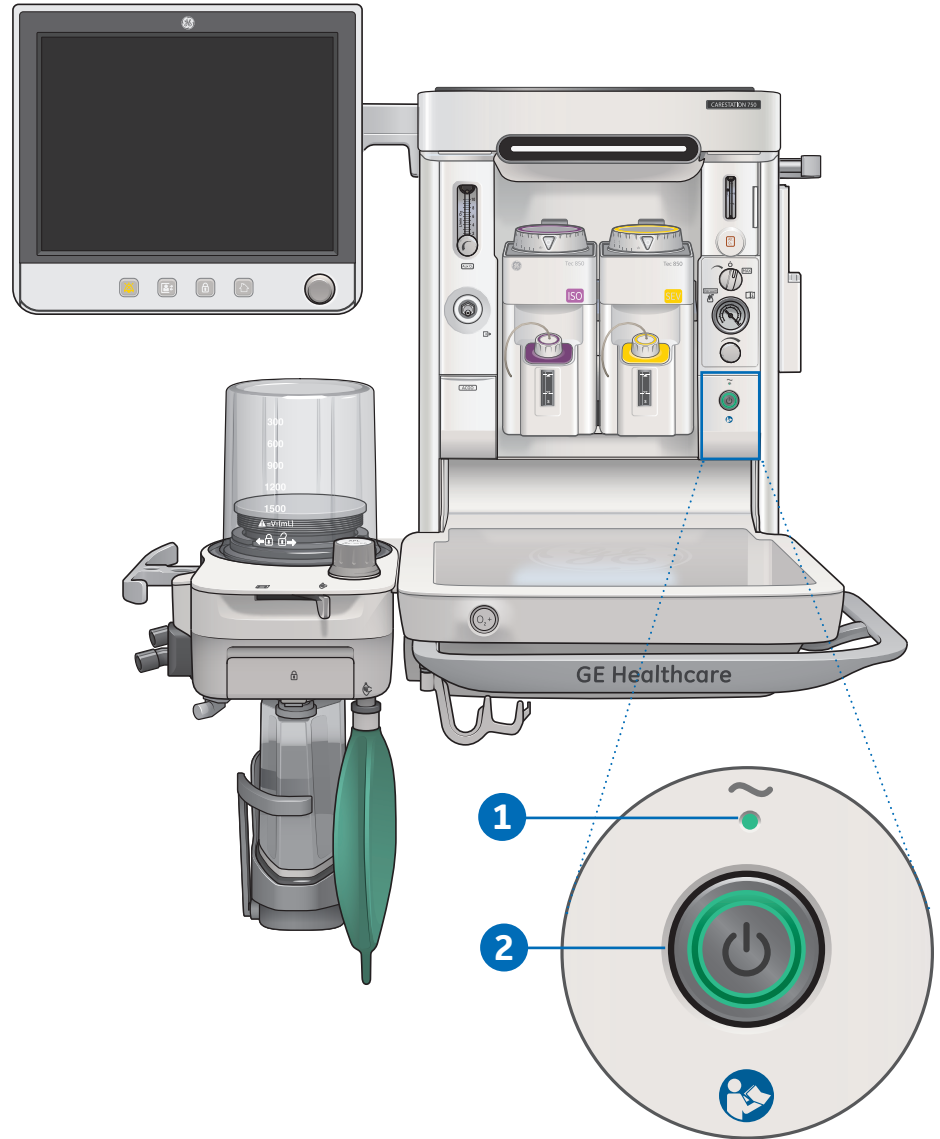


03 Operation overview

Turning on the system

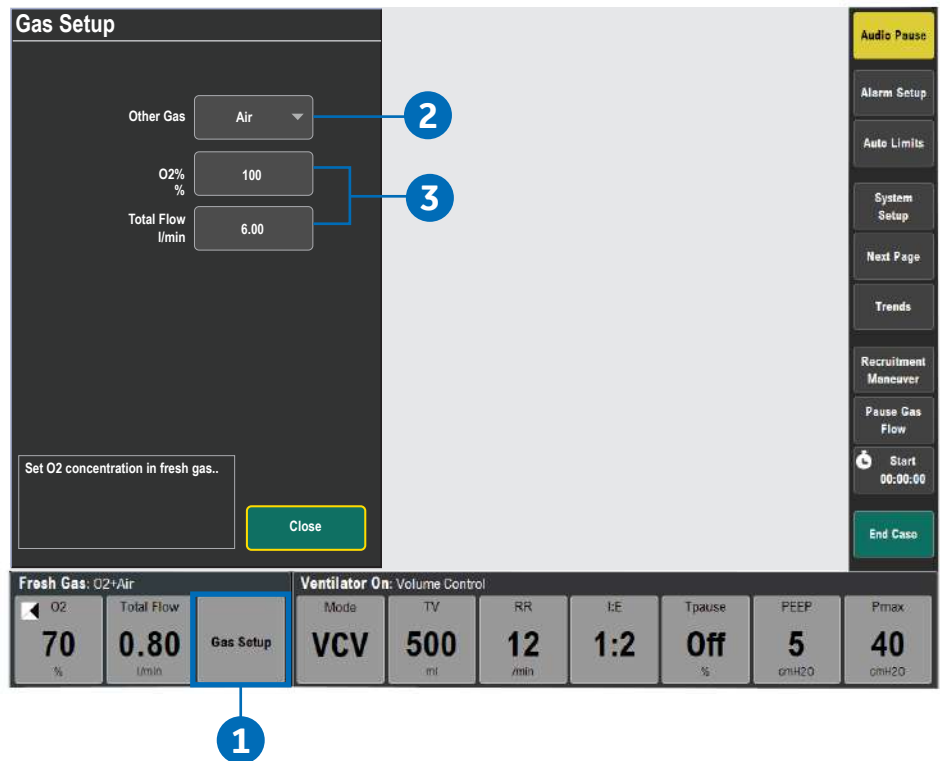
Plug the power cord into an electrical outlet.

1. Make sure the mains indicator light is on.
 - The mains indicator is lit when AC power is connected
 - Battery is charging if it is not already fully charged
2. Push the **On/Standby** switch for 1 second to turn on the system.



Changing gas settings

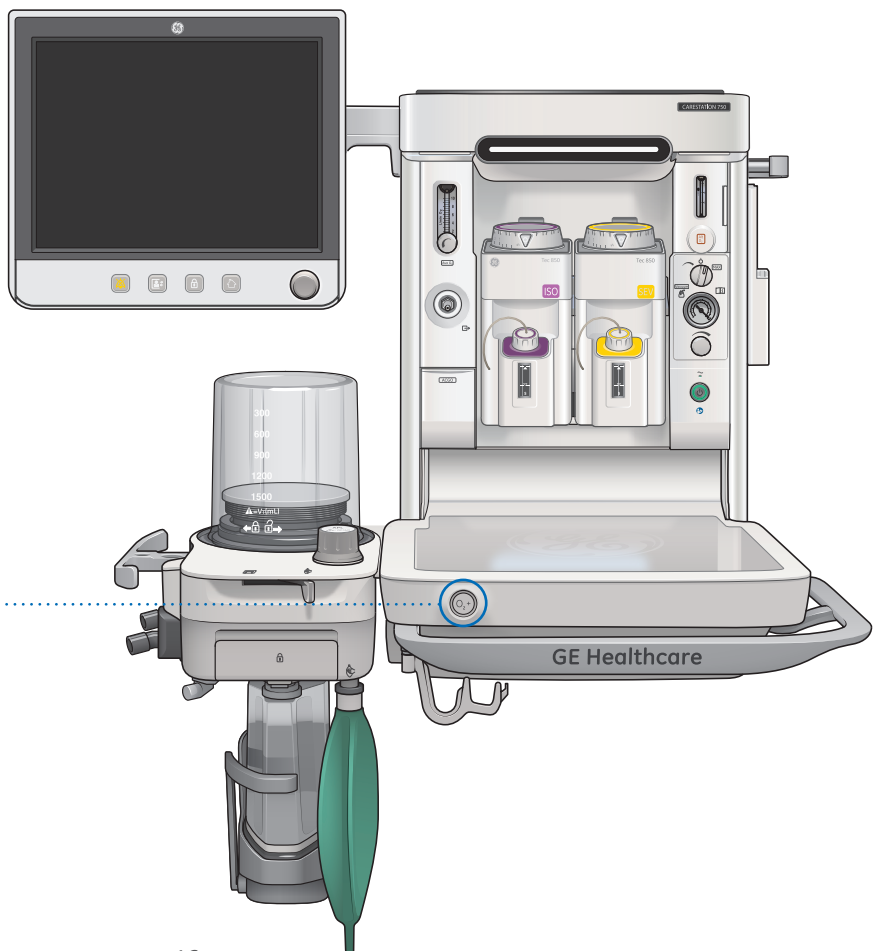
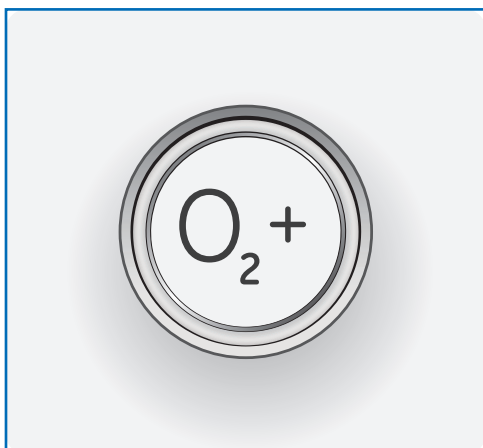
1. Select the **Gas Setup** quick key.
2. For **Other Gas**, select the menu item and change using the drop-down menu.
3. For **O₂%**, and **Total Flow**, select the setting and make the change using the ComWheel and push to confirm the setting.



Using the O₂ flush button

The O₂ flush button supplies a high flow of O₂ to the breathing system.

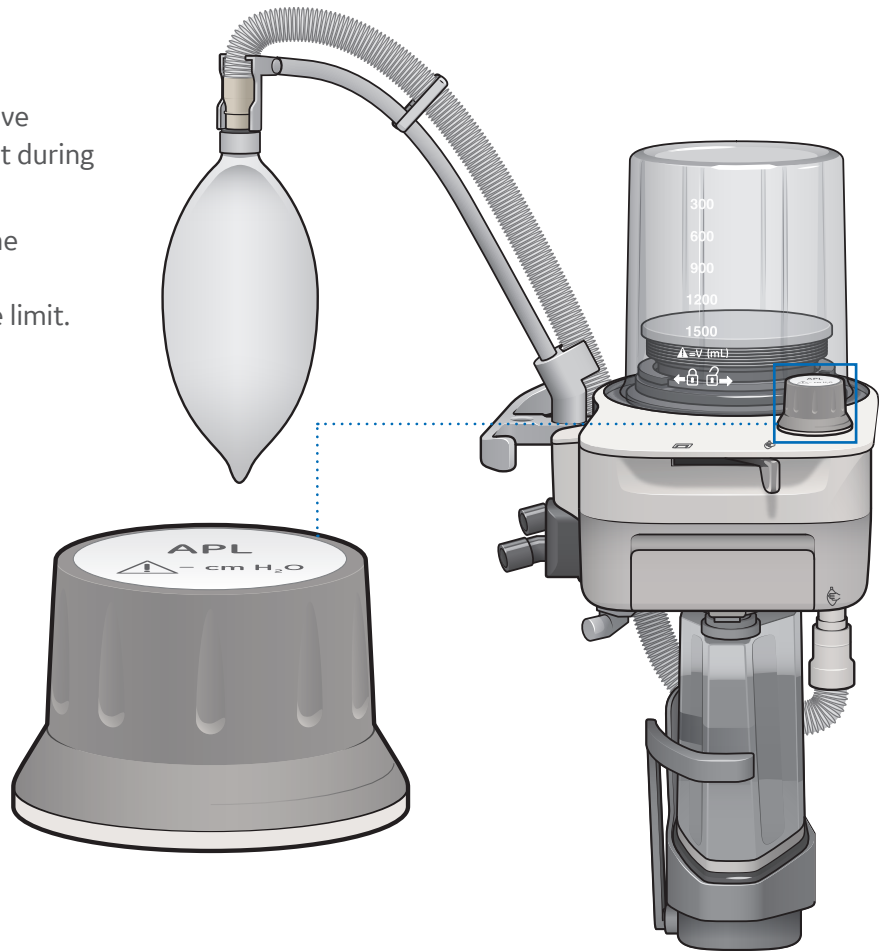
1. Push the **O₂ flush** button to deliver a high flow of O₂.
2. Release the **O₂ flush** button to stop the delivery of a high flow of O₂.



Using the APL valve

The Adjustable Pressure-Limiting (APL) Valve adjusts the breathing system pressure limit during manual ventilation.

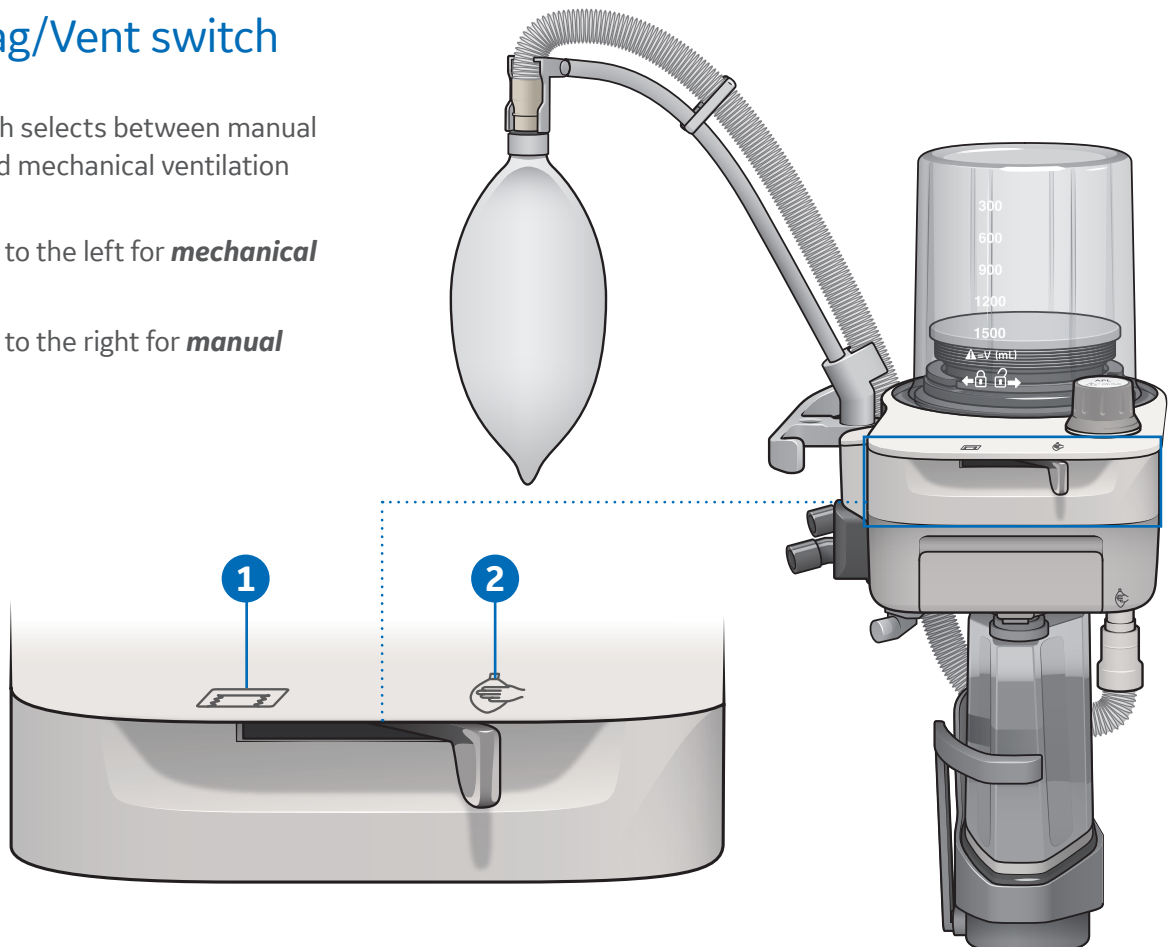
Turn the APL valve clockwise to increase the pressure limit, turn the APL valve counterclockwise to decrease the pressure limit.



Using the Bag/Vent switch

The Bag/Vent Switch selects between manual ventilation (bag) and mechanical ventilation (ventilator).

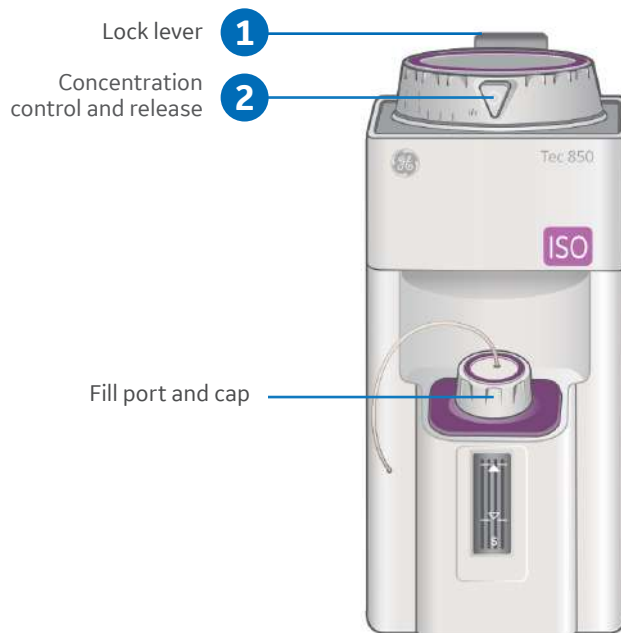
1. Slide the switch to the left for **mechanical ventilation**.
2. Slide the switch to the right for **manual ventilation**.



Using the vaporizer

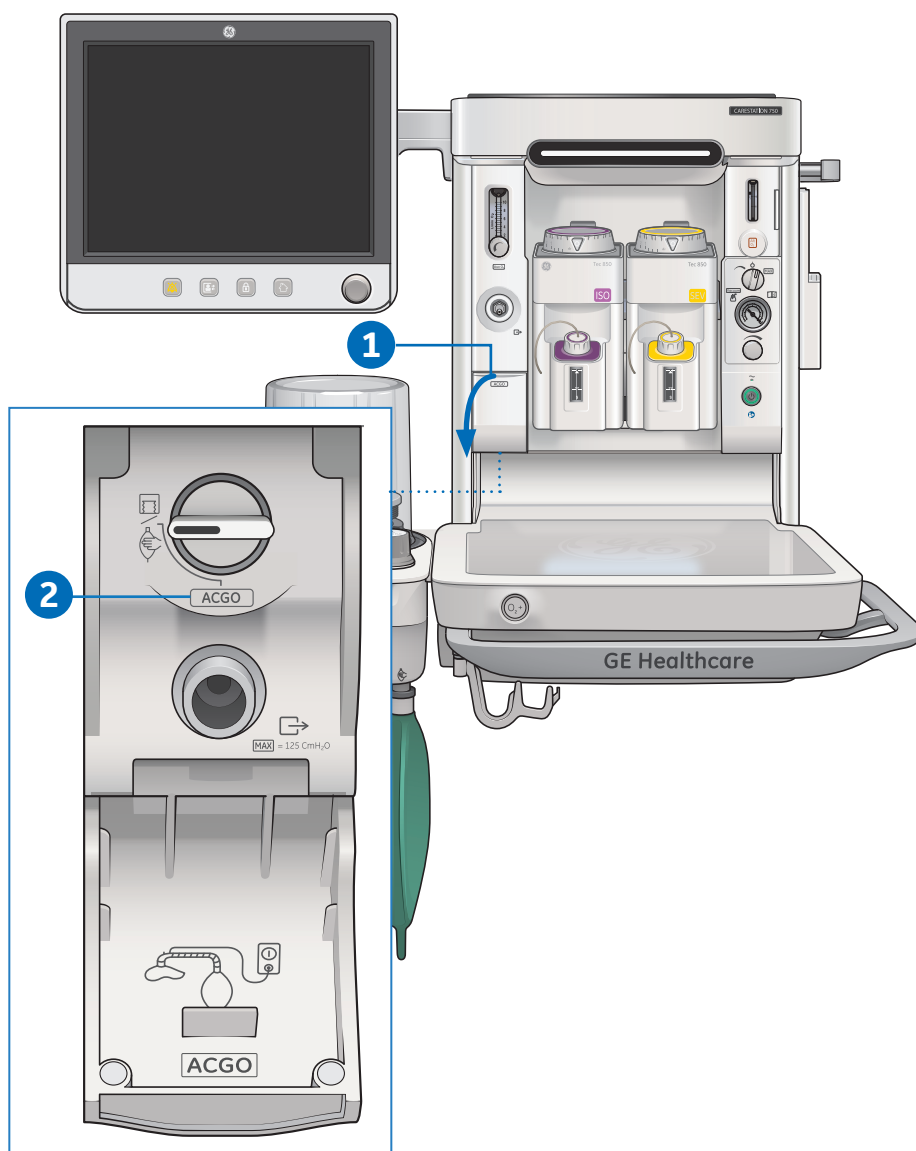
Use only Selectatec™ Series Vaporizers Tec™ 6 Plus Vaporizer or greater.

1. Turn the lock lever full clockwise to lock the vaporizer in position.
2. Push the release and turn the concentration control to set the agent concentration.



Using the ACGO

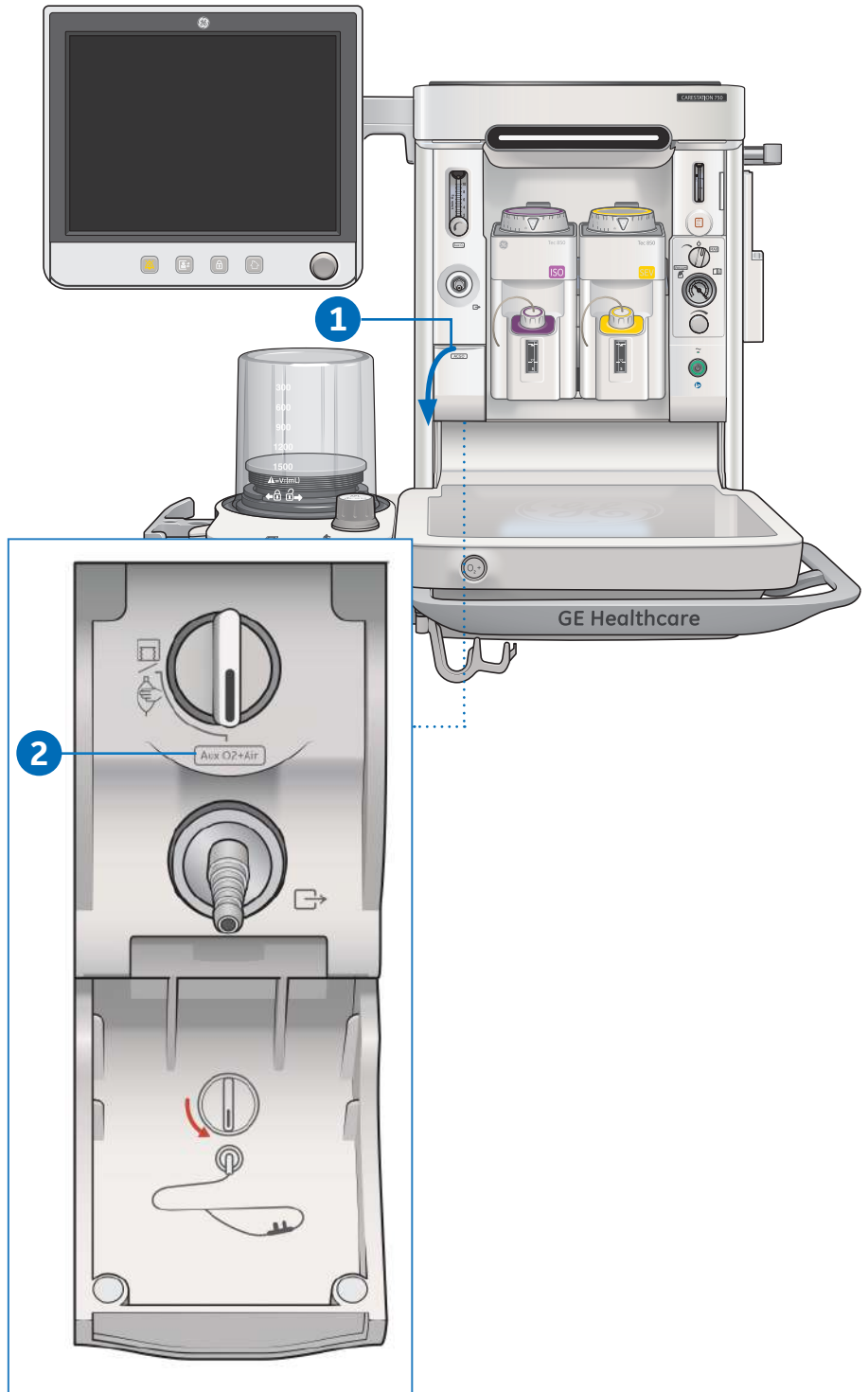
1. Open the ACGO switch cover.
2. Set the ACGO switch to the ACGO position.
 - Fresh gas flows through the ACGO port.
 - Fresh gas oxygen concentration is displayed on the screen if the system has the airway module option.
3. Set the alarm limits to clinically appropriate settings.
4. To stop fresh gas flow through the ACGO port, set the ACGO switch to the circle circuit position.



Using Aux O₂+Air

Use the optional Auxiliary O₂+Air (Aux O₂+Air) switch to deliver O₂ and Air through the Aux O₂+Air outlet on the front of the system. No anesthetic agent is delivered through the Aux O₂+Air outlet. When the switch is set to the Aux O₂+Air position during a case, the outlet indicator is lit and N₂O flow is automatically shut off. The Aux O₂+Air outlet provides 100% O₂ or a mixture of O₂ and Air. Select Gas quick keys to adjust the O₂ concentration and total flow.

1. Open the Aux O₂+Air switch cover.
2. Set the Aux O₂+Air switch to the Aux O₂+Air position.
3. Adjust O₂ and Air with selected Gas quick keys.
 - Set O₂%, the default is 100%
 - Set Total Flow, the default is the case default
 - With individual gas control, set the O₂ and Air flow separately
4. Set the switch to the circle circuit position to stop fresh gas flow through the Aux O₂+Air outlet.
 - Total flow or individual flows from Aux O₂ + Air remain
 - Air as Other gas remains



04 Checkout

Checkout overview

The Checkout menu shows on the display after turning on the system. To access the Checkout menu between cases, select **Checkout**. Step-by-step instructions show in the Checkout menu during the tests. Use the Checkout menu to:

- Perform a **Full Test**
- Perform any of the individual tests
- View the **Test Log**
- Start a case

Perform the **Full Test** at the start of each day. The full test runs automatically and beeps to indicate when it is finished or if interaction is required.

The **Full Test** or the individual tests must be performed at least once within every 24-hour period.

Checkout

Full Test

Individual Tests

Vent and Gas

Vaporizer Leak

Circuit Leak

Calibration

Start Case

Instructions

Perform the Checkout prior to use. Do not start a test while the patient is connected.

1. Connect a patient circuit and a manual bag.

2. Check the absorber and the absorbent.

3. Check that the vaporizers are off and filled with agent.

4. Select Full Test and follow the instructions.

Vent and Gas

Vaporizer

Circuit Leak

Calibration

Pass

NA

Pass

Last

15-Jan-2020 19:36

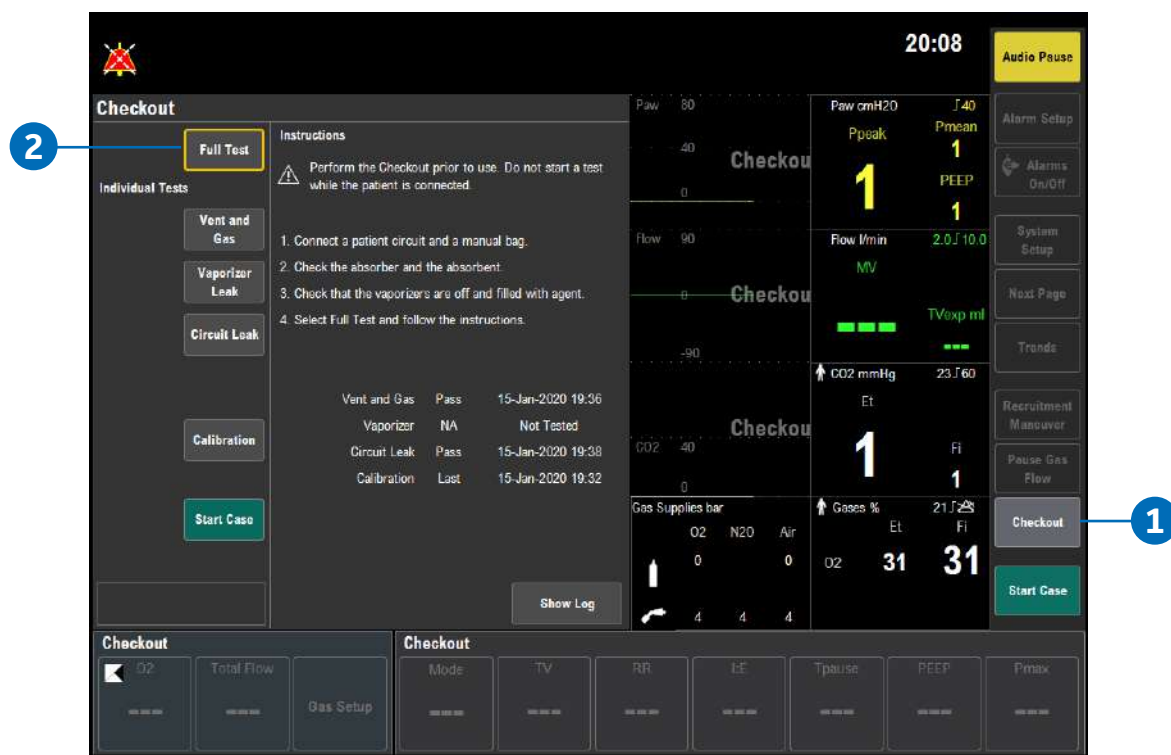
Not Tested

15-Jan-2020 19:38

15-Jan-2020 19:32

Show Log

Checkout full test



The full test runs automatically and beeps to indicate when it is finished or if interaction is required.

Perform a **Full Test** when any component of the system is changed (breathing system, vaporizers, pipeline inlets).

The **Full Test** does the following tests: **Vent and Gas**, **Vaporizer Leak**, and **Circuit Leak**. When one of the tests is completed, the next test begins.

1. Select **Checkout**.
2. From the Checkout menu, select **Full Test** and follow the instructions.

If a test fails, follow the instructions to perform a retest or accept the results, or select **Help** to follow the troubleshooting tips to check the problem.

Note: In case of a patient emergency, the **Full Test** may be bypassed by selecting **Start Case** and then selecting **Bypass**. The general message **Please Do Checkout** is displayed if a **Full Test** or all of the individual tests are not completed with passing results within **24** hours. The messages **Checkout has not passed** and **Checkout bypass will be recorded to the system log** and will be displayed in Checkout menu when checkout is bypassed.

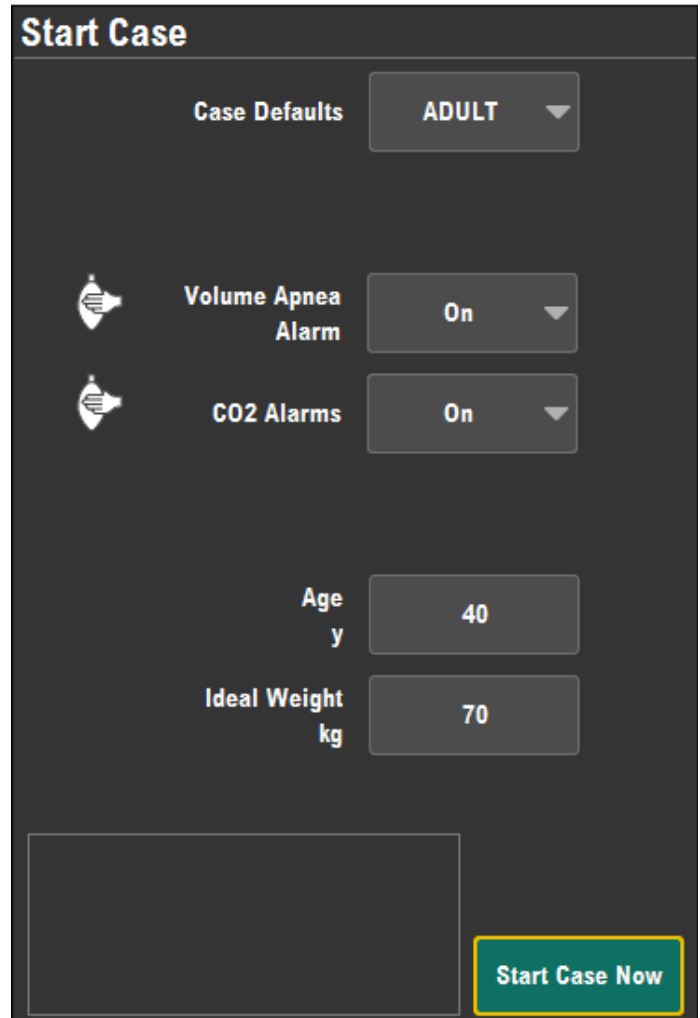
05 Starting a case

Start Case menu overview

Note: A super user is an authorized personnel who has been trained and qualified to change default settings.

Use the **Start Case** menu to set the case data and start the case. A case can be started using default settings or using custom settings. The default settings are configured by the Super User.

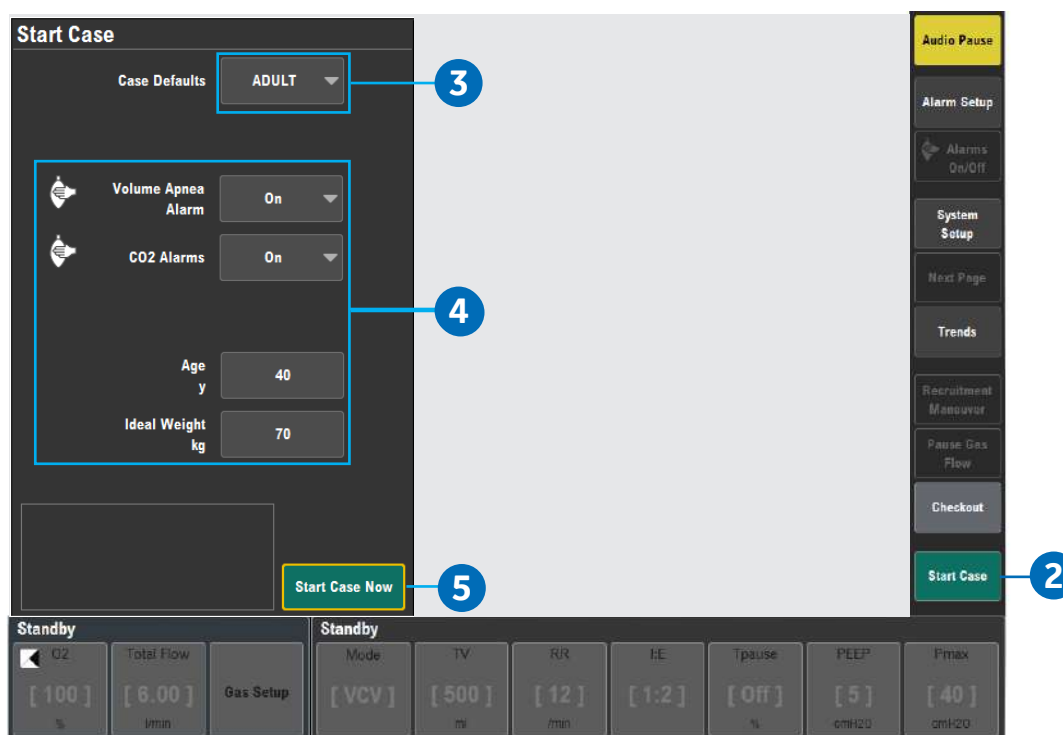
Default Settings selection shows the first of five default case types when the **Start Case** menu is accessed. The **Ideal Weight**, **Age**, and **Volume Apnea Alarm** values are set to the pre-selected settings defined by the Super User corresponding to the case type.



The screenshot shows the 'Start Case' menu interface. At the top, the title 'Start Case' is displayed. Below it, there is a 'Case Defaults' section with a dropdown menu set to 'ADULT'. Further down, there are two rows of settings, each preceded by a hand icon. The first row is 'Volume Apnea Alarm' with a dropdown set to 'On'. The second row is 'CO2 Alarms' with a dropdown set to 'On'. Below these, there are two more settings: 'Age y' with a value of '40' and 'Ideal Weight kg' with a value of '70'. At the bottom right, there is a green button labeled 'Start Case Now' with a yellow border. A large empty rectangular box is located at the bottom left of the interface.

Starting a case using default settings

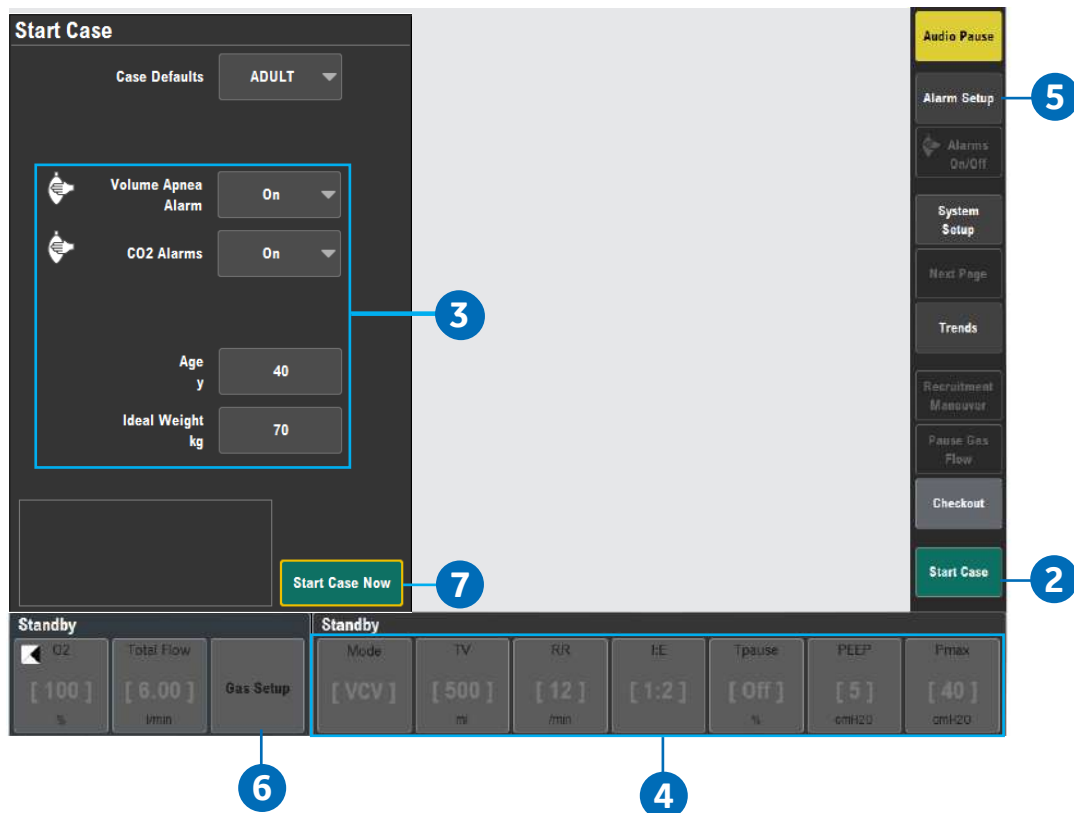
Case Defaults contain five case type selections. Each case type has preset values for **Ideal Weight**, **Age**, and **Volume Apnea Alarm**. The first four default case types are configured and named by the Super User. The fifth default case is **Last Case**.



1. Set the Bag/Vent switch to Bag.
2. Select **Start Case**.
 - The **Case Defaults** selection shows the first preset case type
 - **Ideal Weight**, **Age**, **CO2 Alarms**, and **Volume Apnea** Alarm show the default settings that correspond to the case type shown
3. Verify or change the **Case Defaults** selected.
4. Verify the settings are clinically appropriate.
5. Select **Start Case Now**. Gas flow starts.

Starting a case using custom settings

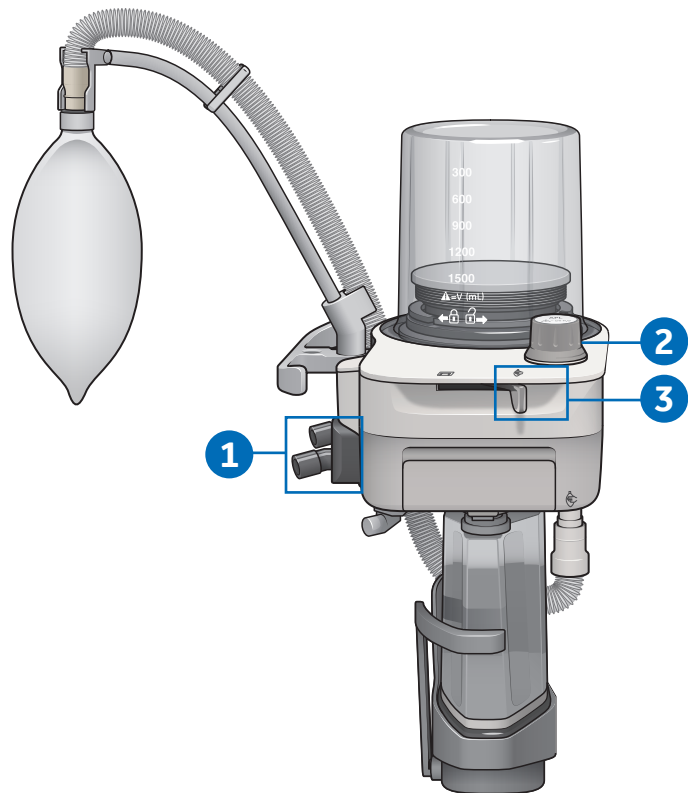
Ideal Weight, Age, CO₂ Alarms, and **Volume Apnea Alarm** can be custom set on the **Start Case** menu before starting a case.



1. Set the Bag/Vent switch to Bag.
2. Select **Start Case**.
 - The **Case Defaults** selection shows the first preset case type
 - **Ideal Weight, Age, CO₂ Alarms,** and **Volume Apnea Alarm** show the default settings that correspond to the case type shown
3. Change **Ideal Weight, Age,** or **Volume Apnea Alarm** settings on the menu.
 - The **Case Defaults** changes from the case name to **Preset**
 - If the **CO₂ Alarms** setting on the menu is changed, the **Case Defaults** remains as previously selected
4. To change ventilation mode, select **Mode** and make the change. To change the ventilation settings, select a ventilator quick key or **More Settings** and make the change.
5. To change alarm settings, select **Alarm Setup** and make the change.
6. To change the gas settings or the circuit type, select **Gas Setup** and make the change.
7. From the **Start Case** menu, select **Start Case Now**. Gas flow starts.

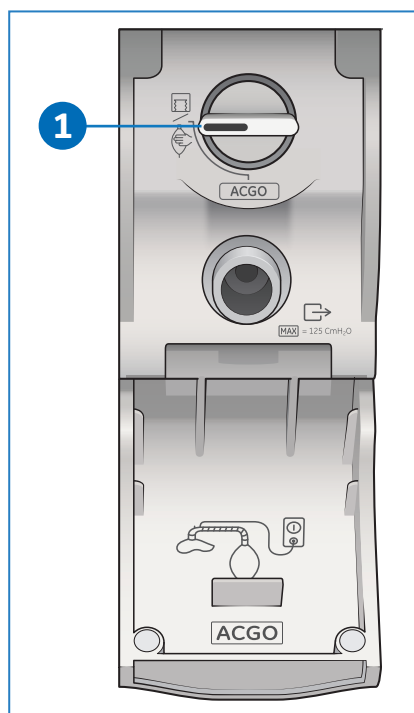
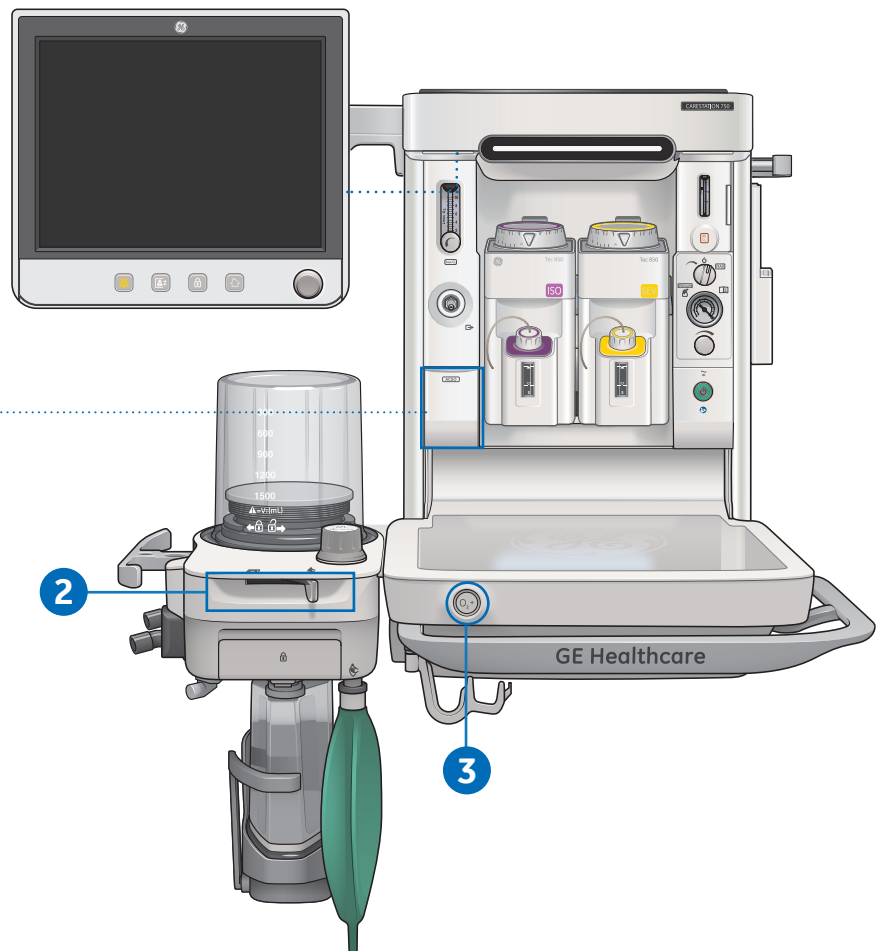
Starting manual ventilation

1. Connect a manual breathing circuit.
2. Make sure the APL valve is set to a clinically appropriate value.
3. Set the Bag/Vent switch to **Bag**.

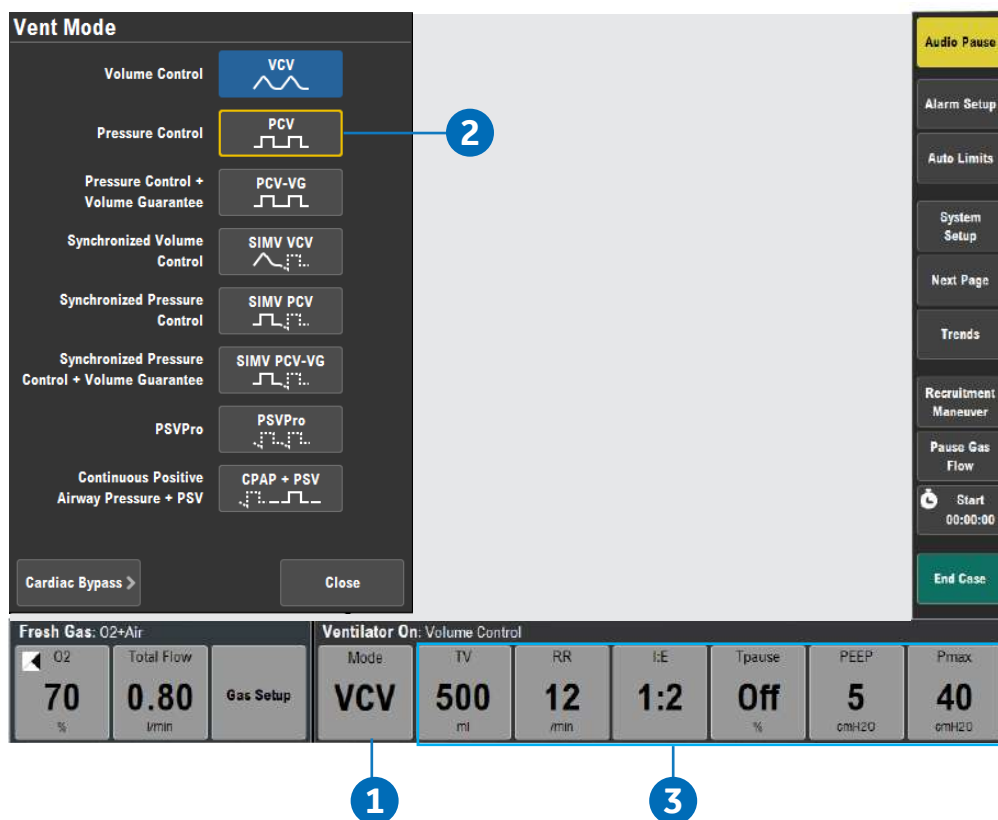


Starting mechanical ventilation

1. Set the ACGO switch to the circle circuit position.
2. Set the Bag/Vent switch.
If Bag/Vent switch is set to Bag, move to Vent position to start mechanical ventilation.
3. If needed, push the O₂ flush button to inflate the bellows.



Changing a ventilator mode and settings

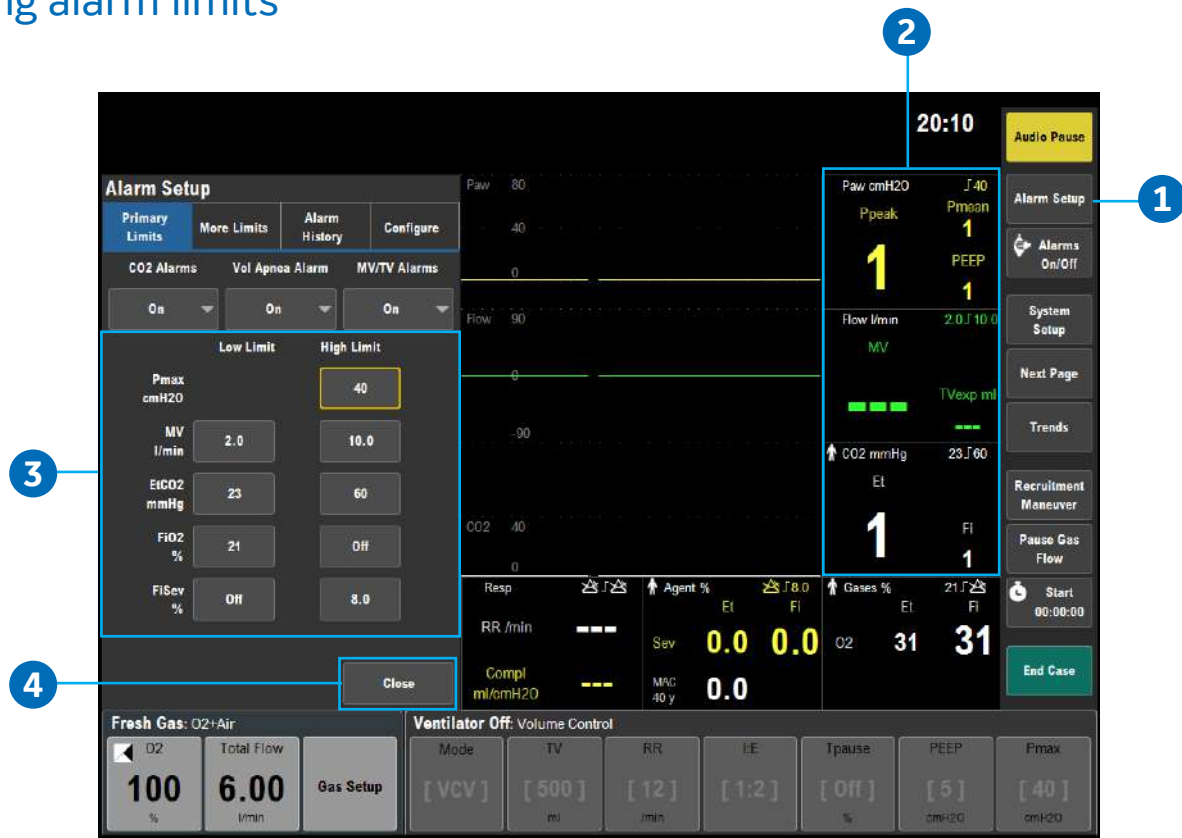


To change a vent mode:

1. Select the **Mode** quick key. The **Vent Mode** menu shows.
2. Select the desired ventilation mode. Set and confirm the primary ventilation setting to activate the ventilation mode.
3. Controls that are frequently used in the ventilation mode can be adjusted with the ventilator quick keys and the **More Settings** quick key. **To change a ventilator setting:** Select the ventilation setting to be adjusted. Set the desired value and then push the ComWheel to activate the change.

06 Alarms and Trends

Setting alarm limits



To set an alarm limit:

1. Select **Alarm Setup** or...
2. Select one of the Measured Value fields.
3. From the **Primary Limits** and **More Limits** tabs, select the alarm limit and make the change.
4. Push the **Home** key, touch the waveform area of the display, or select **Close** to close the menu.

Additional alarm settings

The following alarms can be turned off to reduce nuisance alarms during manual ventilation if clinically appropriate:

1. **CO₂ Alarms:** Use the **CO₂ Alarms** setting to turn off the CO₂ 'Apnea' alarm, **EtCO₂ low**, **EtCO₂ high**, and **FiCO₂ high** and **Absorbent OK?** alarms during manual ventilation.
2. **Vol Apnea Alarm:** Use the **Vol Apnea Alarm** setting to turn off the volume apnea alarm during manual ventilation.
3. **MV/TV Alarms:** Use the **MV/TV Alarms** setting to turn off the MV and TV alarms. If **MV/TV Alarms** is set to **Off** during manual ventilation, the alarms remain off until the Bag/Vent switch is set to Vent or the **MV/TV Alarms** is set to **On**. If the **MV/TV Alarms** is set to **Off** during mechanical ventilation, the alarms remain off when manual ventilation starts.

Note: **CO₂ Alarms** and **Apnea Alarm** selection will not be visible unless enabled by a Super User. **CO₂ Alarms** and **Vol Apnea Alarm** can only be turned off while in manual ventilation.

Alarm Setup

Primary Limits | More Limits | Alarm History | Configure

CO₂ Alarms | Vol Apnea Alarm | MV/TV Alarms

On | On | On

	Low Limit	High Limit
Pmax cmH ₂ O		40
MV l/min	2.0	10.0
EtCO ₂ mmHg	23	60
FiO ₂ %	21	Off
FiSev %	Off	8.0

Close

Setting Auto Limits

Use the **Auto Limits** menu to quickly set alarm ranges for 'MV', 'TV', and 'EtCO₂' during mechanical ventilation.

1. Select the **Auto Limits** key.
The menu shows the current measured values and the proposed low and high alarm limits. Check the proposed parameters.
2. Select **Confirm** to use the proposed low and high alarm limits.
3. Select **Cancel** to leave the alarm limits unchanged.
4. Select **Case Default Limits** to set the alarm limits to the case default limits.

The screenshot shows the 'Auto Limits' menu. At the top, there's a table with columns 'Current Value', 'Low', and 'High'. The rows are for MV (l/min), TV (ml), and EtCO₂ (mmHg). Below this table is a 'Case Default Limits' button. At the bottom are 'Cancel' and 'Confirm' buttons. On the right side, there's a vertical menu with 'Auto Limits' highlighted. Numbered callouts point to: 1. 'Auto Limits' in the right menu; 2. 'Confirm' button; 3. 'Cancel' button; 4. 'Case Default Limits' button.

	Current Value	Low	High
MV l/min	3.6	1.6	6.0
TV ml	465	Off	700
EtCO ₂ mmHg	36	26	47

Buttons: Cancel, Confirm, Case Default Limits

Bottom status bar: Fresh Gas: O2+Air (O2: 70%, Total Flow: 0.80 l/min, Gas Setup), Ventilator On: Volume Control (Mode: VCV, TV: 500 ml, RR: 12 /min, I:E: 1:2, Tpause: Off, PEEP: 5 cmH2O, Pmax: 40 cmH2O)

Viewing Trends

Use the **Trends** menu to view patient trends and set the time scale.

1. Select the **Trends** key.
2. Select the desired view.
3. Select **Scroll** to move through the current trend view.
4. Select **Time Scale** to select the desired scale from the dropdown menu.
5. Select **Next Page** to view additional parameters.
6. Select **Close** to close the menu.

The screenshot shows the 'Trends' menu. On the left, there's a 'View' section with 'Graphical', 'Measured', and 'Settings' options. Below that is a 'Time Scale' dropdown menu set to '30 min'. At the bottom are 'Next Page' and 'Close' buttons. On the right side, there's a vertical menu with 'Trends' highlighted. Numbered callouts point to: 1. 'Trends' in the right menu; 2. 'Measured' view option; 3. 'Scroll' button; 4. 'Time Scale' dropdown; 5. 'Next Page' button; 6. 'Close' button.

Page 1 Measured Data 16-Jan-2020

Time	O2% Et/Fi	CO2 mmHg	AA % Et/Fi	AA ID	N2O% Et/Fi
17:10	41/34	36/1	2.1/2.2	Sev	0/0
17:15	41/34	36/1	2.1/2.2	Sev	0/0
17:20	41/34	36/1	2.1/2.2	Sev	0/0

Page 1 of 3

Buttons: Next Page, Close

Bottom status bar: Fresh Gas: O2+Air (O2: 70%, Total Flow: 0.80 l/min, Gas Setup), Ventilator On: Volume Control (Mode: VCV, TV: 500 ml, RR: 12 /min, I:E: 1:2, Tpause: Off, PEEP: 5 cmH2O, Pmax: 40 cmH2O)

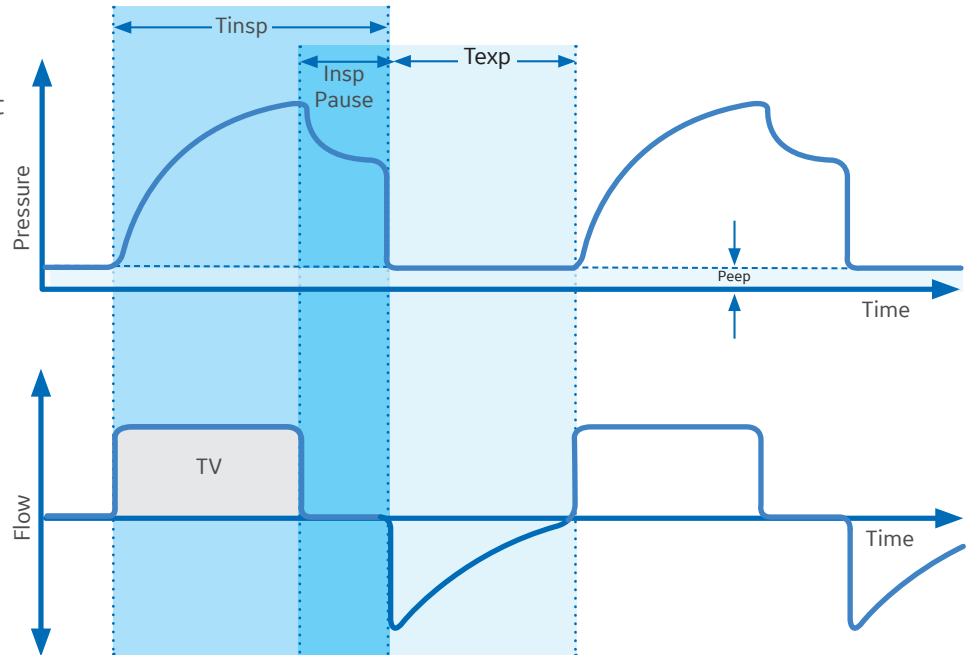
07 Ventilation modes

Volume control mode (VCV)

- Supplies a set volume to the patient
- Calculates a flow based on the set tidal volume and the length of the inspiratory time
- Can compensate for breathing system compliance, fresh gas flow, and moderate breathing system leaks
- Inspiratory pause is available

VCV mode settings:

- TV
- RR
- I:E
- T_{pause}
- PEEP
- P_{max}

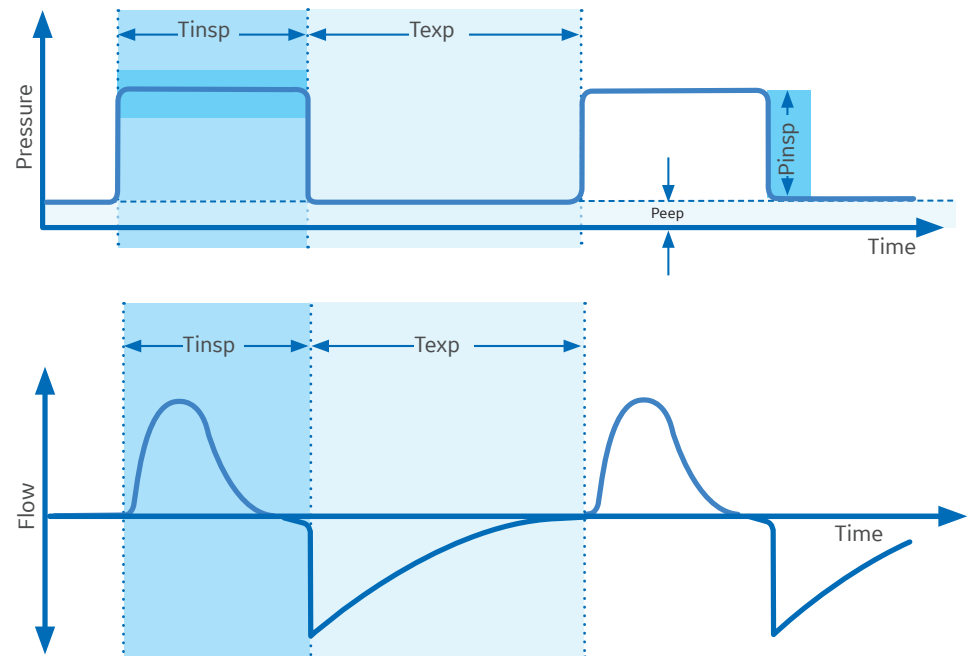


Pressure control mode (PCV)

- Supplies a constant set pressure during inspiration
- Inspiratory time is calculated from the rate and I:E settings
- High initial flow
- Flow is adjusted automatically to maintain set inspiratory pressure

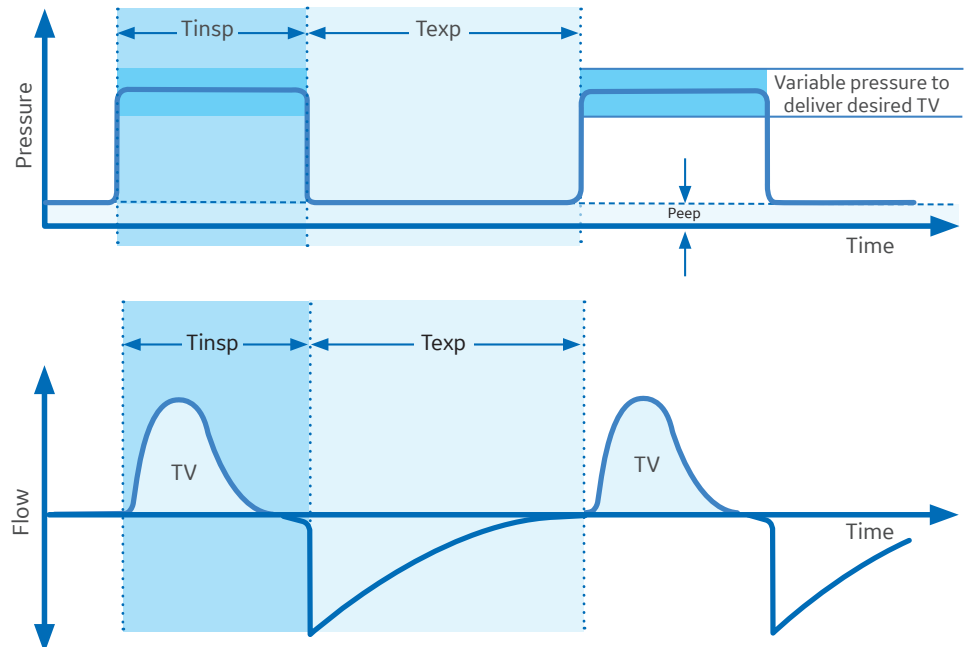
PCV mode settings:

- P_{insp}
- RR
- I:E
- PEEP
- P_{max}
- Rise Rate



PCV-VG mode

- Tidal volume is set and volume is delivered using a decelerating flow and constant pressure
- The ventilator will adjust the inspiratory pressure needed to deliver the set tidal volume breath-by-breath so that the lowest pressure is used
- The patient's compliance is determined from a volume breath delivered at the set tidal volume, and the inspiratory pressure level is then established for the next PCV-VG



PCV-VG mode settings:

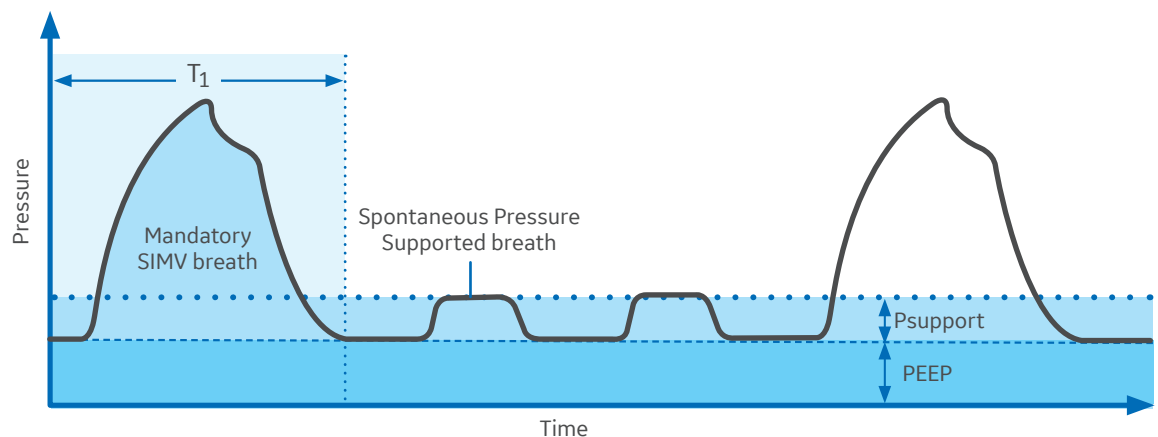
- TV
- RR
- I:E
- PEEP
- P_{max}
- Rise Rate

SIMV VCV mode

- Periodic volume breaths are delivered at preset intervals
- Between the machine delivered breaths, the patient can breathe spontaneously
- Spontaneous breaths can be pressure supported
- Spontaneous breaths are indicated by a color change in the waveform

SIMV-VCV mode settings:

- TV
- RR
- T_{insp}
- T_{pause}
- P_{support}
- PEEP
- P_{max}
- Trig Window
- Flow Trigger
- End of Breath
- Rise Rate

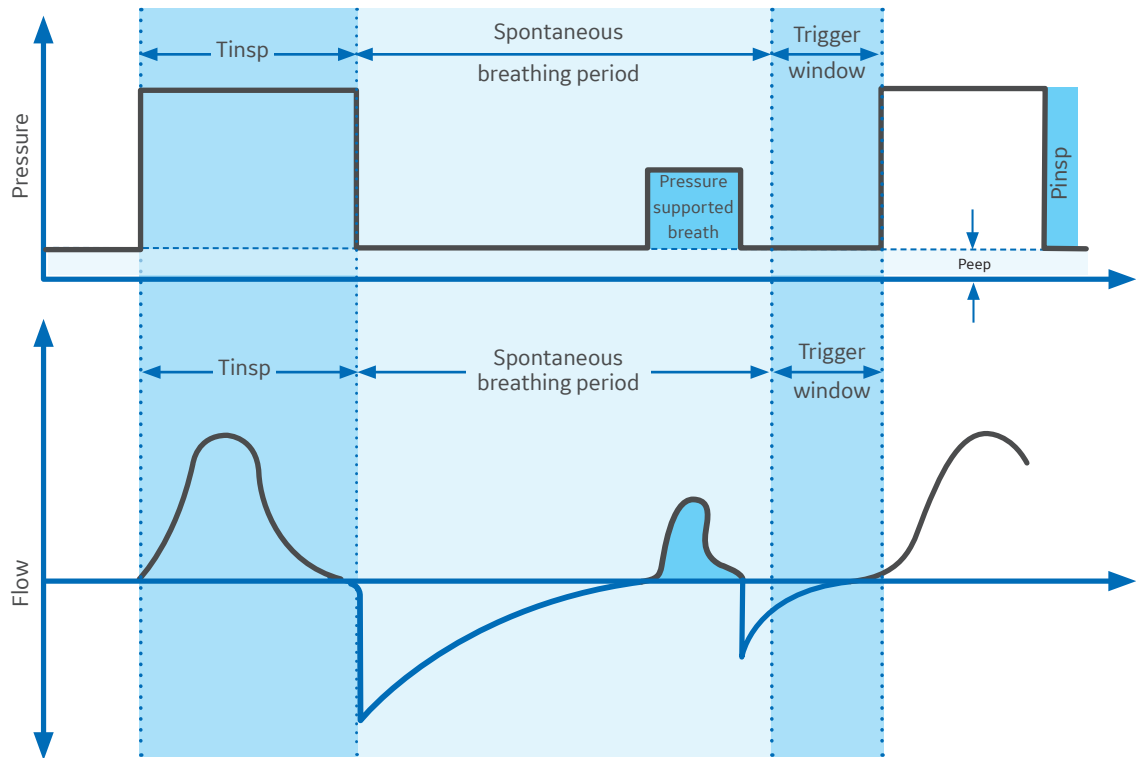


SIMV PCV mode

- Delivers a relatively slow breathing rate with pressure controlled breathing
- Combines mandatory breaths with spontaneous breath support
- If a trigger event occurs within the synchronized window, a new pressure-controlled breath is initiated
- If a trigger event occurs elsewhere during the expiratory phase, a support for a spontaneous breath is provided with pressure support added as set by the clinician.

SIMV PCV mode settings:

- P_{insp}
- RR
- T_{insp}
- P_{support}
- PEEP
- P_{max}
- Trig Window
- Flow Trigger
- End of Breath
- Rise Rate
- Exit Backup

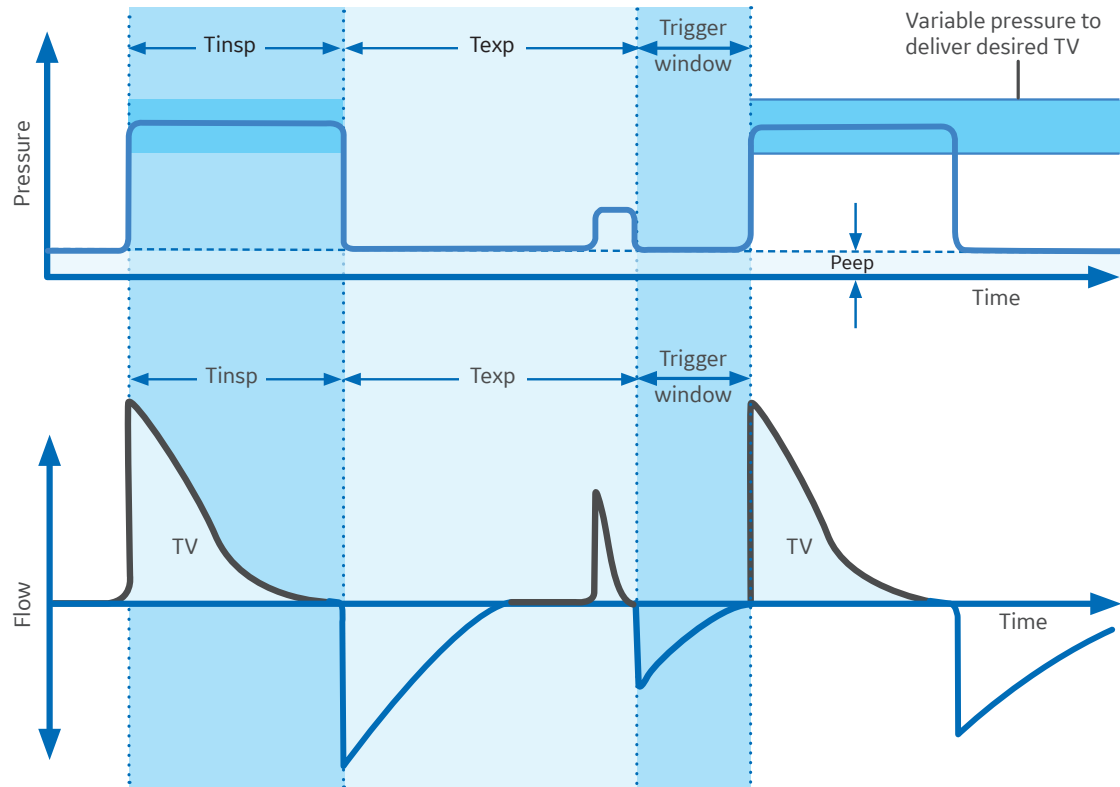


SIMV PCV-VG mode

- Delivers a set rate of pressure controlled breaths with a guaranteed volume
- The ventilator will adjust the inspiratory pressure needed to deliver the set tidal volume breath-by-breath so that the lowest pressure is used.
- The patient's compliance is determined from the volume controlled ventilation breath and the inspiratory pressure level is then established for the next PCV-VG breath.

SIMV PCV-VG mode settings:

- TV
- RR
- Flow Trigger
- P_{support}
- PEEP
- T_{insp}
- P_{max}
- Trig Window
- End of Breath
- Rise Rate
- PSV Rise Rate

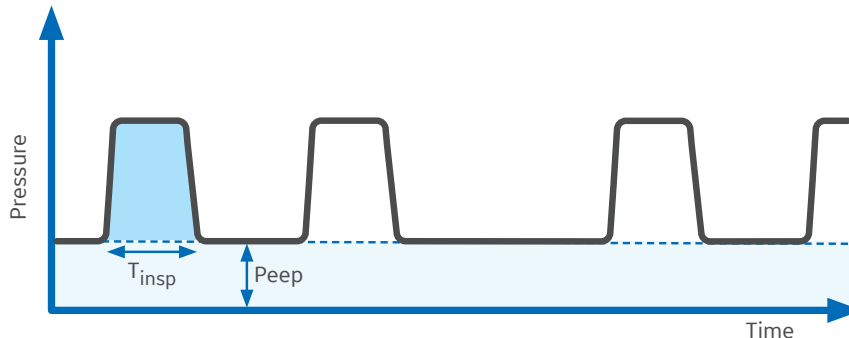


PSVPro™ Ventilation Mode

- Pressure supported ventilation with apnea backup
- Clinician sets the P_{support} and PEEP levels, the patient establishes the rate, inspiratory flow and inspiratory time
- Tidal volume is determined by the pressure, lung characteristics and patient effort
- Apnea backup mode (SIMV PCV) is provided if the patient stops breathing
- In backup mode, the Backup Mode active alarm is shown until PSVPro™ Ventilation Mode is reinstated or another ventilation mode is selected

PSVPro mode settings:

- P_{support}
- PEEP
- Trig Window
- Flow Trigger
- End of Breath
- P_{max}
- Backup Time
- P_{insp}
- RR
- T_{insp}
- Rise Rate
- Exit Backup

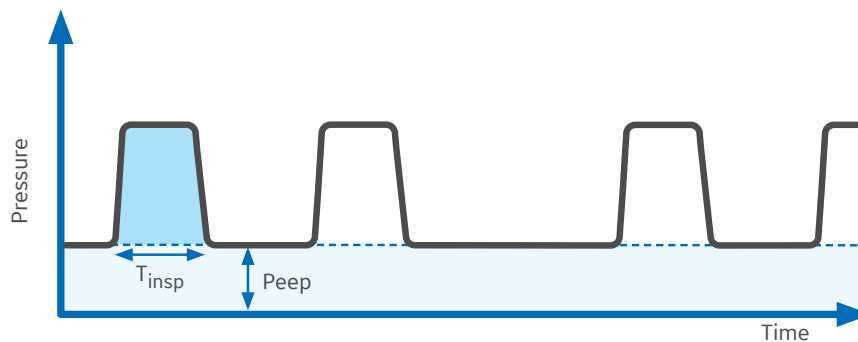


CPAP + PSV mode

- Provides a constant support pressure for spontaneously breathing patients once the ventilator senses an inspiratory effort
- The patient establishes the rate, inspiratory flow, and inspiratory time
- The tidal volume is determined by the pressure, lung characteristics, and patient effort.
- Spontaneous breaths that occur are indicated by a color change in the waveform

CPAP + PSV settings:

- P_{support}
- PEEP
- Flow Trigger
- End of Breath
- P_{max}
- P_{insp}
- Minimum RR
- T_{insp}
- Rise Rate



08 Special features

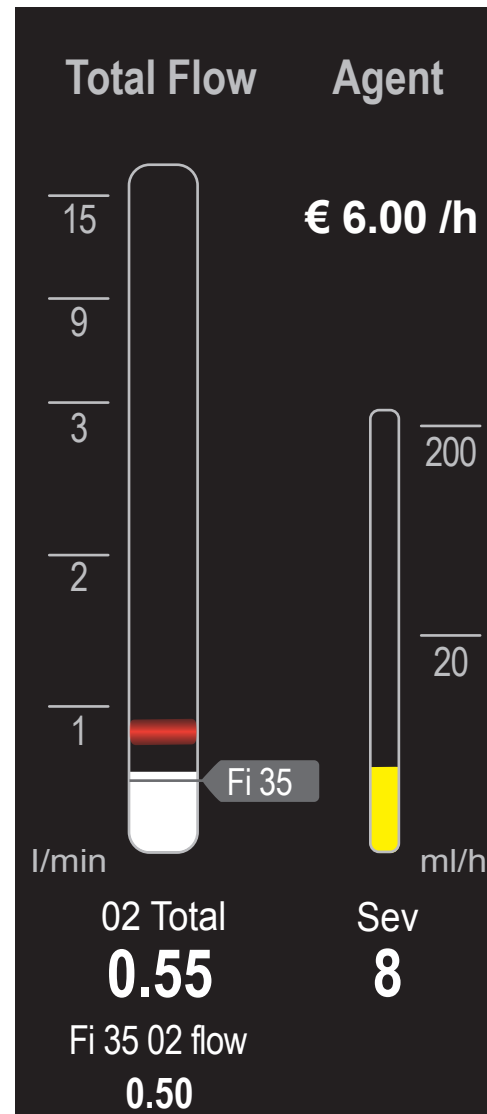
ecoFLOW overview

The ecoFLOW option provides a split screen view that shows the approximate minimum O₂ flow to maintain a preset FiO₂ value. It also shows the approximate agent used per hour and the cost.

The split screen shows the Paw gauge in the upper area and the ecoFLOW gauge in the lower portion of the screen. The ecoFLOW gauge consists of a fresh gas flow tube, an agent flow indicator, and related parameters.

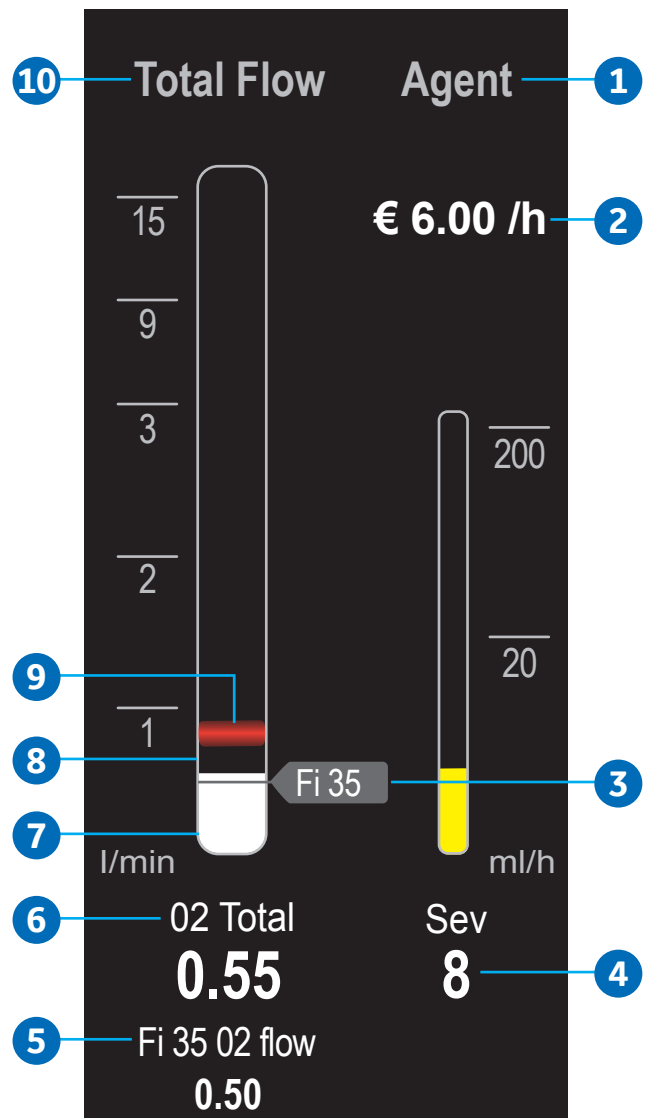
Below the fresh gas flow tube is the measured total O₂ flow to the patient and the calculated FiO₂ flow value. The FiO₂ flow value is based on the FiO₂ setting specified by a Super User. This is the minimum O₂ flow needed to deliver a preset inspired O₂ concentration. O₂ Total flow greater than the Fi25 O₂ flow represents excess flow which can be reduced, while still maintaining desired FiO₂ preset value. The FiO₂ flow value is specific to each patient and case.

The agent flow indicator shows the amount of liquid agent flow as related to the fresh gas setting. The calculated cost of the agent shows above this indicator. This cost is based on agent flow and the values entered in the Super User mode.



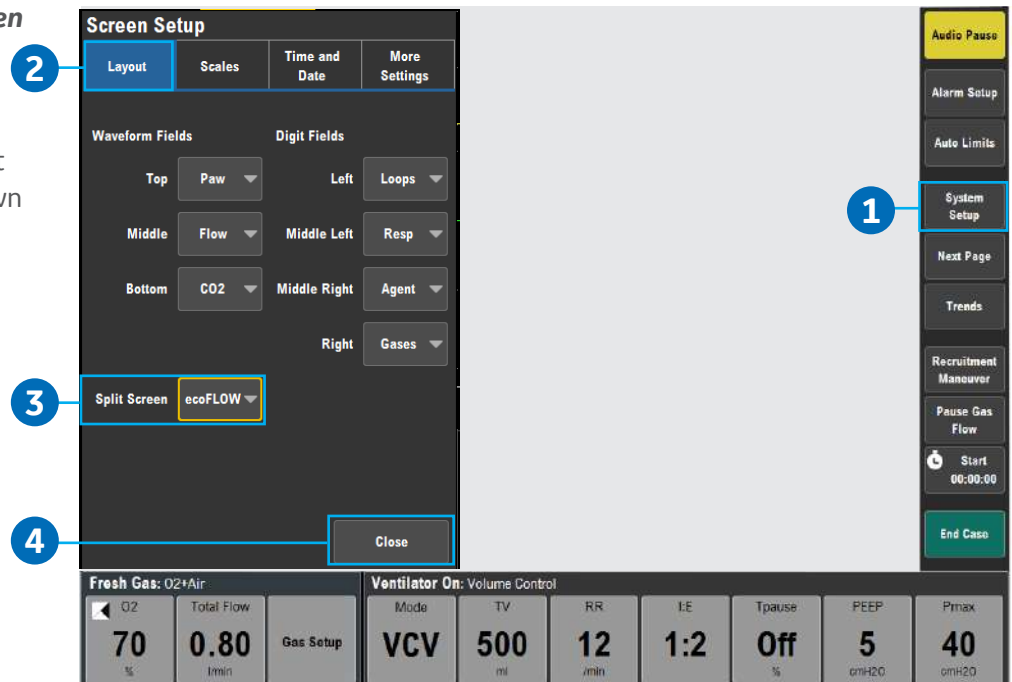
ecoFLOW menu components

1. **Agent:** Shows Agent cost and flow information.
2. **Agent Cost:** The cost of the current agent flow. This value is determined by the agent flow multiplied by the agent cost set by the Super User.
3. **FiO₂ flow marker:** The graphical representation on the flow tube of the FiO₂ flow value. This marker can be removed by the Super User
4. **Agent flow:** The measured value of the liquid agent flow from the vaporizer. The agent flow may have a delayed response.
5. **FiO₂ flow:** The minimum O₂ flow needed to maintain the set inspired O₂ flow. This item can be disabled by the Super User.
6. **O₂ total (numeric):** The O₂ total equals the set of O₂ flow. If N₂O is the balance gas, this equals the set O₂ flow. If Air is the balance gas, this is the set of O₂ flow plus 21% of the Air flow.
7. **O₂ total (graphical):** The graphical representation of the total O₂ flow.
8. **N₂O total and N₂ total:** The N₂O total equals the set N₂O flow. The N₂ total equals the N₂ in the Air flow.
9. **Flow bobbin:** The height of this represents the total fresh gas flow delivered to the breathing system.
10. **Total flow:** Shows Total Flow information.



Activating the ecoFLOW split screen

1. Select **System Setup > Screen Setup**.
2. Select the **Layout** tab.
3. Select Split Screen and select **ecoFLOW** from the drop-down menu.
4. Select **Close**.

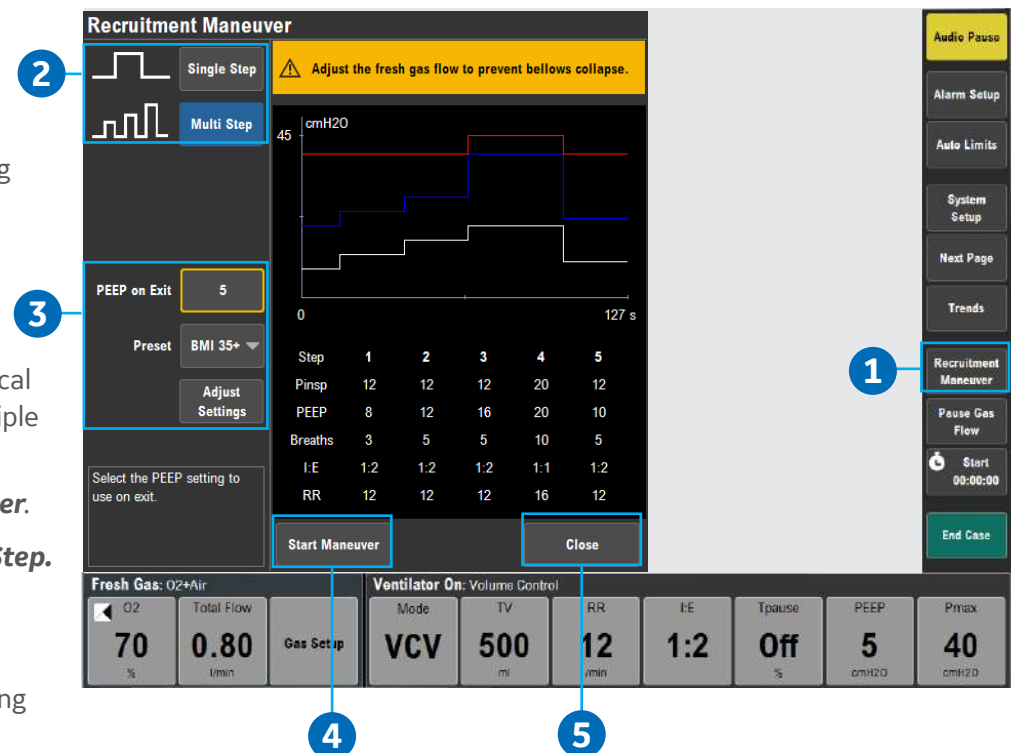


Recruitment Maneuver

Use the Single Step recruitment maneuver to deliver a pressure breath for a set time during mechanical ventilation, without making multiple ventilator setting changes.

Use the Multi Step recruitment maneuver to deliver pressure breaths through a series of ventilation steps during mechanical ventilation, without making multiple ventilator setting changes.

1. Select **Recruitment Maneuver**.
2. Select **Single Step** or **Multi Step**.
3. Adjust any required settings.
4. Select **Start Maneuver**. Stop maneuver anytime by selecting **Stop Maneuver**.
5. Select **Close**.

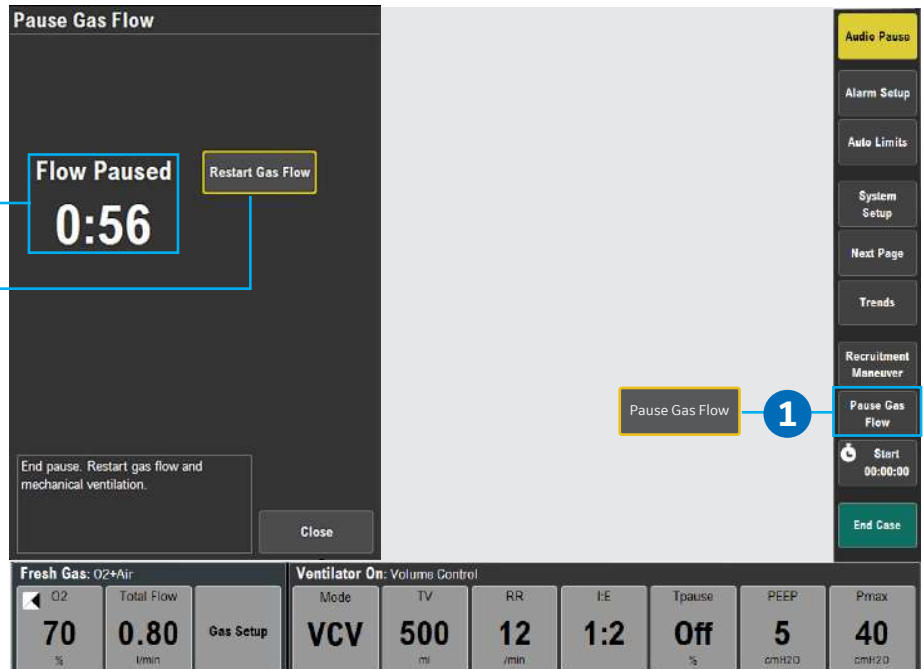


Note: The image shown is for the **Multi Step** maneuver only.

Pause Gas Flow

Use Pause Gas Flow to temporarily suspend the flow of gas during a case. Using Pause Gas Flow while the breathing circuit is disconnected prevents the flow of gas into the room. Pause Gas Flow is available during both mechanical ventilation and manual ventilation.

1. Select the **Pause Gas Flow** function key, and then select **Pause Gas Flow** from the Pause Gas Flow menu.
2. The amount of time remaining in the gas flow pause shows in the window.
 - Gas flow stops for 1 minute and automatically resumes after 1 minute.
 - If mechanical ventilation is on, mechanical ventilation stops for 1 minute and then automatically resumes after 1 minute.
3. Resume the flow of gas at any time during the pause by selecting **Restart Gas Flow**.



Spirometry overview

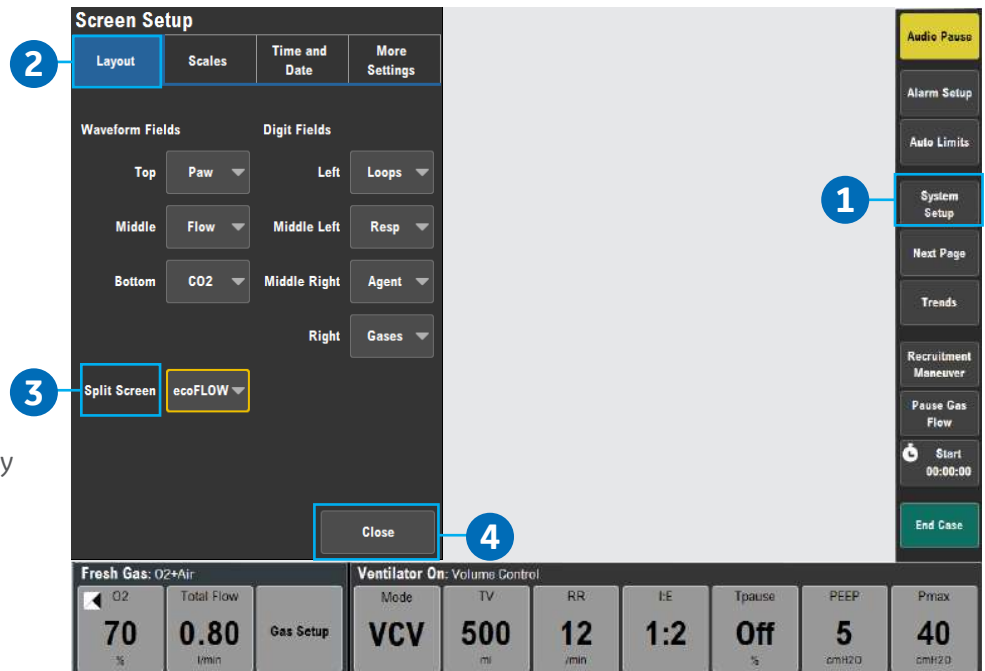
Use the Spirometry menu to:

- Set the loop type
- Adjust the loop scaling
- Save a loop to memory
- Access the Setup Loops menu
- View a saved loop
- Delete a saved loop

Note: If Spirometry is being displayed in a digit field, you can also access the Spirometry menu by selecting the loop in the digit field.

To activate the Spirometry split screen:

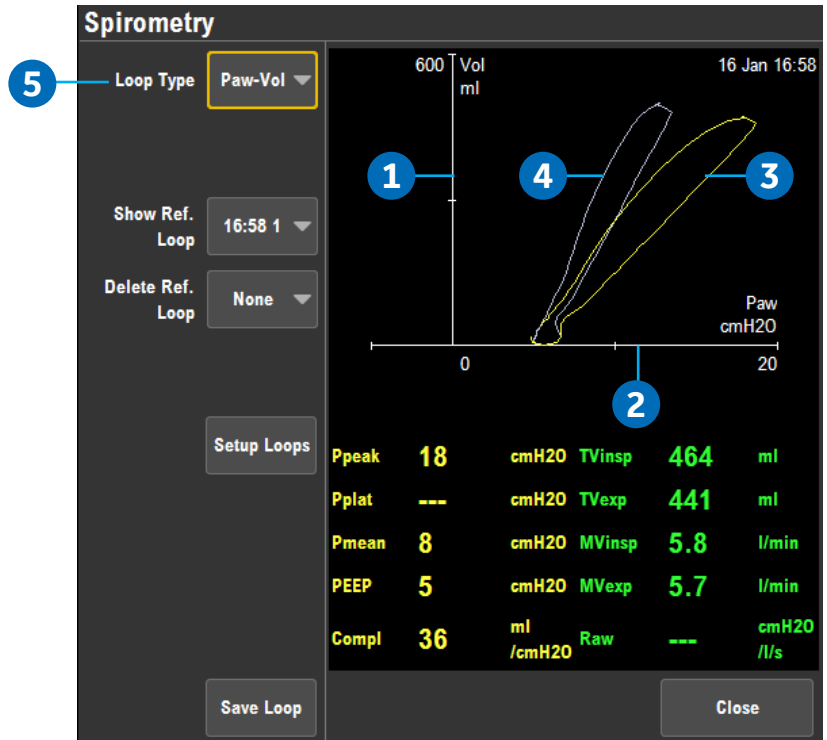
1. Select **System Setup > Screen Setup**.
2. Select the **Layout** tab.
3. Select **Split Screen** and select **Spirometry** from the drop-down menu.
4. Select **Close**.



Spirometry loop components

Spirometry loop components:

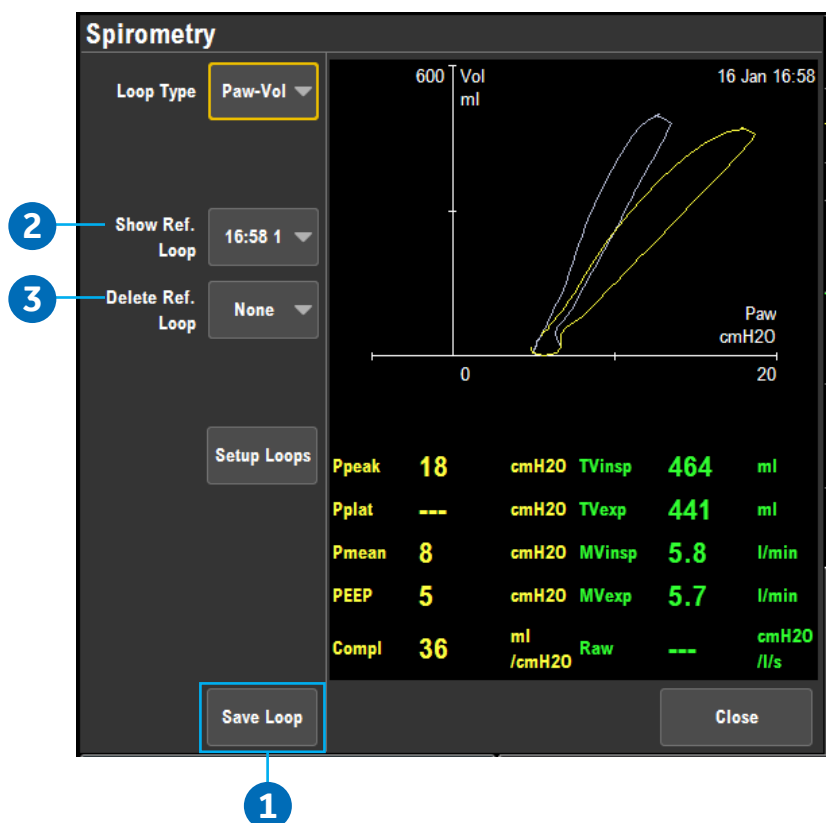
1. Volume axis
2. Pressure axis
3. Real-time loop (yellow)
4. Reference loop (grey)
5. There are three types of spirometry loops that can be selected from the **Loop Type** drop-down menu: Pressure-Volume (**Paw-Vol**), Flow-Volume (**Flow-Vol**), and Pressure-Flow (**Paw-Flow**).



Saving, viewing and deleting spirometry loops

Spirometry loops can be saved, viewed, and deleted through the Spirometry menu.

1. **Save Loop:** To store a loop to memory, select **Save Loop**. Up to six loops can be saved.
2. **Show Ref. Loop:** To view a saved loop, set **Show Ref. Loop** to the time at which it was saved.
3. **Delete Ref Loop:** To delete a saved loop, set **Delete Ref. Loop** to the time at which it was saved.



Spirometry setup

Select **Setup Loops** from the Spirometry menu to access the Setup loops menu.

1. **Spirometry Scaling:** Set the scales of the spirometry loop graph. The available settings for the volume, Paw, and flow graph axis are dependent on the set patient type of adult or pediatric.

- **Auto:** automatically adjusts the volume, Paw, and flow axis of the loop.
- **Linked:** links the adjustment of the volume, Paw, and flow axis of the loop graph together.
- **Indep.** allows the axis of the loop graph to be changed separately for the volume, Paw, and flow axis.

2. **Patient and Sensor:** Select **Adult** or **Pedi** depending on the sensor used.

3. **Data Source:** Select **Patient** to have spirometry data sourced from the airway module or **Vent** to have spirometry data sourced from the ventilator.

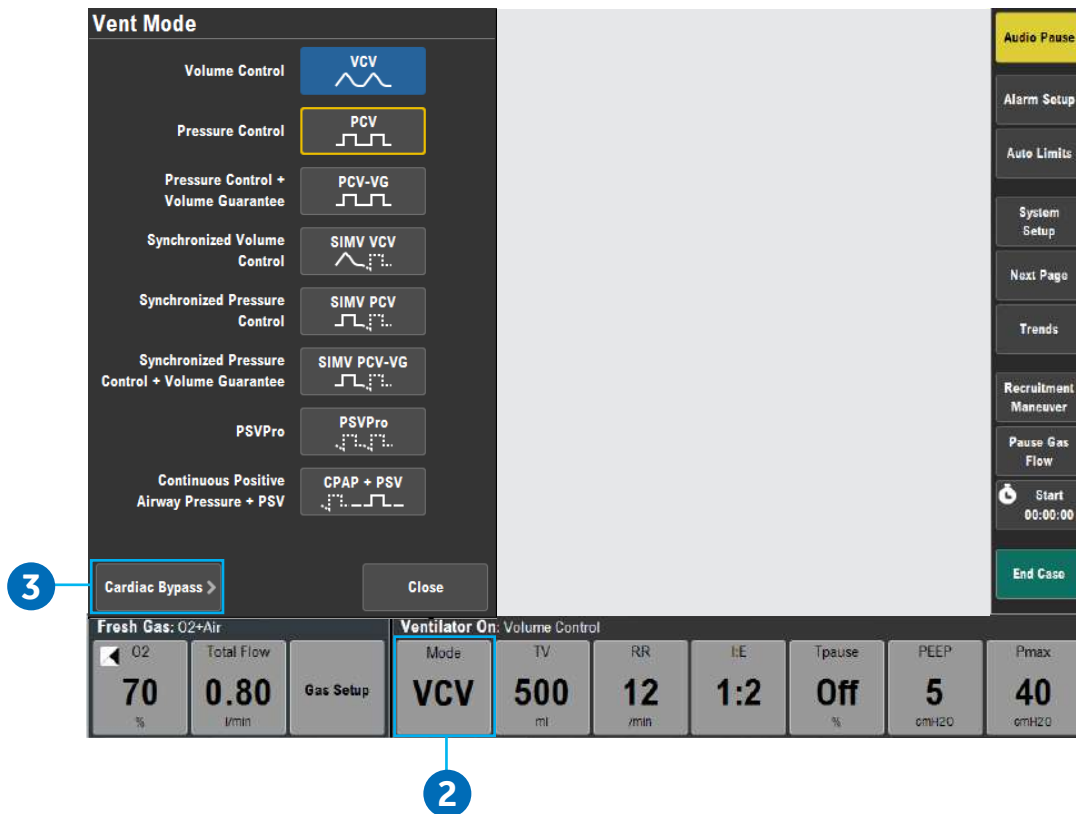
4. **Show MV or TV:** Set to **TV** to show TVinsp and TVexp on the spirometry split screen. Set to **MV** to show MVinsp and MVexp on the spirometry split screen.

The screenshot shows the 'Spirometry' setup interface. On the left, there are settings for 'Loop Type' (Paw-Vol), 'Show Ref. Loop' (16:58 1), and 'Delete Ref. Loop' (None), along with a 'Setup Loops' button. On the right, under 'Spirometry Scaling', the 'Auto' option is selected and highlighted with a yellow box and a blue circle with the number 1. Below this, 'Volume ml' is set to 600, 'Paw cmH2O' to 20, and 'Flow l/min' to 60. Further down, 'Patient and Sensor' is set to 'Adult' (callout 2), 'Data Source' is set to 'Vent' (callout 3), and 'Show MV or TV' is set to 'TV' (callout 4). At the bottom are 'Save Loop' and 'Back' buttons.

Cardiac Bypass

There are two types of cardiac bypass. Manual ventilation cardiac bypass is standard. VCV cardiac bypass is optional. Manual ventilation cardiac bypass suspends alarms for patients on cardiac bypass when the ventilator is not mechanically ventilating.

Systems with the VCV cardiac bypass option enabled can mechanically ventilate while in VCV mode. The VCV mode is the only ventilation mode available while using VCV cardiac bypass.



Using Manual Ventilation Cardiac Bypass:

1. Set the Bag/Vent switch to Bag.
2. Select **Ventilation Mode** quick key.
3. Select **Cardiac Bypass**, and then select **Start Cardiac Bypass**. The **Cardiac Bypass** message shows in the waveforms and in the general message field when manual ventilation cardiac bypass is active.

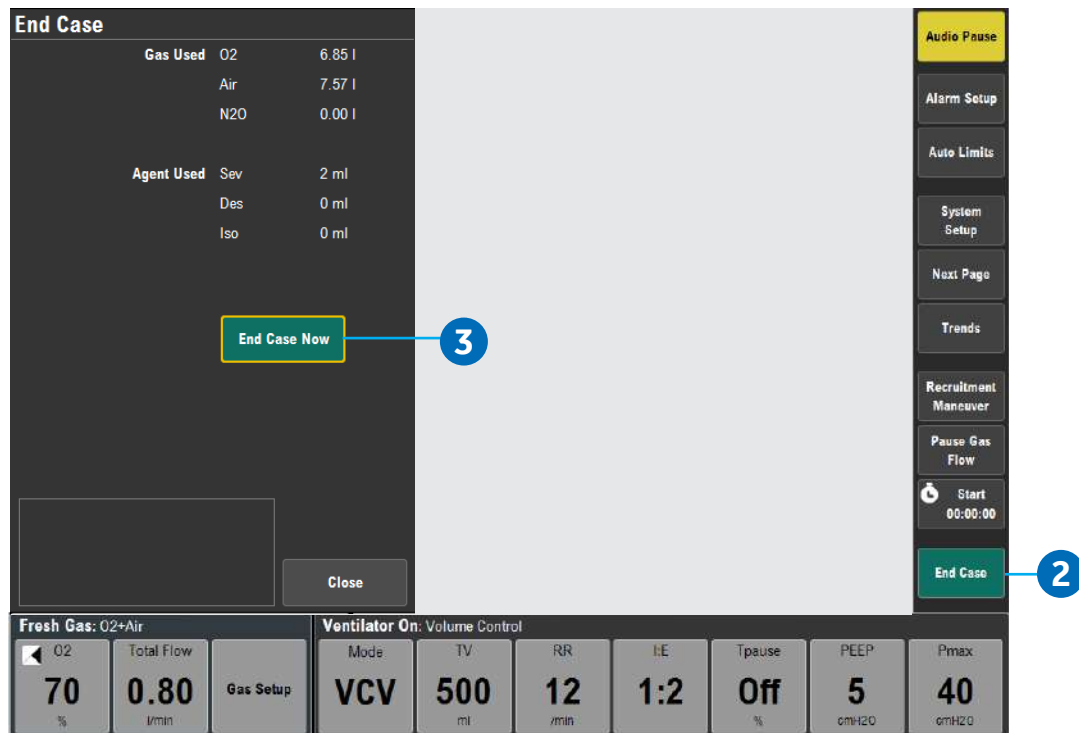
Using VCV Cardiac Bypass:

1. Start mechanical ventilation in VCV mode.
2. Select **Ventilation Mode** quick key.
3. Select **Cardiac Bypass**, and then select **Start Cardiac Bypass**.
 - PEEP is set to 5 cmH₂O
 - TV settings of less than 170 ml prior to starting cardiac bypass remain at the set TV.
 - TV settings of more than 170 ml prior to starting cardiac bypass change to 170 ml.
 - The 'VCV Cardiac Bypass' message shows in the waveforms and in the general message field when VCV cardiac bypass is active.

09 End of Case and Standby

End Case

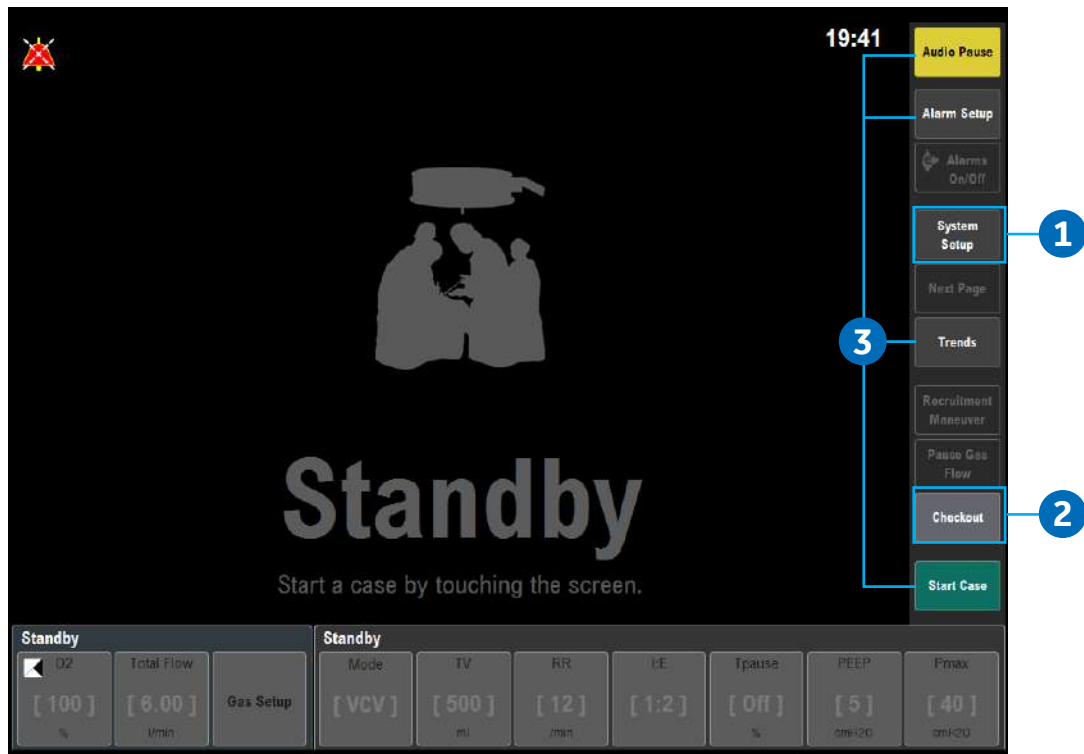
Use the **End Case** menu to stop gas flow and end the patient alarms. The amount of gas used and agent used during the case shows in the menu.



1. Set the Bag/Vent switch to Bag.
2. Select **End Case**.
3. Select **End Case Now** on the menu (the gas flow and patient alarms stop). The system is now in Standby. Select a quick key or the **Start Case** button to start a case.

Standby

When in Standby, most of the alarms are disabled. The Standby screen shows after **End Case** is selected.



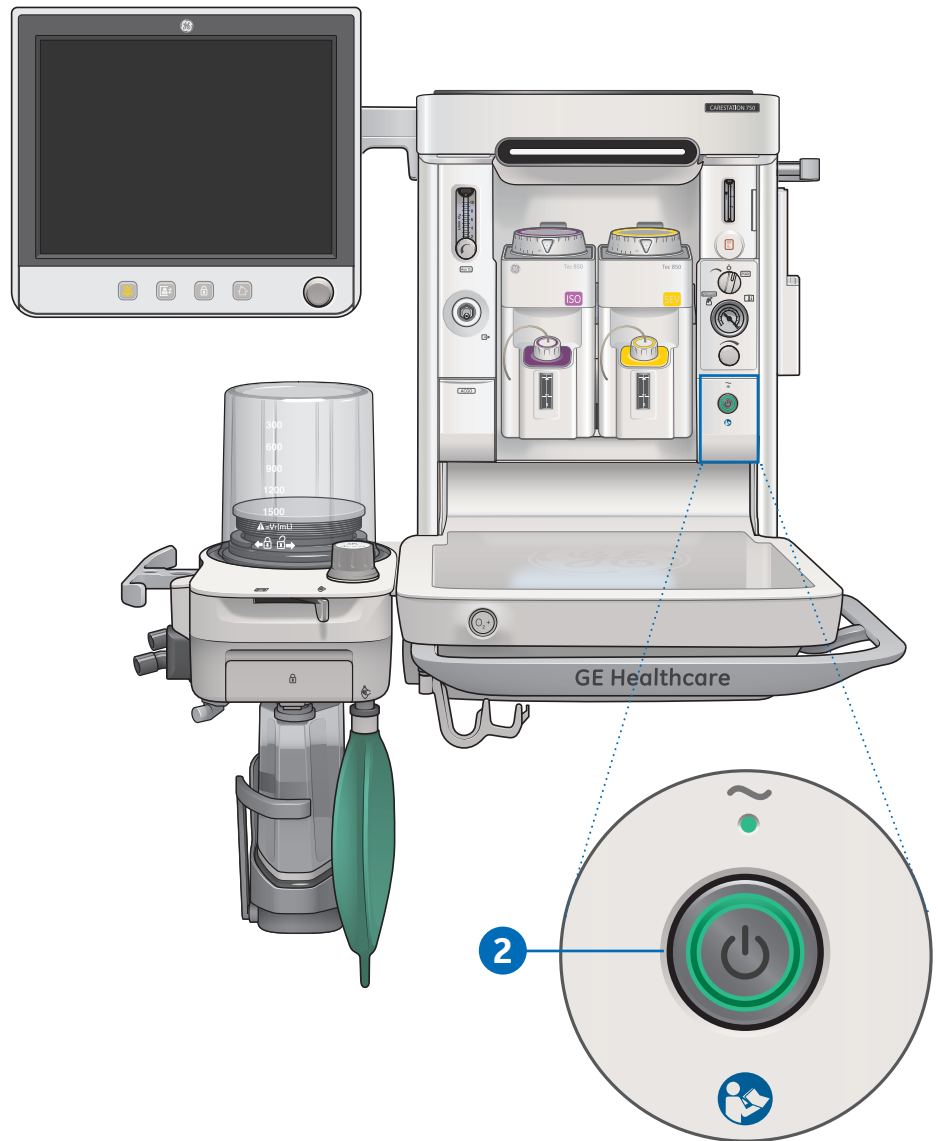
From the Standby menu:

1. Select **System Setup** to open the System Setup menu.
2. Select **Checkout** to open the Checkout menu.
3. Select any other active function key to open the Start Case menu.
4. A case can be started using the default settings by setting Bag/Vent switch to vent, turning on Aux O₂+Air switch, or by turning on ACGO switch.

Turning off the system

1. Perform the **End a case** procedure, if appropriate.
2. Push and hold the On/Standby switch for 1 second.
3. Select **Confirm** or push the ComWheel within 10 seconds to turn off the system.

If no action is performed within 10 seconds, the screen automatically returns to the previous display.





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CARESCAPE respiratory modules

User's Manual



CARESCAPE respiratory modules
English
9th edition
2082250-001 paper
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Due to continuing product innovation, specifications in this manual are subject to change without notice.

For technical documentation purposes, the abbreviation GE is used for the legal entity names, GE Medical Systems *Information Technologies*, Inc. and GE Healthcare Finland Oy.

Contents

About this manual.....	5
CARESCAPE respiratory modules' indications for use.....	5
Intended use of this manual.....	5
Intended audience of this manual	5
Training requirements.....	5
Manufacturer responsibility.....	5
Related documents	6
Safety precautions	6
Safety message signal words.....	6
Disposal and storage warnings.....	6
Disposal and storage cautions.....	6
Module overview	7
System compatibility.....	7
CARESCAPE respiratory module parameters	7
About the measurements.....	8
CARESCAPE respiratory module connectors	9
Airway gases measurement.....	9
Airway gases equipment to patient connections with CARESCAPE respiratory modules	9
Setting up the airway gases measurement	10
Airway gases warnings.....	10
Airway gases cautions.....	12
Scavenging	12
Airway gases points to note	13
Airway gases troubleshooting.....	13
Patient Spirometry measurement.....	14
Patient Spirometry equipment to patient connection	14
Preparing the Patient Spirometry measurement	14
Patient Spirometry warnings.....	15
Patient Spirometry cautions.....	15
Patient Spirometry points to note	15

Patient Spirometry troubleshooting.....	16
Gas exchange measurement.....	16
Gas exchange equipment to patient connection.....	16
Gas exchange warnings	17
Gas exchange cautions	18
Gas exchange measurement limitations.....	19
Gas exchange points to note	19
Gas exchange troubleshooting	19
Cleaning and care.....	20
D-fend Pro(+) water trap	21
Reusable D-lite and Pedi-lite sensor cleaning instructions	21
Calibration warnings.....	21
Airway gas calibration	21
Patient Spirometry calibration.....	22
System compatibility	22
Supplies and accessories	23
Gas accessories	23
Patient Spirometry and gas exchange accessories.....	27
Technical specifications.....	29
Physical characteristics	29
Operating characteristics	29
Airway gases specifications	30
Patient Spirometry specifications	33
Gas exchange specifications.....	34

About this manual

CARESCAPE respiratory modules' indications for use

The CARESCAPE Respiratory Modules (E-sCO, E-sCOV, E-sCOVX, E-sCAiO, E-sCAiOV, E-sCAiOVX, E-sCAiOE, E-sCAiOVE) are indicated for use with a host device for monitoring respiratory parameters (CO₂, O₂, N₂O, anesthetic agents, anesthetic agent identification, and respiratory rate) and ventilatory parameters (airway pressure, flow and volume) of adult, pediatric, and neonatal patients and gas exchange parameters (VCO₂, VO₂) of adult and pediatric patients.

When monitoring neonatal or other patients that have high respiration rate or low tidal volume these modules shall be used within the limits of respiration rates and tidal volumes to ensure specified measurement accuracy.

These modules are intended for use by qualified medical personnel only.

Intended use of this manual

This manual is to be used with the user documentation of the patient monitor. Pay special attention to all generic safety statements and safety symbols listed in the monitor's user documentation.

Intended audience of this manual

This manual is intended for clinical professionals. Clinical professionals are expected to have a working knowledge of medical procedures, practices and terminology required to provide patient care. Using the device should never replace nor impede the human intervention and required patient care provided by clinical professionals.

Training requirements

No product-specific training is required for the use of these modules.

Manufacturer responsibility

GE is responsible for the effects on safety, reliability, and performance of the equipment only if:

- Assembly operations, extensions, readjustments, modifications, servicing, or repairs are carried out by authorized service personnel.
- The electrical installation of the relevant room complies with the requirements of the appropriate regulations.
- The equipment is used in accordance with the instructions for use.

Related documents

The module may be used with multiple host devices. Always check with the host device's user manual for additional information.

There are two separate technical manuals for the respiratory modules providing information about installing, maintaining, and servicing the modules:

- One for modules E-sCO, E-sCOV, E-sCOVX, E-sCAiO, E-sCAiOV, and E-sCAiOVX used with monitoring host devices
- One for modules E-sCAiO, E-sCAiOV, E-sCAiOVX, E-sCAiOE, and E-sCAiOVE used in the anesthesia systems Avance CS² or Aisys CS². If the E-sCAiOE or E-sCAiOVE module is used in a patient monitor, also refer to the E-sCAiO, E-sCAiOV, E-sCAiOVX, E-sCAiOE, E-sCAiOVE specific technical manual for instructions on how to perform the module fresh gas branch leak test in connection with preventive maintenance and after servicing the module.

Safety precautions

Safety precautions given in this manual apply to the CARESCAPE respiratory modules. For generic system-level safety statements, refer to the monitor's user documentation. For accessory-specific statements, refer to their own instructions for use.

Safety message signal words

Safety message signal words designate the severity of a potential hazard.

DANGER	Indicates a hazardous situation that, if not avoided, will result in death or serious injury.
WARNING	Indicates a hazardous situation that, if not avoided, could result in death or serious injury.
CAUTION	Indicates a hazardous situation that, if not avoided, could result in minor or moderate injury.
NOTICE	Indicates a hazardous situation not related to personal injury that, if not avoided, could result in property damage.

Disposal and storage warnings



WARNING

DISPOSAL. At the end of their service life, the products described in this manual, as well as their accessories, must be disposed of in compliance with the guidelines regulating the disposal of each product. If you have any questions concerning disposal of a product, please contact GE or its representatives.

Disposal and storage cautions



General cautions

This symbol is identified by a white background, black triangular band, and a black symbol.

CAUTION

PACKAGING DISPOSAL. Dispose of the packaging material, observing the applicable waste control regulations.

CAUTION

STORAGE AND USE. Do not use or store equipment outside the specified temperature, humidity, or altitude ranges.

Module overview

System compatibility

The CARESCAPE respiratory modules E-sCO, E-sCOV, E-sCOVX, E-sCAiO, E-sCAiOV, E-sCAiOVX, E-sCAiOE, and E-sCAiOVE can be used for respiratory monitoring in the following host systems:

- CARESCAPE Monitor B850
- CARESCAPE Monitor B650
- CARESCAPE Monitor B450
- B40 Patient Monitor (2060600-002)
- Aisys CS²
- Avance CS²
- S/5 Anesthesia Monitor, software version L-ANE06(A) 24.1 or later
- S/5 Critical Care Monitor, software version L-ICU06(A) 24.1 or later
- S/5 Compact Anesthesia Monitor, software version L-CANE 05(A) 19.6 or later
- S/5 Compact Critical Care Monitor, software version L-CICU 05(A) 19.6 or later

NOTE

Low sample gas flow situation is indicated with the message **Replace D-Fend** in the L-xxx06(A) software versions 24.1 and L-xxx05(A) software versions 19.6.

NOTE

The CARESCAPE respiratory modules cannot be used in the S/5 Extension Frame.

NOTE

The Neonatal Intensive Care Unit (NICU) software package of the CARESCAPE modular patient monitors may not support the use of CARESCAPE respiratory modules.

NOTE

Displayed data (including but not limited to TV, MV, RR, Raw and N₂O), trends and alarms may vary depending on the host device. Specifications listed represent the capabilities of the modules. Always check the host device's user manual for additional information.

NOTE

The following modules are considered identical and cannot be used in the same system at the same time: E-CO, E-sCO, E-COV, E-sCOV, E-COVX, E-sCOVX, E-CAiO, E-sCAiO, E-sCAiOE, E-CAiOV, E-sCAiOV, E-sCAiOVE, E-CAiOVX, E-sCAiOVX, E-miniC, N-CAiO, N-FC, N-FCREC.

CARESCAPE respiratory module parameters

The CARESCAPE respiratory modules use the sidestream method to measure the airway gas concentrations, and optionally Patient Spirometry. The following table shows the parameters measured by different modules. The x indicates that the module measures the parameter referred to in the column heading.

Module	CO ₂	N ₂ O	O ₂	Anes- thetic agents	Agent ID	Patient Spirom- etry	Gas exchange	Aisys CS ² end-tidal control
E-sCO	x	x *	x					
E-sCOV	x	x *	x			x		
E-sCOVX	x	x*	x			x	x	
E-sCAiO	x	x	x	x	x			
E-sCAiOE	x	x	x	x	x			x
E-sCAiOV	x	x	x	x	x	x		
E-sCAiOVX	x	x	x	x	x	x	x	
E-sCAiOVE	x	x	x	x	x	x		x
* N ₂ O is not displayed by all host devices.								

For more information on the use of the end-tidal control, refer to the Aisys CS² user documentation.

About the measurements

The CARESCAPE respiratory modules draw a 120 ml/min flow of sampled gas through the gas sampling line and water trap to the gas sensors. CO₂, N₂O, and anesthetic agent concentrations are measured with an infrared absorption sensor, and the O₂ concentration with a paramagnetic sensor.

The module finds the time instant of the highest CO₂ concentration in each breath. Concentration at that instant is the ET CO₂ reading. Because nitrous oxide and anesthetic agents are measured by the same sensor as CO₂, the ET readings of those gases are obtained directly at the time instant of ET CO₂. For calculating ET readings of oxygen, the module synchronizes the O₂ waveform with the CO₂ waveform. The ET reading of O₂ is then determined as O₂ concentration at the time instant of ET CO₂. If no breaths are detected for a given time (20 s, for example), an apnea situation is triggered. During apnea, the ET values are updated every two seconds to the current concentration of each gas.

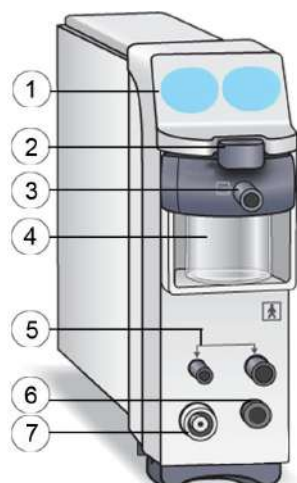
The infrared sensor also identifies the anesthetic agent and mixtures of two anesthetic agents in the sampled gas. The module has a gas exhaust port that can be connected to a scavenging system.

With the E-sCOV, E-sCOVX, E-sCAiOV, E-sCAiOVX, and E-sCAiOVE modules you can also monitor airway pressures, flow, volumes, compliance and resistance, breath-by-breath. The measurement is taken using the pressure sensors in the module. The sensors are connected to the patient's airway with a double lumen spirometry line that conducts pressures from the D-lite(+)/Pedi-lite(+) spirometry sensor to the module. The respiratory volumes are calculated from the flow data, and the airway compliance and resistance are calculated from both the airway pressure and flow values.

The E-sCOVX and E-sCAiOVX modules also measure gas exchange parameters VCO₂ and VO₂.

For instructions on how to use the airway gases and Patient Spirometry measurements, see the host device's user documentation.

CARESCAPE respiratory module connectors



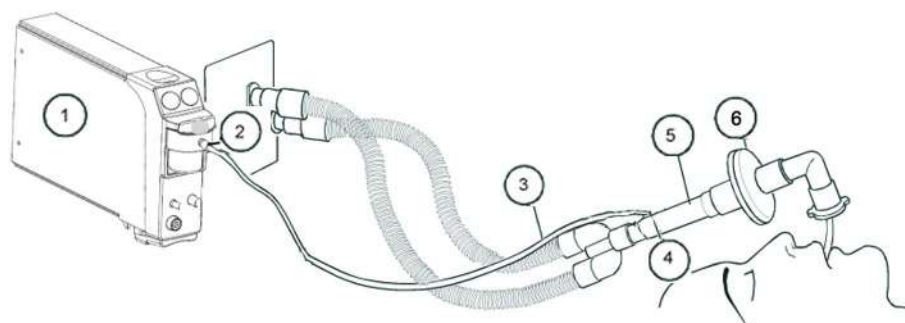
1. Patient Spirometry keys (**Save Loop**, **Change Loop**)
2. Water trap release/latching latch
3. Gas sample, sampling line connector on the water trap
4. Water trap container
5. Connectors for Patient Spirometry tubes
6. Connector for fresh gas used in end-tidal control. For more information on the use of the end-tidal control, please refer to the Aisys CS² user documentation.
7. Gas exhaust, connector for the gas exhaust line

NOTE

Only qualified service personnel may remove the protecting screw from the fresh gas connector and attach the fresh gas sample tubing.

Airway gases measurement

Airway gases equipment to patient connections with CARESCAPE respiratory modules



1. CARESCAPE respiratory module
2. Gas sample, gas sampling line connector on the water trap
3. Gas sampling line

4. Gas sampling line connector on the airway adapter; place the connector upwards
5. Airway adapter with sampling line connector
6. Heat and moisture exchanger with filter (HMEF) (optional)

Setting up the airway gases measurement

1. Make sure that the water trap container is empty and properly attached.
2. Connect the gas sampling line to the sampling line connector on the water trap.
3. Connect the sample gas outlet to gas scavenging if N₂O or volatile agents are used.
4. Turn on the monitor or connect the module to the monitor. The monitor performs a self-check for the module when the module is connected. Automatic agent identification is activated in those modules that have this feature.
5. Wait until the message **Calibrating** or **Calibrating gas sensor** disappears before connecting the sampling line to the airway adapter or the airway adapter to the ventilator circuit.
6. Connect the sampling line to the airway adapter or the airway adapter to the ventilator circuit. Position the adapter with the sampling port upwards to minimize the amount of condensed water possibly entering the sampling line.
7. Check that the airway adapter connections are tight and that the adapter is operating properly.

NOTE Check that the sample line is connected to the water trap before connecting the module to the monitor or turning on the monitor.

NOTE To minimize the amount of dust drawn into the gas sampling system, always keep the water trap connected to the module. When gas measurement is not in use, you can disconnect the module from the monitor to eliminate the operating sound of the gas pump.

Airway gases warnings



General warnings

This symbol is identified by a yellow background, black triangular band, and a black symbol.

WARNING Always inspect the airway adapter for a tight connection and proper operation before attaching it to the patient.

WARNING Leaks in the gas sampling circuit (water trap and sampling line) may cause inaccurate readings.

WARNING Remove the airway sampling line from the patient's airway while nebulized medications are being delivered.

WARNING Handle the water trap and its contents as you would any body fluid. Infectious hazard may be present.

WARNING	Since sample gas may contain anesthetic agents, make sure that it is not released in the room. Connect exhaust to a scavenging system to prevent exposure to anesthetic agents.
WARNING	Strong scavenging suction may cause excessive sample gas flow and inaccurate gas readings.
WARNING	Route all tubing away from the patient's throat to avoid strangulation.
WARNING	To avoid the spread of infectious disease, do not allow the exhaust to discharge in the direction of the patient or user.
WARNING	EtCO ₂ values may differ from blood gas readings.
WARNING	Do not use a CO ₂ module at the same time as a multi-gas module.
WARNING	When using the CARESCAPE respiratory modules with volume controlled ventilation at low tidal volumes, the specified gas withdrawal rate may significantly reduce the amount of gas delivered to the patient.
WARNING	Make sure to compensate for the possible reduction of tidal volume caused by the 120 ml/min gas sample flow.
WARNING	A failure in zeroing or calibrating airway gases may cause inaccurate readings.
WARNING	Make sure that the module is always in vertical position when used.
WARNING	Since calibration gas contains anesthetic agents, always ensure sufficient ventilation of the room during calibration.
WARNING	Always ensure the correct size and fit of accessories according to patient type and application, especially when monitoring pediatric and neonatal patients. The size and fit of accessories may impact the measured gas concentration values at low tidal volumes. It is recommended to have the gas sampling port close to the proximal end of the endotracheal tube. Excessive dead space in the circuit, including the accessories, may cause re-breathing of gases. Very low accessory dead space between the breathing circuit Y-piece and the gas sampling site may impact the measured gas concentration due to dilution of the sampled exhaled gas with fresh gas from the ventilator. To confirm accurate correlation with measured gases and blood, check arterial blood gas values to confirm a suitable setup is used.
WARNING	EQUIPMENT FAILURE OR INACCURATE READINGS. Planned maintenance should be carried out annually according to the instructions given in the technical manual. Failure to implement the recommended maintenance schedule may cause equipment failure or inaccurate readings.

WARNING	PATIENT CROSS-INFECTION. Returning the sampled gas to the patient circuit causes a risk of patient cross-infection.
WARNING	PATIENT CROSS-INFECTION. Always use a bacterial breathing system filter proximal to the patient when returning the sampled gas to the patient circuit. If a bacterial breathing system filter is not used, a failure in the D-Fend Pro water trap may cause a risk of patient cross-infection.
WARNING	PATIENT CROSS-INFECTION. If the sampled gas is returned to the patient circuit, ensure the protective function of the D-Fend Pro water trap by replacing it at least once a week, or immediately in case of a defective or missing bacterial breathing system filter. Otherwise, there is a risk of patient cross-infection.

Airway gases cautions



CAUTION

Never connect the loose end of the gas sampling line to the Patient Spirometry connector as this may break the spirometry unit. The Patient Spirometry connector is meant for the Patient Spirometry tube only.



CAUTION

Do not apply pressurized air or gas to any outlet or tubing connected to the monitor. Pressure may destroy sensitive elements.

Scavenging

Preventing operating room pollution

When N₂O and volatile anesthetics are used, prevent operating room pollution by connecting the sample gas outlet (gas exhaust) of the module to the scavenging system.

Scavenging through the ventilator reservoir

1. Connect an exhaust line to the sample gas outlet (gas exhaust) on the module's front panel.
2. Attach the other end of the line to the ventilator reservoir. Make sure that the reservoir tube diameter is at least 2 to 3 times larger than the exhaust line.

Scavenging through the anesthesia gas scavenging system

Anesthesia machines are equipped with an anesthesia gas scavenging system (AGSS), and in some machines you can connect the sample gas outlet directly to it. See the anesthesia machine's user documentation to find out where and how the sample gas can be connected.

Connecting directly to the scavenging system

1. Connect the exhaust line to the module's sample gas outlet.
2. Connect the exhaust line only to an open scavenging system where gas is removed at room pressure.

NOTE

Do not connect the module directly to a strong vacuum scavenging system.

Returning sampled gas to the patient circuit

Returning sampled gas to the patient circuit causes a risk of patient cross-infection. To prevent patient cross-infection always use a bacterial breathing system filter proximal to the patient. Ensure the protective function of the D-Fend Pro water trap by replacing it at least once a week, or immediately in case of a defective or missing bacterial breathing system filter.

1. Connect the exhaust line to the module's gas outlet.
2. Connect the exhaust line to the patient circuit.

NOTE

Refer to the anesthesia machine's documentation to find out where and how the sample gas can be returned.

Airway gases points to note

- Use GE anesthesia sampling lines (PE/PVC) when anesthetic agents are used. If no anesthetic agents are present, you can use GE CO₂ sampling lines (PVC)
- Make sure that you are using the D-fend Pro or D-fend Pro+ water trap.
- Empty the water trap container as soon as it is more than half full. With a sample gas temperature of 37°C, a room temperature of 23°C, and sample gas relative humidity of 100 %RH, the water trap should be emptied every 24 hours (applies when the sample gas flow is within 120 ± 20 ml/min).
- When using an HMEF filter, place it between the patient and airway adapter.
- Place the airway adapter between the HMEF and Y-piece.
- Place the airway adapter in 45° tilt and all ports upwards to prevent condensed water from entering the adapter interior and the tubing
- Always check the tightness of all connections.
- Make sure that the gas sampling line is properly connected to the water trap and the water trap is properly connected to the airway gas module. Gas leaks in these connections may dilute the gas sample from the patient circuit, thus resulting in erroneous gas readings. During normal operation, all sampled gas flows out of the sample gas outlet. Room air is used as reference gas for the oxygen measurement and it is mixed with the sampled gas. The sampled gas is diluted by room air so that the fraction of room air in the exhaust gas is about 20%.

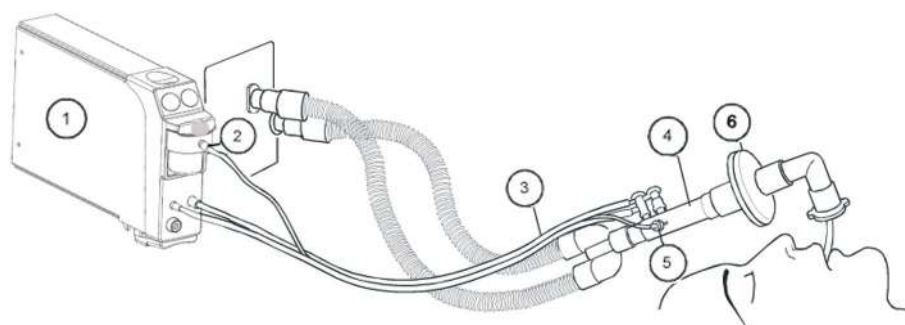
Airway gases troubleshooting

Problem	Solution
Airway gas values seem too low	• Check the sampling line and connectors for leakage. • Check the patient status. • Check the arterial blood gas values.
Airway gas values seem too high	• Check the sampling line for blockage. • Check the patient status. • Check the arterial blood gas values.

Problem	Solution
Module does not work	- Check and clean the filter if necessary. - Check the water trap and water trap connectors. Liquid may have entered the module. Replace the module and have it checked by authorized service personnel.
No airway gas values	Check that the gas sampling line is connected to the water trap.

Patient Spirometry measurement

Patient Spirometry equipment to patient connection



1. E-sCOV, E-sCOVX, E-sCAiOV, E-sCAiOVX, or E-sCAiOVE module
2. Gas sample, gas sampling line connector on the water trap
3. Gas sampling and spirometry tubes
4. D-lite/Pedi-lite sensor, or D-lite+/Pedi-lite+ sensor for humid conditions
5. Gas sampling line connector
6. Heat and moisture exchanger with filter (HMEF)

Preparing the Patient Spirometry measurement

1. Take a new Patient Spirometry tube and connect the tube to the D-lite(+)/Pedi-lite(+) sensor by inserting the angle connectors in the sensor connectors. Place all D-lite(+)/Pedi-lite(+) ports upwards with approximately a 45 °C tilt to prevent condensed water from entering the sensor interior and the tubings.
2. Connect the other end of the Patient Spirometry tube to the pressure connectors on the module.
3. Connect a gas sampling line to the Luer connector on the other side of the D-lite(+)/Pedi-lite(+) sensor.
4. Connect the other end of the gas sampling line to the sampling line connector on the module's water trap.
5. Make sure that the connections are tight.
6. Select the correct sensor type.
7. Connect the D-lite(+)/Pedi-lite(+) between the Y-piece and the intubation tube in the breathing circuit.

Patient Spirometry warnings



General warnings

This symbol is identified by a yellow background, black triangular band, and a black symbol.

WARNING

The presence of Helium or Xenon in the breathing circuit causes incorrect measurement values.

WARNING

Make sure you select the correct sensor type for the patient: D-lite(+) for adult patients, Pedi-lite(+) for pediatric patients. Also check the sensor type selection in the host device.

Patient Spirometry cautions



CAUTION

Never connect the loose end of the gas sampling line to the Patient Spirometry connector as this may break the spirometry unit. The Patient Spirometry connector is meant for the Patient Spirometry tube only.



CAUTION

Do not apply pressurized air or gas to any outlet or tubing connected to the monitor. Pressure may destroy sensitive elements.

Patient Spirometry points to note

- Place an HME/HMEF/filter between the D-lite(+)/Pedi-lite(+) sensor and the patient.
- Disconnect the HME/HMEF/filter and D-lite(+)/Pedi-lite(+) during nebulization of medications.
- The flow measurement should be calibrated once a year or when there is a permanent difference between inspiratory and expiratory volume. For further information, see the modules technical manual.
- Using a cuffless intubation tube may affect Patient Spirometry readings due to potential leakages around the endotracheal tube.
- When anesthetic agents are used, use a module with anesthetic agent (Ai) identification option.
- The flow and volume measurement of the CARESCAPE respiratory module is compensated for the density of the gas which is important for measurement accuracy with heavy molecules of anesthetic agents like Desflurane. However, using high concentrations of anesthetic agents may still affect flow and tidal volume readings. In this case, the CARESCAPE respiratory module tends to underestimate flow and volume.
- Depending on the type of patient circuit used, the temperature and humidity inside the D-lite flow sensor vary between dry ambient temperature air and 100% humid 37 °C air. As the CARESCAPE respiratory module needs to convert the measured volume/flow to ATPD or BTPS conditions, it needs to assume the temperature and humidity of the gas that flows through the flow sensor. By default the module assumes conditions equivalent to an HME patient circuit. If active humidification is used, the module will therefore overestimate the measured volume/flow by approx. 5%. For some host devices you can select the type of patient circuit used, and in this case the remaining error is minimized.

- When using active humidification, there might be condensation in the D-lite flow sensor affecting flow and volume readings. In this case, the CARESCAPE respiratory module tends to overestimate flow and volume.

Patient Spirometry troubleshooting

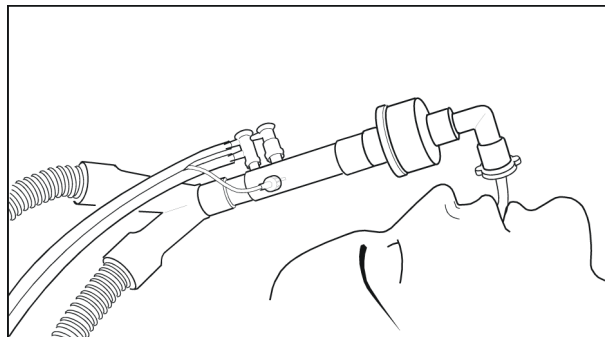
Problem	Solution
Values seem erroneous	• Check the patient status. • Check that you are using the correct sensor type: D-lite(+) for adult patients, Pedi-lite(+) for pediatric patients. • Check the sensor type selection. • Check that the Patient Spirometry tube connectors and their connections are tight and not leaking. • Check the arterial blood gas values. • Check that the sampling line is not kinked.
Values seem unstable	• Remove the D-lite(+)/Pedi-lite(+) and shake drops away. • Check that the connectors on the D-lite(+)/Pedi-lite(+) are intact and that connections are tight.
Strong vibrations in the loop	• Check the patient status. • Check the patient and system for water or secretions.

Gas exchange measurement

Gas exchange equipment to patient connection

The equipment to patient connections for gas exchange are similar to those of Patient Spirometry but there are also some connection-related issues to be noted. Only the modules E-sCAiOVX and E-sCOVX measure gas exchange.

Gas exchange patient connections with HME/HMEF



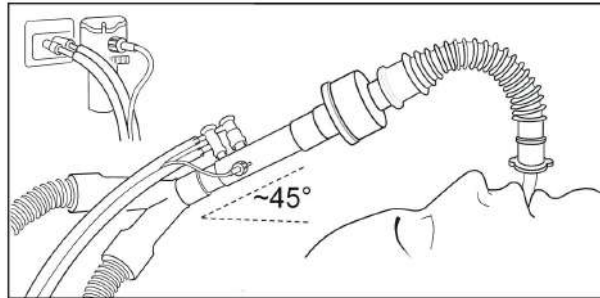
NOTE

Always place the HME/HMEF between the D-lite(+) sensor and the patient.

NOTE

By-pass flow together with long expiration flow pause time may disturb the measurement. Consider using shorter expiration time to diminish the effect. In addition, you may use a suitable spacer with a 5 to 10 ml dead space (e.g., a straight T-adapter) between the Y-piece and D-lite(+)/Pedi-lite(+). The by-pass flow effect may exist even in an adult setting, but it is more emphasized when monitoring pediatric patients and using the Pedi-lite(+).

Gas exchange patient connections with flexible tube

**NOTE**

Place all D-lite ports upwards with a 20° to 45° tilt to prevent condensed water from entering the sensor interior and the tubings.

NOTE

When monitoring pediatric patients with tidal volumes less than 300 ml, use the Pedi-lite(+) sensor. Remember to select the sensor type accordingly.

Gas exchange warnings

Before using the gas exchange measurement, familiarize yourself with safety precautions related to airway gases and Patient Spirometry measurements as they apply to the gas exchange measurement also.

**General warnings**

This symbol is identified by a yellow background, black triangular band, and a black symbol.

WARNING

The presence of Helium or Xenon in the breathing circuit causes incorrect measurement values.

WARNING

Make sure you select the correct sensor type for the patient: D-lite(+) for adult patients, Pedi-lite(+) for pediatric patients. Also check the sensor type selection in the host device.

WARNING

If the expiration gas flow during the end phase of the patient's expiration is close to zero for more than two seconds before the next inspiration starts, the ventilator's bypass flow may affect the measurement.

WARNING

INACCURATE READINGS. As the gas exchange parameters are calculated from O_2 , CO_2 , and airway flow data, any conditions affecting the accuracy of these parameters will also affect the accuracy of gas exchange parameters. To avoid the risk of inaccurate gas exchange readings that may result in compromised patient safety, adhere to the given measurement guidelines for O_2 , CO_2 , and airway flow measurements and check that these measurements are functioning properly.

WARNING

INACCURATE READINGS. The following conditions affect the accuracy and performance of the gas exchange measurement:

- A leaking airway.
- The use of a sampling line other than a 2-meter non-nasal sampling line.
- The use of high FiO_2 .
- The fluctuation of the delivered FiO_2 level during inspiration.
- The use of N_2O in ventilation.
- High pressure variation from PEEP to Ppeak.
- The use of Helium or Xenon in ventilation.
- High respiration rates.
- The use of high frequency ventilation (HFV).
- The use of bi-level positive airway pressure (BiPAP).
- Irregular airway flow pattern.
- High bias flow, especially when using ventilation settings resulting in periods with no airway flow.
- Irregular CO_2 amplitude.

If these conditions are present, there is a risk of inaccurate readings, which may result in compromised patient safety.

WARNING

INACCURATE READINGS. Increased inspiratory dead space in breathing systems without expiratory by-flow through the Y-piece may cause too large VCO_2 and VO_2 readings. To avoid any risk to the patient, always take this into account when interpreting the measurement results with such breathing systems.

Gas exchange cautions



General cautions

This symbol is identified by a white background, black triangular band, and a black symbol.

**CAUTION**

Never connect the loose end of the gas sampling line to the Patient Spirometry connector as this may break the spirometry unit. The Patient Spirometry connector is meant for the Patient Spirometry tube only.

**CAUTION**

Do not apply pressurized air or gas to any outlet or tubing connected to the monitor. Pressure may destroy sensitive elements.

Gas exchange measurement limitations

- This measurement is not available **in the NICU software package.**
- Only the E-sCAiOVX and E-sCOVX modules measure gas exchange.

NOTE

Routine calibration checks are required to ensure the measurement accuracy.

Gas exchange points to note

- Gas exchange measurement is for intubated patients only.
- Use only 2-meter (7-ft) gas sampling lines. Using other lines may cause inaccurate readings.
- FiO₂ delivery from the ventilator side should be stable.
- High PEEP or ventilating pressures may activate a message prompting to check the water trap. In this case, you may consider decreasing the PEEP if possible.
- To ensure measurement accuracy, check the accuracy of airway gas measurement every two months: feed calibration gas mixture to the monitor in the normal operation mode (without entering the calibration menu) and check that the readings on the monitor match those on the calibration gas bottle. If they do not match, calibrate airway gases.
- When anesthetic agents are present, use the E-sCAiOVX module for monitoring airway flow and gas exchange.
- Any acute change in alveolar ventilation will be immediately reflected in CO₂ output, which will not measure the metabolic production of CO₂ until a new steady state has been achieved. The time required for the stabilization varies widely and ranges from 30 to 120 minutes.



Gas exchange troubleshooting

Problem	Solution
Gas exchange values are too low.	• Check the sampling line and connectors for leakage.
Gas exchange values seem unreliable.	• Check the ventilation settings. • Check the inspired oxygen concentration and correct if necessary (max. 85%). • Check that pressure variation from PEEP to Ppeak is not too high. • Check the Patient Spirometry data to ensure that flow measurement is functioning properly.

Problem	Solution
	If the expiration gas flow during the end phase of the patient's expiration is close to zero for more than two seconds before the next inspiration starts, the ventilator's bypass flow may affect the measurement. You can reduce this effect by adding a suitable spacer with a 5 to 10 ml dead space (e.g., a straight T-adapter) between the Y-piece and the D-lite or the Pedi-lite adapter.
Module does not work.	- Check and clean the filter if necessary. - Check the water trap. If it was too full, liquid may have entered the module. Replace the module and have it checked by authorized service personnel.
No gas exchange values.	Check that the gas sampling line is not connected to the sample gas out connector.
VO ₂ values are non-physiologic.	- Verify that the oxygram curve is stable. - Change the sampling line. - Check the D-lite placement.
Are gas exchange values accurate with 100% oxygen?	No, gas exchange measurements are not possible when the FiO ₂ > 85%. This is also indicated on screen by the replacement of numbers by ---. Please also note that full measurement accuracy is obtained when FiO ₂ is less than 65%. Between 65% and 85% FiO ₂ , the accuracy is reduced to +/-15%
Can the gas exchange modules be used with active humidification?	Yes, they can. Use the D-lite+/Pedi-lite+ flow sensor for humid conditions. If HME is used, both the D-lite/Pedi-lite and D-lite+/Pedi-lite+ can be used.
Can the gas exchange modules be used with pediatric patients?	Yes, for those pediatric patients whose respiration rate is below 35 breaths/minute. When monitoring pediatric patients, use the Pedi-lite sensor and select the sensor accordingly from the monitor menu.
How can I ensure that the VCO ₂ and VO ₂ values are correct?	Always make sure that you are using correct accessories and that the measurement setup and patient connections are correct.
Why does the RQ value rise above 1.0?	The physiological range of RQ is usually between 0.7 and 1.0. If the value is out of this range, check the measurement setup.
Why does the RQ value sometimes show unphysiological values such as RQ < 0.6?	Usually this is due to a non-steady state: the ventilator settings have been changed, FiO ₂ has changed, the ventilation is irregular.

Cleaning and care

For detailed maintenance instructions, refer to the respiratory modules' technical documentation.

**WARNING**

EQUIPMENT FAILURE OR INACCURATE READINGS. Planned maintenance should be carried out annually according to the instructions given in the technical manual. Failure to implement the recommended maintenance schedule may cause equipment failure or inaccurate readings.

For detailed cleaning instructions, refer to the host device's user documentation.

**CAUTION**

Do not apply pressurized air or gas to any outlet or tubing connected to the monitor. Pressure may destroy sensitive elements.

D-fend Pro(+) water trap

- Change the water trap every two months (D-fend Pro) or every 24 hours (D-fend Pro+), or whenever a message prompts you to do so.
- If the sampled gas is returned to the patient circuit, ensure the protective function of the D-Fend Pro water trap by replacing it at least once a week, or immediately in case of a defective or missing bacterial breathing system filter.
- Remove the water trap by pressing the release latch and pulling the water trap out.
- Attach the water trap by pushing it firmly to its place, so that the locking latch makes a clicking sound.
- Empty the container whenever half full and for each new patient. In normal conditions, the container fills up in 24 hours.
- The water trap cartridge is disposable. Do not wash or reuse the cartridge.
- Also read the water trap instructions for use in the accessory package.

Reusable D-lite and Pedi-lite sensor cleaning instructions

Reusable D-lite and Pedi-lite sensors can be washed, disinfected, or steam autoclaved. Make sure that the sensor is dry and the connectors are not damaged. A tight connection is essential for correct measurement.

Also read the sensor instructions for use in the accessory package.

Calibration warnings

**General warnings**

This symbol is identified by a yellow background, black triangular band, and a black symbol.

WARNING

A failure in zeroing or calibrating airway gases may cause inaccurate readings.

WARNING

Since calibration gas contains anesthetic agents, always ensure sufficient ventilation of the room during calibration.

Airway gas calibration

Follow the recommended calibration intervals (every six months in normal use and every two months in continuous use) to ensure that the measurement accuracy remains within specifications.

- E-sCAiO, E-sCAiOV, E-sCAiOVX, E-sCAiOE, E-sCAiOVE: Use calibration gas 755583-HEL.
- E-sCO, E-sCOV, E-sCOVX: Use calibration gas 755581-HEL.
- All modules: Use regulator 755534-HEL.

NOTE Calibration gas bottles with anesthetic agents must be disposed of in compliance with the guidelines regulating the disposal of products containing anesthetic agents.

For detailed instructions, see the monitor's user documentation.

Patient Spirometry calibration

Perform flow calibration if the difference between the inspiratory and expiratory volumes is permanent. For instructions, see the modules technical manual.

System compatibility

The CARESCAPE respiratory modules E-sCO, E-sCOV, E-sCOVX, E-sCAiO, E-sCAiOV, E-sCAiOVX, E-sCAiOE, and E-sCAiOVE can be used for respiratory monitoring in the following host systems:

- CARESCAPE Monitor B850
- CARESCAPE Monitor B650
- CARESCAPE Monitor B450
- B40 Patient Monitor (2060600-002)
- Aisys CS²
- Avance CS²
- S/5 Anesthesia Monitor, software version L-ANE06(A) 24.1 or later
- S/5 Critical Care Monitor, software version L-ICU06(A) 24.1 or later
- S/5 Compact Anesthesia Monitor, software version L-CANE 05(A) 19.6 or later
- S/5 Compact Critical Care Monitor, software version L-CICU 05(A) 19.6 or later

NOTE Low sample gas flow situation is indicated with the message **Replace D-Fend** in the L-xxx06(A) software versions 24.1 and L-xxx05(A) software versions 19.6.

NOTE The CARESCAPE respiratory modules cannot be used in the S/5 Extension Frame.

NOTE The Neonatal Intensive Care Unit (NICU) software package of the CARESCAPE modular patient monitors may not support the use of CARESCAPE respiratory modules.

NOTE Displayed data (including but not limited to TV, MV, RR, Raw and N₂O), trends and alarms may vary depending on the host device. Specifications listed represent the capabilities of the modules. Always check the host device's user manual for additional information.

NOTE

The following modules are considered identical and cannot be used in the same system at the same time: E-CO, E-sCO, E-COV, E-sCOV, E-COVX, E-sCOVX, E-CAiO, E-sCAiO, E-sCAiOE, E-CAiOV, E-sCAiOV, E-sCAiOVE, E-CAiOVX, E-sCAiOVX, E-miniC, N-CAiO, N-FC, N-FCREC.

Supplies and accessories

**General warnings**

This symbol is identified by a yellow background, black triangular band, and a black symbol.

WARNING

Single-use products are not designed to be reused. Reuse may cause a risk of cross-contamination, affect the measurement accuracy and/or system performance, and cause a malfunction as a result of the product being physically damaged due to cleaning, disinfection, re-sterilization and/or reuse.

WARNING

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

Always ensure the correct size and fit of accessories according to patient type and application, especially when monitoring pediatric and neonatal patients.

The listed GE accessories may be used to perform the full respiratory gas monitoring, Patient Spirometry and gas exchange measurements.

NOTE

Certain accessories are not available in all markets.

NOTE

For information regarding materials used in accessories, see the instructions for use for the specific accessory.

Gas accessories

Part Number	Gas Accessory Description	Approved for use with
M1182629	D-fend Pro Water Trap for anesthesia, reusable. Recommended use: anesthesia, recommended time to replace: 2 months or when occluded.	E-sCO, E-sCOV, E-sCOVX, E-sCAiO, E-sCAiOE, E-sCAiOV, E-sCAiOVX, E-sCAiOVE
M1200227	D-fend Pro+ Water Trap for critical care, single use. Recommended use: ICU or other humid conditions, recommended time to replace: 24 hours or when occluded.	E-sCO, E-sCOV, E-sCOVX, E-sCAiO, E-sCAiOE, E-sCAiOV, E-sCAiOVX, E-sCAiOVE
73385-HEL	Straight T-adapter, 22mm/15mm, dead space: 7.5 ml	E-sCO, E-sCOV, E-sCOVX, E-sCAiO, E-sCAiOE, E-sCAiOV, E-sCAiOVX, E-sCAiOVE

Part Number	Gas Accessory Description	Approved for use with
733856	Straight T-adapter, 22mm/15mm, dead space: 7.5 ml	E-sCO, E-sCOV, E-sCOVX, E-sCAiO, E-sCAiOE, E-sCAiOV, E-sCAiOVX, E-sCAiOVE
M1145066	Straight T-adapter UK Version	E-sCO, E-sCOV, E-sCOVX, E-sCAiO, E-sCAiOE, E-sCAiOV, E-sCAiOVX, E-sCAiOVE
73386-HEL	Elbow Adapter, 22mm/15mm, dead space: 10 ml	E-sCO, E-sCOV, E-sCOVX, E-sCAiO, E-sCAiOE, E-sCAiOV, E-sCAiOVX, E-sCAiOVE
733866	Elbow Adapter, 22mm/15mm, dead space: 10 ml	E-sCO, E-sCOV, E-sCOVX, E-sCAiO, E-sCAiOE, E-sCAiOV, E-sCAiOVX, E-sCAiOVE
M1145067	Airway Elbow Adapter, Disposable, UK Version	E-sCO, E-sCOV, E-sCOVX, E-sCAiO, E-sCAiOE, E-sCAiOV, E-sCAiOVX, E-sCAiOVE
8001540	Low Dead Space Adapter for ET tubes with ID 2.5 mm, dead space: 0.1 ml	E-sCO, E-sCOV, E-sCOVX, E-sCAiO, E-sCAiOE, E-sCAiOV, E-sCAiOVX, E-sCAiOVE
8001541	Low Dead Space Adapter for ET tubes with ID 3.0 mm, dead space: 0.15ml	E-sCO, E-sCOV, E-sCOVX, E-sCAiO, E-sCAiOE, E-sCAiOV, E-sCAiOVX, E-sCAiOVE
8001542	Low Dead Space Adapter for ET tubes with ID 3.5 mm, dead space: 0.2ml	E-sCO, E-sCOV, E-sCOVX, E-sCAiO, E-sCAiOE, E-sCAiOV, E-sCAiOVX, E-sCAiOVE
8001543	Low Dead Space Adapter for ET tubes with ID 4.0 mm, dead space: 1 ml	E-sCO, E-sCOV, E-sCOVX, E-sCAiO, E-sCAiOE, E-sCAiOV, E-sCAiOVX, E-sCAiOVE
8000062	Low Dead Space Adapter for ET tubes with ID 4.5 mm, dead space: 1 ml	E-sCO, E-sCOV, E-sCOVX, E-sCAiO, E-sCAiOE, E-sCAiOV, E-sCAiOVX, E-sCAiOVE
8000063	Low Dead Space Adapter for ET tubes with ID 5.0 mm, dead space: 1 ml	E-sCO, E-sCOV, E-sCOVX, E-sCAiO, E-sCAiOE, E-sCAiOV, E-sCAiOVX, E-sCAiOVE
73318-HEL	Disposable Anesthesia Gas Sampling Line, Male/Male Luer-Lok, 2 m/7 ft., material: PVC/PE, inner Ø 1.2 mm, outer Ø 2.8 mm	E-sCO, E-sCOV, E-sCOVX, E-sCAiO, E-sCAiOE, E-sCAiOV, E-sCAiOVX, E-sCAiOVE

Part Number	Gas Accessory Description	Approved for use with
733188	Disposable Anesthesia Gas Sampling Line, Male/Male Luer-Lok, 2 m/7 ft., material: PVC/PE, inner Ø 1.2 mm, outer Ø 2.8 mm	E-sCO, E-sCOV, E-sCOVX, E-sCAiO, E-sCAiOE, E-sCAiOV, E-sCAiOVX, E-sCAiOVE
M1145069	Disposable Anesthesia Gas Sampling line, 2m/7ft, UK Version	E-sCO, E-sCOV, E-sCOVX, E-sCAiO, E-sCAiOE, E-sCAiOV, E-sCAiOVX, E-sCAiOVE
73319-HEL	Disposable Anesthesia Gas Sampling Line, Male/Male Luer-Lok, 3 m/10 ft., material: PVC/PE, inner Ø 1.2 mm, outer Ø 2.8 mm	E-sCO, E-sCOV, E-sCOVX, E-sCAiO, E-sCAiOE, E-sCAiOV, E-sCAiOVX, E-sCAiOVE
733199	Disposable Anesthesia Gas Sampling Line, Male/Male Luer-Lok, 3 m/10 ft., material: PVC/PE, inner Ø 1.2 mm, outer Ø 2.8 mm	E-sCO, E-sCOV, E-sCOVX, E-sCAiO, E-sCAiOE, E-sCAiOV, E-sCAiOVX, E-sCAiOVE
M1145070	Disposable Anesthesia Gas Sampling Line, 3m/10ft, UK Version	E-sCO, E-sCOV, E-sCOVX, E-sCAiO, E-sCAiOE, E-sCAiOV, E-sCAiOVX, E-sCAiOVE
73306	Disposable Anesthesia Gas Sampling Line, Male/Male Luer-Lok, 6 m/20 ft., material: PVC/PE, inner Ø 1.2 mm, outer Ø 2.8 mm	E-sCO, E-sCOV, E-sCOVX, E-sCAiO, E-sCAiOE, E-sCAiOV, E-sCAiOVX, E-sCAiOVE
M1145071	Disposable Anesthesia Gas Sampling Line, 6m/20ft, UK Version	E-sCO, E-sCOV, E-sCOVX, E-sCAiO, E-sCAiOE, E-sCAiOV, E-sCAiOVX, E-sCAiOVE
733170	Disposable Anesthesia Gas Sampling Line with elbow connector Male/Male elbow Luer-Lok, 3 m/10 ft., material: PVC/PE, inner Ø 1.2 mm, outer Ø 2.8 mm	E-sCO, E-sCOV, E-sCOVX, E-sCAiO, E-sCAiOE, E-sCAiOV, E-sCAiOVX, E-sCAiOVE
M1145072	Disposable Anesthesia Gas Sampling Line with elbow connector Male/Male elbow Luer-Lok, 3m/10ft, UK Version	E-sCO, E-sCOV, E-sCOVX, E-sCAiO, E-sCAiOE, E-sCAiOV, E-sCAiOVX, E-sCAiOVE
8004383	Disposable Anesthesia Gas Sampling Line with elbow connector Male/Male elbow Luer-Lok, 2 m/7 ft., material: PVC/PE, inner Ø 1.2 mm, outer Ø 2.8 mm	E-sCO, E-sCOV, E-sCOVX, E-sCAiO, E-sCAiOE, E-sCAiOV, E-sCAiOVX, E-sCAiOVE
M1145073	Disposable Anesthesia Gas Sampling Line, with elbow connector Male/Male elbow Luer-Lok, 2 m/7 ft, UK Version	E-sCO, E-sCOV, E-sCOVX, E-sCAiO, E-sCAiOE, E-sCAiOV, E-sCAiOVX, E-sCAiOVE
733162-HEL	Disposable CO2 Sampling Line, Male/Male Luer-Lok, 2 m/7 ft., material: PVC, inner Ø 1.2 mm, outer Ø 2.8 mm	E-sCO, E-sCOV, E-sCOVX
M1145075	Disposable CO2 Sampling Line, Male/Male Luer-Lok, 2 m/7 ft., UK Version	E-sCO, E-sCOV, E-sCOVX

Part Number	Gas Accessory Description	Approved for use with
733163	Disposable CO2 Sampling Line, Male/Male Luer-Lok, 3 m/10 ft., material: PVC, inner Ø 1.2 mm, outer Ø 2.8 mm	E-sCO, E-sCOV, E-sCOVX
M1145076	Disposable CO2 Sampling Line, Male/Male Luer-Lok, 3 m/10 ft., UK Version	E-sCO, E-sCOV, E-sCOVX
878033	Nasal Sampling Line, pediatric, 2 m/7 ft., material: PVC	E-sCO, E-sCOV, E-sCOVX, E-sCAiO, E-sCAiOE, E-sCAiOV, E-sCAiOVX, E-sCAiOVE
878034	Nasal Sampling Line, adult, 2 m/7 ft., material: PVC	E-sCO, E-sCOV, E-sCOVX, E-sCAiO, E-sCAiOE, E-sCAiOV, E-sCAiOVX, E-sCAiOVE
878035	Nasal Sampling Line, large adult, 2 m/7 ft., material: PVC	E-sCO, E-sCOV, E-sCOVX, E-sCAiO, E-sCAiOE, E-sCAiOV, E-sCAiOVX, E-sCAiOVE
M1031274	Exhaust Line for gas return or scavenging, 2 m/7 ft., disposable	E-sCO, E-sCOV, E-sCOVX, E-sCAiO, E-sCAiOE, E-sCAiOV, E-sCAiOVX, E-sCAiOVE
8004462	Exhaust Line with Coulter fitting, 1 m/41 in., disposable	E-sCO, E-sCOV, E-sCOVX, E-sCAiO, E-sCAiOE, E-sCAiOV, E-sCAiOVX, E-sCAiOVE
8004463	Exhaust Line with Coulter fitting, 18 cm/7 in., disposable	E-sCO, E-sCOV, E-sCOVX, E-sCAiO, E-sCAiOE, E-sCAiOV, E-sCAiOVX, E-sCAiOVE
755534-HEL	D-gate Calibration Gas Regulator for Quick Cal calibration gas aerosol cans	E-sCO, E-sCOV, E-sCOVX, E-sCAiO, E-sCAiOE, E-sCAiOV, E-sCAiOVX, E-sCAiOVE
M1006864	Calibration Gas Regulator for Quick Cal calibration gas, aerosol cans	E-sCO, E-sCOV, E-sCOVX, E-sCAiO, E-sCAiOE, E-sCAiOV, E-sCAiOVX, E-sCAiOVE
755581-HEL	Quick Cal Calibration Gas, aerosol can, contains 5.0% CO ₂ , 40.0% N ₂ O, 55.0% O ₂ , balance O ₂ , accuracy: ±0.5% relative	E-sCO, E-sCOV, E-sCOVX
755587	Quick Cal Calibration Gas, aerosol can, contains: 5.0% CO ₂ ±0.03% abs, balance O ₂	E-sCO, E-sCOV, E-sCOVX
755583-HEL	Quick Cal Calibration Gas, aerosol can, contains 2.0% Desflurane, 5.0% CO ₂ , 33.0% N ₂ O, 55.0% O ₂ , balance N ₂ , accuracy: ±2.0% relative	E-sCAiO, E-sCAiOE, E-sCAiOV, , E-sCAiOVX, E-sCAiOVE
2070599-001	Adult O ₂ Nasal Cannula with CO ₂ sampling, 2 m (7 ft)	E-sCO, E-sCOV, E-sCOVX, E-sCAiO, E-sCAiOE, E-sCAiOV, E-sCAiOVX, E-sCAiOVE

Part Number	Gas Accessory Description	Approved for use with
2070600-001	Pediatric O ₂ Nasal Cannula with CO ₂ sampling, 2 m (7 ft)	E-sCO, E-sCOV, E-sCOVX, E-sCAiO, E-sCAiOE, E-sCAiOV, E-sCAiOVX, E-sCAiOVE
4797 (Salter Labs part number)	Salter Labs Adult oral/nasal CO ₂ sampling cannula with O ₂ line, 2 m (7 ft)	E-sCO, E-sCOV, E-sCOVX, E-sCAiO, E-sCAiOE, E-sCAiOV, E-sCAiOVX, E-sCAiOVE
4793 (Salter Labs part number)	Salter Labs Pediatric oral/nasal CO ₂ sampling cannula with O ₂ line, 2 m (7 ft)	E-sCO, E-sCOV, E-sCOVX, E-sCAiO, E-sCAiOE, E-sCAiOV, E-sCAiOVX, E-sCAiOVE
4000 (Salter Labs part number)	Salter Labs Adult nasal CO ₂ sampling cannula, 2 m (7 ft)	E-sCO, E-sCOV, E-sCOVX, E-sCAiO, E-sCAiOE, E-sCAiOV, E-sCAiOVX, E-sCAiOVE
4100 (Salter Labs part number)	Salter Labs Pediatric nasal CO ₂ sampling cannula, 2 m (7 ft)	E-sCO, E-sCOV, E-sCOVX, E-sCAiO, E-sCAiOE, E-sCAiOV, E-sCAiOVX, E-sCAiOVE

Patient Spirometry and gas exchange accessories

Part Number	Patient Spirometry and Gas Exchange Accessory Description	Approved for use with
733950	D-lite Sensor, 22mm M/15mm F-15mm M, material: yellow polystyrene, dead space: 9.5 ml, resistance: 0.5 cm H ₂ O at 30 l/min; patient range: TV 150 - 2000 ml	E-sCOV, E-sCOVX, E-sCAiOV, E-sCAiOVE, E-sCAiOVX
M1145077	D-lite Sensor, 22mm M/15mm F-15mm M, material: yellow polystyrene, UK Version	E-sCOV, E-sCOVX, E-sCAiOV, E-sCAiOVE, E-sCAiOVX
896952	D-lite+ Sensor, for humid conditions, 22mm M/15mm F-15mm M, material: clear polystyrene, dead space: 9.5 ml, resistance: 0.5 cm H ₂ O at 30 l/min; patient range: TV 150 - 2000 ml	E-sCOV, E-sCOVX, E-sCAiOV, E-sCAiOVE, E-sCAiOVX
8001948	Pedi-lite+ Sensor for humid conditions, 22mm M/ 15mm F - 15mm M, material: clear polystyrene, dead space 2.5 ml, resistance: 1.0 cm H ₂ O at 10 l/min; patient range: TV 15 - 300 ml	E-sCOV, E-sCOVX, E-sCAiOV, E-sCAiOVE, E-sCAiOVX
733910-HEL	D-lite Sensor, 22mm M/15mm F-15mm M, material: transparent yellow polyphenylsulfone, dead space: 9.5 ml, resistance: 0.5 cm H ₂ O at 30 l/min; patient range: TV 150 - 2000 ml	E-sCOV, E-sCOVX, E-sCAiOV, E-sCAiOVE, E-sCAiOVX
73393	Pedi-lite Sensor, 22mm M/15mm F-15mm M, material: transparent yellow polyphenylsulfone, dead space: 2.5 ml, resistance: 1.0 cm H ₂ O at 10 l/min; patient range: TV 15 - 300 ml	E-sCOV, E-sCOVX, E-sCAiOV, E-sCAiOVE, E-sCAiOVX

Part Number	Patient Spirometry and Gas Exchange Accessory Description	Approved for use with
890031	Spirometry Tube, yellow, 2 m/7 ft.	E-sCOV, E-sCOVX, E-sCAiOV, E-sCAiOVE, E-sCAiOVX
M1145087	Spirometry Tube, yellow, 2 m/7 ft., UK Version	E-sCOV, E-sCOVX, E-sCAiOV, E-sCAiOVE, E-sCAiOVX
884101	Spirometry Tube, yellow, 3 m/10 ft.	E-sCOV, E-sCOVX, E-sCAiOV, E-sCAiOVE, E-sCAiOVX
M1145088	Spirometry Tube, yellow, 3 m/10 ft., UK Version	E-sCOV, E-sCOVX, E-sCAiOV, E-sCAiOVE, E-sCAiOVX
889560	Patient Spirometry Kit, adult, includes: • 1 disposable 3 m/10 ft. anesthesia sampling line (73319-HEL) • 1 disposable yellow, D-lite sensor (733950) • 1 disposable 3 m/10 ft. spirometry tube, yellow (884101)	E-sCOV, E-sCOVX, E-sCAiOV, E-sCAiOVE, E-sCAiOVX
M1145081	Patient Spirometry Kit, Adult, UK Version	E-sCOV, E-sCOVX, E-sCAiOV, E-sCAiOVE, E-sCAiOVX
8002718	Patient Spirometry Kit, pediatric, includes: • 1 disposable 2m/7 ft. anesthesia sampling line (73318) • 1 disposable Pedi-lite+ flow sensor (8001948) • 1 disposable 2 m/7 ft. spirometry tube (890031)	E-sCOV, E-sCOVX, E-sCAiOV, E-sCAiOVE, E-sCAiOVX
M1032634	Patient Spirometry Kit, pediatric, includes: • 1 disposable 3 m/10 ft. anesthesia sampling line (73319-HEL) • 1 disposable Pedi-lite+ flow sensor (8001948) • 1 disposable 3 m/10 ft. spirometry tube (884101)	E-sCOV, E-sCOVX, E-sCAiOV, E-sCAiOVE, E-sCAiOVX
894255	Patient Spirometry Kit for ICU, includes: • 1 disposable 2 m/7 ft. CO₂ sampling line (733162) • 1 disposable 2 m/7 ft. spirometry tube (890031) • 1 single-use D-lite sensor (733950) • 1 HMEF 1000 (557070100)	E-sCOV, E-sCOVX
8004381	Patient Spirometry Kit for humid conditions, includes: • 1 disposable 2m/7ft. anesthesia gas sampling line with elbow connector (8004383) • 1 disposable D-lite+ sensor (896952) • 1 disposable 2m/7ft. spirometry tube (890031)	E-sCOV, E-sCOVX, E-sCAiOV, E-sCAiOVE, E-sCAiOVX

Part Number	Patient Spirometry and Gas Exchange Accessory Description	Approved for use with
8004382	Patient Spirometry Kit for humid conditions, includes: • 1 disposable 3m/10ft., anesthesia gas sampling line with elbow connector (733170) • 1 disposable D-lite+ sensor (896952) • 1 disposable 3m/10ft. spirometry tube (884101)	E-sCOV, E-sCOVX, E-sCAiOV, E-sCAiOVE, E-sCAiOVX
884202	Spirometry Tester, measurement range: tidal volumes 0-300/1200 ml, pressures 0-29 cm H ₂ O	E-sCOV, E-sCOVX, E-sCAiOV, E-sCAiOVE, E-sCAiOVX
891191-HEL	Spirometry Tube, yellow, 6m/20ft	E-sCOV, E-sCOVX, E-sCAiOV, E-sCAiOVE, E-sCAiOVX
M1145089	Spirometry Tube, yellow, 6m/20ft, UK Version	E-sCOV, E-sCOVX, E-sCAiOV, E-sCAiOVE, E-sCAiOVX

Technical specifications

Physical characteristics

Size (H x W x D)	112 x 37 x 205 mm (4.4 x 1.5 x 8.7 in)
Weight	0.7 kg (1.5 lb)
Power consumption	3.9 W

Operating characteristics

Warm-up time	CO ₂ , O ₂ and N ₂ O measurements: 1 minute Anesthetic agent measurement and identification: 5 minutes
Gas sampling rate	120 ml/min ±20 ml/min
The electronic sampling rate of the gas sensor signals is 25 Hz, equaling a new data point on the gas waveform traces every 40 ms.	
Automatic compensation for ambient pressure	

Operating conditions

Ambient temperature	+10°C to +40°C
Ambient pressure	660 mbar to 1060 mbar
Ambient humidity	0%RH to 98%RH, non-condensing

Storage conditions

Ambient temperature	-25°C to +60°C
Ambient pressure	500 mbar to 1060 mbar
Ambient humidity	10%RH to 90%RH, non-condensing

Airway gases specifications

General characteristics

Specifications are valid at the following normal operating conditions:

Ambient temperature	+18°C to +28°C, within $\pm 5^\circ\text{C}$ of calibration
Ambient pressure	660 mbar to 1060 mbar, ± 67 mbar of calibration
Ambient humidity	20%RH to 80%RH, non-condensing, $\pm 20\%$ RH of calibration
Sampling line length	2 and 3 meters
Respiration rate	4 to 70 breaths/minute (Halothane 4 to 50 breaths/minute)
Airway pressure	-20 mbar to +100 mbar
Module operating time	>20 minutes continuously

The displayed ranges of parameter values depend on the host device. For more information, refer to the host device's user documentation.

Respiration rate

Breath detection	1 vol% change in CO_2 level
Measurement range	4 to 100 breaths/min
Accuracy	At 4 to 20 breaths/min: ± 1 breath/min At 20 to 100 breaths/min: $\pm 5\%$

RR value is updated breath-by-breath.

Respiration rate verification method

The rated respiration rate range and the corresponding end-tidal gas reading accuracy were tested with reference gases of known concentrations. The test gases were fed to the gas sampling system of the module through an electrically actuated valve with very low internal volume. Depending on its actuation status, the valve directed either room air or a test gas to the gas sampling line. The desired respiration rates were set by the electrical actuating times of the valve.

The measurement accuracy of the end-tidal gas readings was tested using 3-meter gas sampling lines connected to the gas sample port of the D-fend Pro water trap. The gas sampled to the sampling line was switched from room air to the test gases using electrically actuated valve with low internal dead space to generate step changes in the gas concentrations. The electrical actuating signal of the valve was generated using a highly accurate signal generator to accurately control the simulated respiration rate.

Expiration time and end-tidal readings

The length of expiration time has impact on the accuracy of the gas-specific end-tidal readings. The longer the expiration time, the better the module achieves the correct end-tidal reading. With I:E 2:1, the gas specific end-tidal values are within specifications up to respiration rate 45 1/min except with halothane (32 1/min with halothane). With other I:E values, the end-tidal readings are within specifications.

Carbon dioxide

Measurement range	0 vol% to 15 vol% 0 kPa to 15 kPa 0 mmHg to 113 mmHg
Accuracy	$\pm(0.2 \text{ vol\%} + 2\% \text{ of reading})$
Gas cross effects by O ₂ , N ₂ O, and anesthetic agents	<0.2 vol%
Total system response time	< 3.3 s
Rise time	< 260 ms
CO ₂ drift	< 0.1 vol%
EtCO ₂ and FiCO ₂ values are updated breath-by-breath.	

Oxygen

Measurement range	0 vol% to 100 vol%
Accuracy	$\pm(1 \text{ vol\%} + 2\% \text{ of reading})$
Gas cross effects by anesthetic agents	<1 vol%
Gas cross effects by N ₂ O	<2 vol%
Total system response time	< 3.3 s
Rise time	< 260 ms
O ₂ drift	< 0.3 vol%
EtCO ₂ and FiCO ₂ values are updated breath-by-breath.	

Nitrous oxide

Measurement range	0 vol% to 100 vol%
Accuracy at (0 < N ₂ O < 85 vol%)	$\pm(2 \text{ vol\%} + 2\% \text{ of reading})$
Gas cross effects by anesthetic agents	<2 vol%
Total system response time	< 3.4 s
Rise time	< 320 ms
O ₂ drift	< 0.3 vol%
EtCO ₂ and FiCO ₂ values are updated breath-by-breath.	

Anesthetic agents

Measurement range	Sevoflurane: 0 vol% to 8 vol% Desflurane: 0 vol% to 20 vol% Isoflurane, enflurane, halothane: 0 vol% to 6 vol%
Accuracy	$\pm(0.15 \text{ vol\%} + 5\% \text{ of reading})$
Gas cross effects by N ₂ O	0.15 vol%
Total system response time	< 3.5 s (< 3.8 s for Halothane)

Anesthetic agents

Rise time	< 420 ms (< 800 ms for Halothane)
Hal drift	< 0.1 vol%
Enf drift	< 0.1 vol%
Iso drift	< 0.1 vol%
Sev drift	< 0.1 vol%
Des drift	< 0.3 vol%

EtAA and FiAA values are updated breath-by-breath.

The module automatically identifies the anesthetic agent present in the sampled gas and measures the concentration of the identified agent.

Identification threshold	0.15 vol%
Identification time	< 20 s

The module automatically identifies mixtures of two anesthetic agents present in the sampled gas and measures the concentrations of the two identified agents.

Identification threshold for the 2nd agent

At 1 MAC of the 1st agent 0.2 vol% +10% of the concentration of the 1st agent

Non-disturbing gases

A gas is considered non-disturbing if its effects to the measured gas are as follows:

CO ₂	< 0.2 vol%
O ₂ , N ₂ O	< 2 vol%
Anesthetic agents	< 0.15 vol%

The following gases are non-disturbing when tested according to ISO 21647(2004B): ethanol, acetone, isopropanol, methane, nitrogen, carbon monoxide, nitric oxide, freon R134A (for CO₂, O₂ and N₂O), water vapor.

The effects caused by N₂O to the measurement of CO₂, O₂ and anesthetic agents are automatically compensated for.

The effects caused by anesthetic agents to the measurement of CO₂ and N₂O are automatically compensated for.

Effects of interfering gases

Helium (50 vol%)	Decreases CO ₂ readings by less than 0.5 vol% at 5 vol% of CO ₂ Decreases O ₂ readings by less than 2 vol% at 50 vol% of O ₂
Xenon (80 vol%)	Decreases CO ₂ readings by less than 0.5 vol% at 5 vol% of CO ₂ Decreases O ₂ readings by less than 1.5 vol% at 14 vol% of O ₂

Patient Spirometry specifications

General characteristics

Specifications are valid at the following operating conditions:

The module has been operating continuously for 10 minutes.

Airway adapter, adult	D-lite
Airway adapter, pediatric	Pedi-lite
Respiration rate	Adults: 4 to 35 breaths/min Pediatric patients: 4 to 70 breaths/min
I:E ratio	1:4.5 to 2:1
Airway humidity	10 %RH to 100 %RH
Ambient temperature	+10°C to +40°C
Ambient pressure	660 mbar to 1060 mbar
Ambient humidity	10 %RH to 98 %RH (non-condensing)

The displayed ranges of parameter values depend on the host device. For more information, refer to the host device's user documentation.

Airway pressure

Measurement range	-20 cmH ₂ O to +100 cmH ₂ O
Accuracy	±1 cmH ₂ O
Time resolution	10 ms

Values calculated from the measured airway pressure data:

- Peak pressure (P_{peak})
- Plateau pressure (P_{plat})
- Mean pressure (P_{mean})
- Positive end expiratory pressure (PEEP_{tot} or PEEP_i and PEEP_e)
- Static positive end expiratory pressure (static PEEP_e and static PEEP_i)

Airway gas flow

Measurement range	Adults: -100 l/min to +100 l/min Pediatric patients: -25 l/min to +25 l/min
Time resolution	10 ms

Flow measurement has automatic compensation for airway pressure and effects caused by variation in the concentrations of the gas components measured by the module.

Tidal volume

The module calculates the volume by integrating the measured gas flow over time. Tidal volumes (TV_{insp} and TV_{exp}) are obtained as the change of volume during inspiration and expiration.

Measurement range	With D-lite: 150 ml to 2000 ml With Pedi-lite: 5 ml to 300 ml
Accuracy	With D-lite: $\pm 6\%$ or 30 ml (whichever is greater)
Accuracy verified at ATPD conditions.	With Pedi-lite: $\pm 6\%$ or 4 ml (whichever is greater)

Minute volume

The module calculates the inspired and expired minute volumes as the sum of inspired (MV_{insp}) and expired (MV_{exp}) gas volume during one minute.

Measurement range	With D-lite: 2 l to 20 l With Pedi-lite: 0.1 l to 5 l

Compliance

The module calculates both the compliance (Compl) and static compliance (static Compl). Compliance is calculated by dividing the expired gas volume (TV_{exp}) by the change in the airway pressure (P_{plat} - PEEP_{tot}). Static compliance is calculated by dividing TV_{exp} by the difference of static P_{plat} and static PEEP_{tot}.

Measurement range	Adults: 4 ml/cmH ₂ O to 100 ml/cmH ₂ O Pediatric patients: 1 ml/cmH ₂ O to 100 ml/cmH ₂ O

Airway resistance

The module calculates the airway resistance (Raw) by solving the lung model equation $P(t) = Raw * F(t) + V(t) / Compl + PEEP_{tot}$

where: P(t), F(t) and V(t) are the time dependent waveforms of pressure, flow, and volume, respectively

Measurement range	0 cmH ₂ O/l/s to 200 cmH ₂ O/l/s

Inspiration to expiration ratio

The module measures ratio of the inspiratory and expiratory time (I:E). The inspiratory time is the time from the start of inspiration to the start of expiration. The end inspiratory pause, if one exists, is included in the inspiration. Accordingly, expiratory time is the time from the start of expiration to the start of the next inspiration.

Gas exchange specifications

General characteristics

Not valid with N₂O, Xenon, or Helium.

Specifications are valid at the following operating conditions:

The module has been operating continuously for >20 minutes.

Ambient temperature	+18°C to +28°C, within $\pm 5^\circ\text{C}$ of gas calibration
Ambient pressure	660 mbar to 1060 mbar, ± 67 mbar of gas calibration

General characteristics

Ambient humidity	20 %RH to 80 %RH (non-condensing), ± 20 %RH of gas calibration
Sampling line length	2 meters
Airway adapter, adult	D-lite
Airway adapter, pediatric	Pedi-lite
Respiration rate	Adults: 4 to 35 breaths/min Pediatric patients: 8 to 35 breaths/min
Tidal volume	Adults: 150 to 1500 ml Pediatric patients: 50 to 300 ml
Minute volume	Adults: 4 to 14 liters Pediatric patients: 1 to 5 liters
I:E ratio	1:4.5 to 2:1
Airway humidity	10 %RH to 100 %RH
Airway compliance	Adults: 30 to 60 ml/cmH ₂ O Pediatric patients: 10 to 40 ml/cmH ₂ O
Airway resistance	Adults: 5 to 20 cmH ₂ O/l/s Pediatric patients: 10 to 40 cmH ₂ O/l/s
Airway PEEP	0 to 30 cmH ₂ O
FiO ₂	$\leq 85\%$

The displayed ranges of parameter values depend on the host device. For more information, refer to the host device's user documentation.

VCO ₂ and VO ₂ measurement range	20 to 999 ml/min
VCO ₂ and VO ₂ resolution	1 ml/min
VCO ₂ and VO ₂ accuracy (verified in room air conditions using dry gas.)	FiO ₂ < 65%: $\pm 10\%$ or 10 ml, whichever is greater FiO ₂ < 85%: $\pm 15\%$ or 15 ml, whichever is greater
VCO ₂ and VO ₂ measurement	Not valid with O ₂ +N ₂ O mixtures



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B105M/B125M/B155M Patient Monitors

Powering your performance.



B105M/B125M/B155M patient monitors deliver premium clinical performance across care areas. These scalable, precise, dependable monitors with intuitive design are available in choice of 10, 12 or 15 inch touch screen displays.

Advanced capabilities

B1x5M range of monitors can be deployed seamlessly across a variety of care settings:

- EK-Pro v14 ECG 4-lead simultaneous arrhythmia analysis
- DINAMAP™ SuperSTAT non-invasive blood pressure measurement
- Choice of SpO₂ technologies: GE TruSignal™, Masimo SET® or Nellcor™ OxiMax
- GE EtCO₂ sidestream measurement, anesthetic agents and cardiac output
- Entropy™ monitoring* for monitoring the state of the brain
- NMT for neuromuscular transmission blockade and reversal monitoring
- Connectivity to GE CARESCAPE™ networks
- Flexibility to share parameter modules and accessories with CARESCAPE monitors

*For patients older than 2 years.

Intuitive design. Uninterrupted workflow.

- 12 waveforms to view all required parameter waveforms simultaneously
- Bed to Bed communication and Automatic view on alarm (AVOA) to review remote patient monitoring data
- Roving functionality for seamless transition of the monitor from one bedside to another within the CARESCAPE Network
- InSite™ Remote Service platform for remote troubleshooting
- National Early Warning Score (NEWS) for timely intervention

Tough for demanding duty. Secure for a cyber world.

- Follows FDA draft guidance for cyber security in medical devices
- An ECG filter delivers enhanced signal performance in noisy areas
- With High Capacity battery: >4 hrs¹
- Tested with the EMC 4th Edition standard
- Water resistant with IP22 standards

¹ Depending on the configuration, with typical configuration ECG, NIBP cycle time 15 min, SpO₂, display brightness 70%.

Technical specifications

Display

Size	B155M: 15.6 in (diagonal) B125M: 12.1 in (diagonal) B105M: 10.1 in (diagonal)
Resolution	B155M: 1366x768 (HD) B125M / B105M: 1280x800 (WXGA)
Number of waveforms	Up to 12
Display layout and colors	User-configurable
Controls	Capacitive touch screen and Trim Knob™

Parameters and modules

Parameters	Modules ²
ECG	Integrated hemodynamic module
Resp	
SpO ₂	
NIBP	
Temp	
2 channel InvBP	E-miniC ³
Sidestream CO ₂	
Entropy	
Sidestream CO ₂ , O ₂ and N ₂ O	
Sidestream CO ₂ , O ₂ , agents and N ₂ O	
Cardiac Output + 1 Channel InvBP	E-sCO
Neuromuscular Transmission	E-sCAiO, N-CAiO
	E-COP ⁵
	E-NMT

ECG

Leads available	3-lead configuration: I, II, III 5-lead configuration: I, II, III, aVR, aVL, aVF and V 10-lead configuration: I, II, III, aVR, aVL, aVF, V1, V2, V3, V4, V5 and V6
Sweep speed	12.5, 25 or 50 mm/s
Gain range	0.5x, 1x, 2x and 4x
Heart rate accuracy	20 to 300 bpm, $\pm 5\%$ or ± 5 bpm, whichever is greater

Bandwidth

ECG filter	Monitor: 0.5 to 40 Hz ST: 0.05 to 40 Hz Diagnostic: 0.05 to 145 Hz Moderate: 0.5-20 Hz
Pacemaker detection	Voltage range: 2 to 700 mV Pulse width: 0.5 to 2 ms

Arrhythmia Alarms

Lethal Alarms	Asystole, V Fib/V Tach, V Tach
HR Alarms	Brady, Tachy

Ventricular Alarms	VT>2, R on T, V Brady, Couplet, Bigeminy, Accelerated Ventricular, Trigeminy, Multifocal PVCs
Atrial Alarms	A Fib, Missing beat, Pause, Irregular, SV Tachy
PVC Alarm	Frequent PVCs, Frequent SVCs
ST segment analysis	
Numeric range	-9 to +9 mm (-0.9 to +0.9 mV)
Accuracy	± 0.2 mm or $\pm 10\%$, whichever is greater, within the measurement range of -8 to 8 mm
Numeric resolution	0.1 mm (0.01 mV)

Impedance respiration

Range	Adult/pediatric: 4 to 120 breaths/min Neonate: 4 to 180 breaths/min
Accuracy	$\pm 5\%$ or ± 5 breaths/min, whichever is greater
Gain range	0.1 to 5 cm/Ohm

SpO₂

TruSignal SpO₂

<i>Measurement range</i>	
Pulse oximetry	1 to 100%
Pulse rate	30 to 250 bpm
PI (Perfusion Index)	0 to 32
<i>Measurement accuracy</i>	
Saturation	Without motion-adult/pediatric Finger sensor: 70 to 100% $\pm 2\%$ Without motion-neonate: 70 to 100% $\pm 3\%$ With motion-adult/pediatric/ neonate: 70 to 100% $\pm 3\%$ Low perfusion-adult/pediatric: 70 to 100% $\pm 3\%$ (<70% unspecified)
Pulse Rate	Without motion: ± 2 bpm (Adult/Pediatric/Neonatal)

Nellcor OxiMax

<i>Measurement range</i>	
Pulse oximetry	1 to 100%
Pulse rate	20 to 250 bpm
<i>Measurement accuracy</i>	
Saturation	Adult: 70 to 100% $\pm 2\%$ Neonate: 70 to 100% $\pm 3\%$ Low perfusion: 70 to 100% $\pm 2\%$ <70% unspecified
Pulse Rate	± 3 bpm

² Refer to B105M/B125M/B155M User's Manual for more information.

³ CO₂ measurement through E-miniC Module is intended for use with patients weighing over 5kg (11 lb) only.

⁴ E-Entropy module shall only be used in the patient older than 2 years old.

⁵ E-COP is not intended for use on neonatal patients.

Masimo SET

Measurement range

Pulse oximetry	1 to 100%
Pulse rate	25 to 240 bpm

Measurement accuracy

Saturation	Without motion-adult/pediatric: 70 to 100% $\pm 2\%$ Without motion-neonate: 70 to 100% $\pm 3\%$ With motion-adult/pediatric/ neonate: 70 to 100% $\pm 3\%$ Low perfusion: 70 to 100% $\pm 2\%$ ($< 70\%$ unspecified)

Pulse rate	Without motion: ± 3 bpm With motion: ± 5 bpm

PI (Perfusion Index)	Yes

APOD (Adaptive Probe Off Detection)	Yes

NIBP

Measurement technique	Oscillometric with step deflation
Measurement Modes	Manual, Automatic (with customseries cycle time), and STAT
Automatic Cycle Times	Custom, 1, 2, 3, 4, 5, 10, 15, 20, 30 min, 1 h, 1.5 h, and 2 h

NIBP Measurement ranges

Systolic	Adult/Pediatric: 30 to 290 mmHg Neonate: 30 to 140 mmHg
MAP	Adult/Pediatric: 20 to 260 mmHg Neonate: 20 to 125 mmHg
Diastolic	Adult/Pediatric: 10 to 220 mmHg Neonate: 10 to 110 mmHg

Clinical Accuracy

Mean Difference	± 5 mmHg
Standard Deviation	≤ 8 mmHg
Reporting Standard	ANSI/AAMI ISO81060-2 and IEC 80601-2-30

Safety features

Default initial inflation pressure	Adult/Pediatric: 135 ± 15 mmHg Neonate: 100 ± 15 mmHg
Maximum determination time	Adult/Pediatric: 2 min Neonate: 85 s
Over pressure monitor	Adult/Pediatric: 300 ± 6 to 330 mmHg Neonate: 150 ± 3 to 165 mmHg

Pulse Rate from NIBP

Measurement Range	30 bpm to 250 bpm
Accuracy	$\pm 5\%$ or ± 5 bpm (whichever is greater)

Invasive blood pressure

From integrated hemodynamic measurement

Measurement range	-40 to 320 mmHg (-5.3 to 42.7 kPa)
Measurement accuracy	$\pm 4\%$ or ± 2 mmHg, whichever is greater
Frequency response	4 to 22 Hz
Transducer sensitivity	5 μ V/V/mmHg
Pulse Rate (PR) range	30 to 250

From E-COP module

Measurement range	-30 to 320 mmHg (-4.0 to 42.7 kPa)
Measurement accuracy	$\pm 4\%$ or ± 4 mmHg, whichever is greater
Frequency response	4 to 22 Hz
Transducer sensitivity	5 μ V/V/mmHg
Pulse Rate (PR) range	30 to 250

Calculations

SPV (Systolic Pressure Variance)	SBPmax – SBPmin (where SBP is systolic blood pressure)
PPV (Pulse Pressure Variance)	$(PP_{\max} - PP_{\min}) / [(PP_{\max} + PP_{\min}) / 2] \times 100$ (where PP is pulse pressure)

Temperature

Numerical display	T1, T2, Tblood

From integrated hemodynamic measurement (T1, T2)

Measurement range	10 to 45°C (50 to 113°F)
Measurement accuracy	$\pm 0.1^\circ\text{C}$ without probe $\pm 0.2^\circ\text{C}$ with probe from 25 to 45 °C $\pm 0.3^\circ\text{C}$ with probe from 10 to 25 °C (not include 25 °C)
Display resolution	0.1°C

From E-COP module (Tblood)

Measurement range	17.5 to 43°C (63.5 to 109.4°F)
Measurement accuracy	$\pm 0.5^\circ\text{C}$ (17.5°C to 30.9°C) $\pm 0.3^\circ\text{C}$ (31°C to 43.0°C)
Display resolution	0.1°C

Network architecture

Physical N/W	1000BaseT network
Wireless	Wi-Fi IEEE 802.11a/b/g/n, fast roaming

Networking services

Outbound HL7®	Direct Connectivity to EMR or 3rd party systems for numeric trend
CARESCAPE (Unity)	Connectivity to CIS / HIS through CARESCAPE Gateway Other Networking applications
Remote Service	Remote Diagnosis of device via InSite™ RSvP server

CARESCAPE (Unity) networking applications

Bed to Bed window*

Data displayed	Six parameters' waveforms and numeric values, one remote alarm, and remote bed information
Remote beds	Monitor alarms for up to 40 beds
Monitored	View one bed from up to 1023 beds

AVOA (Auto View of Remote beds in alarm)*

Remote alarm message information	Unit and bed name, alarm message, more than 1 beds alarming
Configurable alarm notification	Message, Auto View, Auto View Always

Roving

Functionality	Roving between units and beds; Adding new units and beds; Selecting the printer

I/O Peripherals

Standard Connectors

Ethernet port / WIFI	Supports HL7 and CARESCAPE Unity N/W
USB 2.0 Port	Download service logs Import / Export settings Export numerical trends Installing software, firmware and e-manuals
HDMI Port	Supports secondary clone display B155M: 1366 x 768 pixels B125M/B105M: 1280 x 800 pixels
RS232 Serial Port	Export trend data o/p and alarms to iCollect only through DRI protocol

Non-standard Connectors

Nurse Call connector	connects to nurse calling system of hospital
Defib sync connector	Defibrillator synchronization output
Recorder Connector	Standalone thermal printer B1X5-REC Recorder
B1X5-F2 frame	2nd Frame for additional modules connector

Network and data security

Wi-Fi certificate	CE, FCC
Wi-Fi Authentication	Support WPA-Personal; WPA2-Personal; WPA- Enterprise; WPA2-Enterprise
WIFI Data Encryption	Support WPA/WPA2 with TKIP and AES CCMP
LAN / WLAN Connection	Supports IEEE 802.1X port-based Network Access Control (NAC)
USB file exchange	All USB functions are password protected Encrypted export of numerical trends, user settings, and service logs to USB

Mounting

GCX compatible

Integrated carrying handle

Local thermal printer

Method	Thermal dot array
Horizontal resolutions	24 dots/mm (600 dpi)
Vertical resolution	8 dots/mm (200 dpi)
Waveforms	Selectable 1, 2, or 3 waveforms
Numerics trend printout	HR, Pleth, NIBP, IBP1, IBP2, T1, T2, Et/FiCO ₂ , RR, Pleth, C.O., C.I., REF, SPV, PPV, IBP4, Tblood, RE, SE, BSR, NMT Count, O ₂ , N ₂ O, AA, BAL, MAC
Paper width	50 mm, printing width 48 mm
Paper speed	5, 10, 12.5 and 25mm/s, user configurable
Remote printer	Supports both Laser and thermal printer (with CARESCAPE Central Station)

Module Rack (integrated)

Slot for a single module



B1X5-F2 Second Frame (optional)

Additional second frame for up to two modules



* Compatible only with B155M / B125(M/P) / B105(M/P) VSP3.0 patient monitors

Performance specifications

Alarms

Priority	Adjustable priority: High, Medium, Low and Information Local and remote control from central station
Alarm breakthrough	Asystole, V Fib/V Tach, V Tach, Brady, FiO ₂ Low, EtO ₂ Low and FiN ₂ O high
Alarm configurability	Define VTach rate range and duration criteria for a sustainable VTach alarm
Notification	Audible and visual
Alarm tone	IEC, General, ISO, ISO2
Setting	Default and individual
Visual alarm notification	Red, yellow, cyan Audio silence message General alarm message
Alarm limit adjustment	Local and remote control from central station
Audio pause	2 min
Alarm auto printing	Up to 23 alarms

Trends

Graphical	All parameters, selectable time scales from 20 min to 168h (7 days)
Numerical	All parameters, with 168 hours (7 days) of trend data sampling according to time setting or after NIBP, CO and PCWP determination
Snapshot	Up to 200 snapshots Manual or alarm triggered Event snapshots with waveform (on CARESCAPE Central Station)
OxyCRG trend	Neonate mode only Real time or snapshot view Stores up to 70 OxyCRG snapshots Snapshot duration 6 min before and 2 min after the OxyCRG event
Trend cursor	In graphical trend

Full disclosure

Tab/page: all ECG, Hemo

All ECG view	ECG I, II, III, aVL, aVR, aVF, V1, V2, V3, V4, V5, and V6 waveforms
Hemo view	ECG II, IBP1, IBP2, IBP4, SpO ₂ and Resp waveforms
Parameters supported	ECG, SpO ₂ , IBP and RESP
Configurable waveform review sweep speed	
Storage	72 hours with all waveform data
Integrated link with alarm history	
Full Disclosure review on specific alarm	
Full Disclosure review on specific time	

EWS (Early Warning Score)

Protocol	National Early Warning Score (NEWS) 2
Parameters	Pulse HR/PR, Systolic Blood Pressure, LOC (level of consciousness), TEMP, SpO ₂ , Resp Rate, and Air or Oxygen
History with detailed parameters values and sub-scores	
Total EWS score on the main screen with color coding and time stamps	
Clinical response and individual parameter scores with colors on a dedicated window	
Review EWS Clinical Risk and EWS Guidance	

Environmental specifications

Operating conditions

Temperature	5 to 40°C (41 to 104°F)
Relative humidity	15 to 90% non-condensing
Atmospheric pressure	700 to 1060 hPa (525 to 795 mmHg)

Storage and transport conditions

Temperature	-20 to 60°C (-4 to 140°F)
Relative humidity	10 to 90% non-condensing
Atmospheric pressure	700 to 1060 hPa (525 to 795 mmHg)

Power specifications

AC input	100 to 240V ±10%, 50/60 Hz
Power consumption	Monitor ≤150 VA B1x5-F2 Second frame ≤50 VA
Protection	Class I
Battery	1 Lithium Ion High Capacity
Charging time	< 4 h to 90% capacity
Run time	>4.0 hrs for B155M / B125M >4.5 hrs for B105M with typical configuration: ECG, NIBP cycle time 15 min, SpO ₂ , display brightness 70%



Physical specifications

Monitor

Dimensions (H x W x D)	B155M: 305 x 405 x 175 mm
	B125M: 280 x 312 x 175 mm
	B105M: 275 x 265 x 175 mm
Weight (with battery and w/o modules)	B155M: ≤ 5.2 kg (11.5 lb)
	B125M: ≤ 4.2 kg (9.3 lb)
	B105M: ≤ 3.8 kg (8.4 lb)
Ingress protection	IP22

B1X5-F2 Second Frame

Dimensions (H x W x D)	160 x 132 X 266 mm with mounting plate
Weight	1.4 kg (30.9 lb) with mounting plate

Certifications

IEC 60601-1 passed
CE marking according to EU Medical Device Regulation (EU) 2017/745
UL mark
CB certificate

System

Operation system	Linux®
Cooling system	Natural convection, no fan inside for cooling

Product may not be available in all countries and regions. Full product technical specification is available upon request. Contact a GE Healthcare Representative for more information. Please visit www.gehealthcare.com/promotional-locations.

Data subject to change.

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B125M, B105M, B155M

DOC2378613 2020-09-17

B105M/B125M/B155M patient monitor software version VSP3.0 are not available in all markets and are not 510k cleared.

Patient Monitor B155M-OR/B125M-OR/B105M-OR

User's Manual

Software Version 4.0



5829100-EN
Revision 1
English

Notice

The information in this manual applies to the software version listed on the first page of the manual. Due to continuing product innovation, specifications in this manual are subject to change without notice.

Revision history

Revision	Date	Reason for change
1	2024-05-08	Initial release.

Contents

Standards and Regulations	24
Standards compliance	24
IEC 60601-1	24
EU Medical Device Regulation	25
CISPR 11	25
CE manufacturer and EU Representative	25
CE marking application year	25
About this manual.....	26
Intended use of this manual.....	26
Intended audience of this manual	26
Manual conventions.....	26
Acquisition module naming conventions.....	26
Illustrations and names	27
Related documents.....	27
Ordering manuals	27
Accessing manuals online	27
Accessing manuals on monitor	27
Using E-manuals on monitor	28
Trademarks	28
Third party trademarks	28
Manufacturer responsibility	29
Product availability.....	29
Safety and intended use	30
Safety message signal words	30
System safety	30
System warning safety messages.....	30
Indications for use warnings	30
Accessories warnings.....	31
Cables warnings.....	32
Defibrillation warnings	32
Electrical warnings	33
EMC warnings.....	35
System warnings.....	36
Site requirement warnings.....	37
Interfacing warnings.....	37
System caution safety messages.....	37
Indications for use cautions	37

Loss of data	38
Electrical caution	38
EMC cautions	38
Site requirement cautions.....	39
Interfacing cautions.....	39
Disposal cautions.....	39
Notice safety messages	40
ESD safety precautions	40
Indications for use	40
Indications for use	40
SPI indications for use	41
E-COP indications of use	41
E-sCO, E-sCAiO, N-CAiO modules' indications for use	41
E-miniC indications for use	41
E-Entropy indications for use.....	41
E-NMT indications for use	42
BIS indications for use.....	42
B1X5-F2 frame intended use	42
B1X5-REC recorder intended use	42
Clinical benefit	42
Clinical benefit	42
Clinical benefits of the applicable E-modules.....	42
E-COP module clinical benefit	43
Gas measurement modules clinical benefit.....	43
E-Entropy module clinical benefit.....	43
E-NMT module clinical benefit.....	43
E-BIS module clinical benefit.....	43
B1X5-F2 frame clinical benefit	43
B1X5-REC recorder clinical benefit	43
Intended users	43
Contraindication	44
Equipment symbols.....	44
Unique Device Identifier (UDI)	49
Country of origin	49
Serious incident reporting.....	49
Training requirements	50
Residual risks	50
System introduction.....	51
System safety precautions	51
System warnings.....	51
System caution	53
Short description of the equipment	53

Product models.....	53
System components	55
Front view	56
Left side view	56
Right side view	57
Back view	57
Acquisition modules	57
Module compatibility limitations.....	57
Identical acquisition modules.....	58
E-COP module.....	58
E-miniC module	59
E-sCAiO, E-sCO and N-CAiO module	59
E-Entropy module.....	59
E-NMT module	60
E-BIS module	60
B1X5-F2 Frame	60
B1X5-REC recorder.....	61
Monitor battery	61
Checking the battery charge with monitor software	62
Monitor battery charge symbols on screen	62
Other devices	62
InSite RSvP	63
Monitoring basics.....	64
Operation safety precautions.....	64
Operation warnings	64
Monitor installation points to note	65
Connecting and removing parts.....	65
Connecting B1X5-F2 module.....	65
Connecting E-module.....	66
Removing E-module	66
Connecting the B1X5-REC recorder	66
Inserting the B1X5-REC recorder	67
Removing the recorder.....	67
Connecting the anesthesia machine	67
Connecting to the mains power.....	68
User interface keys.....	68
User interface symbols	72
Main screen layout.....	74
Waveform layout.....	75
Large number layout	76
Split screen and bed to bed view layout	76
Menu layout.....	78

Normal menu layout.....	78
Quick pop-up menu layout	79
An example of a menu	80
Menu options	81
Selecting menu options with a touchscreen	82
Entering data.....	82
Locking the screen	82
Turning the monitor on/off	82
Automatically turn off the monitor	83
Password management.....	83
Setup password at first time to use	83
Import settings from USB at first time to use.....	83
Setup password manually	83
Changing passwords	84
Setup the password policy.....	84
Bad password	84
Password expired	85
Generate and export recovery key.....	85
Reset passwords	85
Resetting password via activation code	85
Resetting password via recovery key in USB.....	86
Performance check	86
Mains supply interruption	86
Downloading logs to USB disk	86
Setting up the monitor before use	87
Waveform field safety precautions	87
Normal screen.....	87
Adjusting sound volumes	87
Adjusting the display brightness.....	88
Screen setup modifications.....	88
Waveforms layout.....	88
Large number layout	88
Setting waveforms layout	88
Selecting the display mode for IBP waveforms.....	89
Setting large number layout	89
Setting the split screen	89
Setting parameters	89
Setting up printing options	90
Other setup changes.....	90
Transferring settings from a monitor to another.....	90
Exporting settings.....	90
Importing settings	91

Starting and ending monitoring	92
Starting and ending safety precautions.....	92
Starting and ending warnings	92
Starting and ending caution.....	92
About the user default settings	92
About user modes	92
Selecting a mode	93
Pre-monitoring checklist	93
Starting monitoring	93
Entering patient data	94
Patient data privacy protection	94
Entering patient data with the monitor	94
Entering patient data with barcode scanner	94
Loading patient information from the CARESCAPE Network	95
About standby	95
Starting standby	95
End of standby	96
About the roving functionality	96
Roving between units	96
Roving between beds	96
Adding new units and beds (manual roving)	97
Selecting the printing device	97
About night mode	97
Setting and entering night mode	97
Exiting night mode.....	98
About Demo Mode	98
About patient discharge	99
Discharging a patient.....	99
About continuing monitoring.....	99
Alarms	100
Alarm safety precautions.....	100
Alarm warnings.....	100
Alarm overview	103
Alarm types	103
Alarm conditions.....	104
Broadcast only alarms.....	104
Checking alarm function	104
Visual alarm indications	104
Alarm icons on the screen	104
Description of alarm and information messages	104
Setting alarm light brightness.....	105

About alarm message functionality	105
Visual alarm signals and priority levels	106
Audible alarm indications	106
Audible alarm signals	106
Alarm tones	106
Adjusting the alarm volume	107
Auditory information signals	107
Parameter alarms.....	107
Setting parameter alarm limits	107
Setting alarm limits automatically	108
Auto alarm limits	108
Returning the default alarm limits.....	109
Alarm priorities and escalation	109
Alarm priority levels	109
Alarm priority escalation.....	109
Selecting parameter alarm priority levels	109
Setting arrhythmia alarms	110
Pausing and silencing alarms.....	110
Audible alarms off behavior	110
Turning audible alarms on/off	110
Pause audio and alarm reset behaviors	111
Alarms' deactivation with the pause audio key	112
Audible alarms' deactivation with gesture	114
Breakthrough alarms.....	114
Breakthrough alarms list.....	115
Latched alarms	115
Remote management of alarms.....	115
Nurse call.....	116
Alarm settings after a power loss	116
Stored alarm data during a power cycle or power loss.....	116
ECG.....	117
ECG safety precautions	117
ECG warnings	117
ECG cautions	119
ECG measurement description.....	120
ECG measurement displayed on the monitor screen	120
ECG measurement limitations.....	120
ECG points to note	120
ECG measurement setup	121
ECG equipment to patient connection	121
Preparing the patient's electrode sites.....	121
Applying the electrodes to the patient	122

3- lead or 5-lead ECG electrode placement.....	122
10-lead ECG electrode placement for cardiac monitoring.....	123
Checking the ECG measurement	123
Using the ECG measurement.....	123
ECG leads settings.....	123
Selecting the first displayed ECG lead	124
Selecting the second displayed ECG lead	124
Selecting the third displayed ECG lead	124
Selecting the V ECG lead position	124
Changing to an ECG cable with fewer leadwires	124
Deactivating the ECG leads off alarm.....	125
Selecting the ECG waveform size	125
Selecting the hemodynamic waveform sweep speed	125
Setting the beat volume	125
Selecting the ECG waveform filter	125
Setting the QRS width	126
Setting the primary HR source.....	126
Showing a second HR value	126
Displaying the ECG grid	127
Viewing and printing all ECG waveforms.....	127
Relearning the patient's QRS pattern	127
ECG alarm limits.....	128
Setting the HR alarm limits	128
Setting PVC alarm limits.....	128
Setting SVC alarm limits.....	128
ECG measurement practicalities	129
Alternate pulse rate source	129
Auto algorithm	129
Pacemaker detection.....	129
Pacemaker detection warnings.....	129
Pacemaker detection points to note.....	130
Selecting the pacemaker detection	130
Arrhythmia monitoring.....	131
Arrhythmia monitoring warnings	131
Arrhythmia detection description.....	132
Arrhythmia measurement limitations	133
Setting arrhythmia alarms	133
Setting the V Tach alarm conditions	133
About V Tach criteria	134
Setting the alarm pause interval.....	134
Setting the SVT length.....	134
Setting HR for SVT	134
Arrhythmia alarm messages	134
ST detection	136
About the ST analysis	136
ST detection measurement limitations	136

Adjusting the ST point manually.....	136
Adjusting the isoelectric measurement (ISO) point.....	137
Adjusting the J point	137
Setting alarm limits for lead groups	137
Impedance respiration	138
Respiration safety precautions.....	138
Respiration warnings.....	138
Respiration cautions.....	139
Respiration measurement description	139
Respiration measurement displayed on the monitor screen	140
Respiration measurement limitations	140
Respiration points to note	141
Respiration measurement setup.....	142
Respiration equipment to patient connection.....	142
Preparing the patient's respiration electrode sites.....	142
Respiration lead and breath detection	142
Respiration lead I electrode placement.....	143
Respiration lead II electrode placement.....	143
Respiration lead RL-LL electrode placement	144
Respiration measurement checks	144
Using the respiration measurement	144
Turning on the respiration measurement	144
Selecting the respiration lead	145
Selecting the respiration waveform size	145
Selecting the waveform speed.....	145
Setting the averaging time	145
Parameter filtering (Resp averaging).....	145
Setting the apnea alarm delay.....	145
Setting the respiration alarm limits.....	145
Turning off the respiration measurement	146
Pulse oximetry	147
SpO ₂ safety precautions	147
SpO ₂ warnings	147
SpO ₂ cautions	152
Masimo warnings.....	152
Masimo cautions.....	154
SpO ₂ measurement description.....	156
SpO ₂ measurement displayed on the monitor screen	157
SpO ₂ measurement limitations.....	157
SpO ₂ points to note.....	157
Masimo points to note.....	158

SpO ₂ measurement guidelines	158
GE TruSignal technology and sensor measurement guidelines.....	158
Masimo SET technology and sensor measurement guidelines.....	159
Additional information for Masimo technology.....	159
Nellcor OxiMax technology and sensor measurement guidelines	159
Additional information for Covidien technology	160
SpO ₂ measurement setup	160
SpO ₂ equipment to patient connection	160
Preparing the SpO ₂ connection	160
Checking the SpO ₂ measurement.....	161
SpO ₂ functional testers	161
Using the SpO ₂ measurement	161
Changing the SpO ₂ waveform scale	161
Selecting the GE TruSignal SpO ₂ response averaging time.....	161
Selecting the Masimo SpO ₂ averaging time	162
Selecting the Masimo SpO ₂ sensor sensitivity level	162
Setting the SpO ₂ to show PI	162
Selecting the SpO ₂ as the primary heart rate source.....	163
Adjusting the SpO ₂ pulse beep tone volume	163
Setting the SpO ₂ alarm limits.....	163
Setting the Masimo SpO ₂ alarm delay	163
Stopping the SpO ₂ measurement.....	163
How to interpret the SpO ₂ values	164
SpO ₂ signal strength.....	164
SpO ₂ waveform quality	164
SpO ₂ waveform stability.....	164
Surgical pleth index	165
SPI safety precautions	165
SPI warnings	165
SPI cautions	165
SPI instruction.....	165
SPI measurement displayed on the monitor screen.....	166
SPI measurement limitations.....	167
SPI points to note.....	167
Using the SPI measurement.....	168
Patient connections and preparing the patient	168
Stopping the SPI and SpO ₂ measurement	168
Basics of SPI measurement	169
SPI clinical implications	169
SPI measurement description.....	169
Normalization	169
Learning	169

How to interpret the SPI values.....	170
SPI in typical general anesthesia	170
Common surgical events.....	170
Laryngoscopy and intubation.....	170
Skin incision.....	170
Maintenance phase	171
The end of anesthesia	171
Sensor removal.....	171
SPI practicalities	171
AoA split screen and the BalView.....	171
SPI and NIBP measurement	172
Physiological and technical issues affecting SPI.....	173
Physiological issues.....	173
Technical issues.....	173
Non-invasive blood pressure	174
NIBP safety precautions	174
NIBP warnings.....	174
NIBP cautions.....	176
NIBP instruction	177
NIBP measurement displayed on the monitor screen.....	177
NIBP measurement limitations	178
NIBP points to note	178
NIBP measurement setup.....	179
NIBP equipment to patient connection.....	179
Preparing the NIBP patient connection.....	179
NIBP cuffs	179
NIBP cuff selection and placement.....	179
Selecting NIBP cuff size	180
Initial NIBP cuff inflation pressure	180
Selecting the auto initial NIBP cuff inflation pressure.....	180
Setting the target NIBP inflation pressure.....	180
Manual NIBP measurements	181
Starting or stopping a single NIBP measurement from the NIBP menu	181
Starting or stopping a single NIBP measurement from the key	181
Automatic NIBP measurements	181
NIBP Auto mode.....	181
Setting the cycle time between NIBP measurements	181
Setting the custom series for NIBP measurement	181
Starting or stopping an Auto NIBP measurement from the NIBP menu.....	181
NIBP STAT mode	182
Starting or stopping a Stat NIBP measurement	182
Venous Stasis.....	182
Selecting the venous stasis pressure	182
Selecting the cuff size for venous stasis	182

Starting or stopping a Venous Stasis measurement	182
NIBP volume and display settings.....	183
Adjusting the NIBP measurement completion tone volume	183
Selecting the blood pressure unit of measurement	183
Selecting the NIBP color.....	183
NIBP alarms.....	183
Setting the NIBP alarm limits.....	183
NIBP alarms' deactivation with pause audio key.....	183
NIBP measurement description	184
DINAMAP SuperSTAT NIBP technology.....	184
DINAMAP Step Deflation technology	185
Invasive blood pressure.....	187
Invasive blood pressure safety precautions	187
Invasive pressure warnings	187
Invasive pressure parameters	188
Invasive pressure measurement on the monitor screen	188
Invasive pressure points to note	190
Invasive blood pressure measurement setup	191
Invasive pressure equipment to patient connection with monitor.....	191
Invasive pressure equipment to patient connection with E-COP module.....	192
Connecting the invasive pressure transducer and cable	192
Checking the invasive pressure measurement	192
Selecting the display mode for IBP waveforms.....	192
Using the invasive blood pressure measurement	193
Invasive pressure measurement mapping	193
About zeroing the invasive pressure transducers	193
Zeroing the invasive pressure transducers.....	193
Selecting an invasive pressure channel label.....	194
Selecting the size of the invasive pressure waveform	194
Optimizing the invasive pressure waveform scale.....	194
Selecting the hemodynamic waveform sweep speed	194
Selecting the displayed invasive pressure format	195
Selecting invasive pressure as the primary heart rate source	195
Selecting the ventilation mode.....	195
Selecting the invasive pressure response time	195
Selecting the invasive pressure noise reduction filter	196
Setting invasive pressure alarm limits.....	196
Systolic pressure variation and pulse pressure variation	196
Changing the SPV source.....	196
Pulmonary capillary wedge pressure (PCWP) measurement.....	197
Showing the PCWP digit field.....	197
Taking an automated PA wedge measurement.....	197
Starting a new PA wedge measurement.....	197

Other selection in the Wedge menu	197
Temperature.....	198
Temperature safety precautions	198
Temperature warnings	198
Temperature measurement description.....	198
Temperature measurement displayed on the monitor screen	199
Temperature points to note.....	199
Temperature measurement setup	200
Temperature equipment to patient connection	200
Preparing the patient for temperature measurement.....	200
Checking the temperature measurement	200
Using the temperature measurement	200
Temperature mappings.....	200
Changing the temperature site label	201
Selecting the temperature unit.....	201
Setting temperature alarms	201
Temperature practicalities	201
Cardiac output.....	202
C.O. safety precautions.....	202
C.O. warnings.....	202
C.O. instruction	203
C.O. parameters, E-COP.....	203
C.O. measurement displayed on the monitor screen	203
C.O. module key.....	204
C.O. measurement limitations	204
C.O. points to note	204
C.O. measurement setup	205
C.O. equipment to patient connection with an in-line probe.....	205
Preparing the C.O. measurement	205
Checking the C.O. measurement	205
Using the C.O. measurement.....	206
Entering patient data for the C.I. value.....	206
C.O. catheter selections.....	206
Selecting a C.O. catheter type.....	206
Entering a user-defined C.O. catheter	206
C.O. measurement modes.....	207
Taking an automatic C.O. measurement	207
Taking a manual C.O. measurement.....	207
C.O. trial measurements.....	208
Editing the C.O. average	208
Canceling a C.O. measurement.....	208
Setting a C.O. right ventricular ejection fraction (REF) measurement.....	208

Selecting the C.O. scale	209
Selecting what to show with C.O./C.I.....	209
Setting the Tblood alarm	209
Adjusting the wedge from the cardiac output menu	209
Stopping the cardiac output measurement	209
C.O. practicalities	209
Cardiac output thermodilution curve	209
How to improve the C.O. accuracy.....	210
Airway gases	212
Airway gases safety precautions	212
Airway gases warnings	212
Airway gases cautions	215
Airway gases instruction.....	215
Airway gases measurement displayed on the monitor screen.....	216
Airway gases parameters.....	217
Airway gases parameters, gas modules	217
Airway gases parameters, E-miniC	217
Airway gases parameters, anesthesia machine	218
Airway gases measurement limitations.....	219
Airway gases points to note.....	219
Airway gases measurement setup	220
Airway gases equipment to patient connections with gas module	220
Airway gases equipment to patient connections with E-miniC, critical care setup	221
Connecting to anesthesia machine	221
Setting up the airway gases measurement	221
Airway gases alternative patient connections	222
Tracheostomy	222
Mask ventilation	222
Infant ventilation	222
Checking the airway gases measurement.....	223
Using CO ₂ measurement	223
Turning on the CO ₂ measurement	223
Starting and stopping pump	223
Selecting the CO ₂ scale.....	223
Selecting the CO ₂ unit	223
Selecting the FiO ₂ level	223
Selecting the N ₂ O level.....	224
Selecting the CO ₂ sweep speed	224
Selecting airway gases measurement source	224
Setting CO ₂ limit alarms	224
Setting CO ₂ alarms on/off (anesthesia source)	224
Using O ₂ measurement.....	225
Turning on the O ₂ measurement	225

Selecting the O ₂ scale	225
Selecting the O ₂ sweep speed	225
Setting O ₂ limit alarms	225
Using AA and N ₂ O measurement	225
Turning on the agent and N ₂ O measurement	225
Selecting the agent scale	226
Selecting the agent sweep speed	226
Setting agent limit alarms	226
Using MAC, MACage and ET Balance measurement	226
Setting MACage calculation	226
Preventing operating room pollution	226
Scavenging through the ventilator reservoir	227
Scavenging through the anesthesia gas scavenging system	227
Connecting directly to the scavenging system	227
Stopping the airway gases measurement	227
Basics of airway gases measurement	227
Airway gases measurement description, E-sCAiO, E-sCO, and N-CAiO modules	227
Airway gases measurement description, E-miniC	228
Sidestream gas sampling	228
Minimum Alveolar Concentration (MAC)	229
MAC and MACage	229
References used for MAC and MACage values	229
MAC values of different anesthetics in oxygen	230
MAC values of different anesthetics in 65% N ₂ O	230
ET balance gas	231
Automatic agent identification	231
Basics of CO ₂ measurement	231
Normal CO ₂ waveform	231
The origin of the CO ₂ waveform	232
Dips in capnogram	232
Oxygen measurement interpretation	233
Airway gases practicalities	234
Ventilation management	234
Prevention of the breathing system contamination	234
How to prevent effects of humidity	234
Oxygen delivery, E-sCAiO, E-sCO, N-CAiO modules	235
Oxygen uptake and consumption	235
Nitrogen elimination	235
Flow reduction	235
Level of anesthesia: E-sCAiO, N-CAiO modules	235
Anesthetic agent uptake	235
Spirometry (from interfaced Anesthesia machine)	236

Spirometry instruction	236
Spirometry measurement displayed on the monitor screen	236
Spirometry supported data	237
Spirometry parameters	238
Spirometry points to note	238
Spirometry measurement setup	239
Connecting to anesthesia machine	239
Using the patient spirometry measurement	239
Selecting the spirometry scales	239
Selecting the spirometry sweep speed	239
Selecting the displayed spirometry show volume type.....	239
Setting the spirometry alarm on/off	239
Entropy	240
Entropy safety precautions	240
Entropy warnings.....	240
Entropy cautions.....	241
Entropy instruction	242
Entropy measurement displayed on the monitor screen.....	243
Entropy module keys.....	243
Entropy measurement limitations	243
Entropy points to note	244
Entropy measurement setup.....	245
Entropy equipment to patient connection.....	245
Preparing the patient for Entropy measurement.....	245
Checking the Entropy measurement	245
Using the Entropy measurement	245
Selecting the Entropy scale.....	245
Selecting the EEG sweep speed	246
Selecting the display format for Entropy.....	246
Selecting the Entropy/SPI trend length.....	246
Using the manual Entropy sensor check.....	246
Using the automatic Entropy sensor check.....	246
Bypassing the Entropy sensor check	247
Setting Entropy alarm limits	247
Stopping the Entropy measurement	247
Entropy measurement basics.....	247
Entropy measurement description.....	247
Entropy parameters.....	248
Entropy frequency and display ranges	248
How to interpret the Entropy values.....	248
Relation of Entropy values to EEG and patient status.....	248
Entropy range guidelines	249
Burst suppression ratio (BSR)	249

Entropy practicalities.....	250
Entropy reference studies.....	250
Entropy reference studies supporting reduction of drugs.....	250
Entropy reference studies supporting titration of drugs	250
Reference studies regarding pediatric use of Entropy	251
Neuromuscular transmission	252
NMT safety precautions	252
NMT warnings	252
NMT cautions	253
NMT instruction.....	253
NMT measurement displayed on the monitor screen	254
NMT waveforms on the monitor screen	255
Typical ElectroSensor TOF responses	256
Typical MechanoSensor TOF responses.....	256
NMT graphic trends on the monitor screen.....	257
NMT module keys	258
NMT measurement limitations.....	258
NMT points to note.....	258
NMT measurement setup	259
NMT equipment to patient connection	259
Preparing the patient for NMT measurement	259
Preparing the ElectroSensor setup	260
Preparing the MechanoSensor setup	260
Preparing the Pediatric MechanoSensor setup.....	261
Checking the NMT measurement.....	261
NMT alternative connections	261
Using the NMT measurement.....	262
Starting the NMT measurement.....	262
Starting the NMT measurement with an already relaxed patient	262
Changing the NMT stimulus current.....	262
Changing the NMT cycle time	263
Changing the stimulation type.....	263
Adjusting the NMT beep volume	263
Using the NMT recovery note	263
Measuring deep relaxation.....	264
Showing the NMT microtrend	264
Continuing the NMT measurement	264
Continuing the NMT measurement in OR after induction	265
Stopping the NMT measurement.....	265
Restarting the NMT measurement.....	265
NMT measurement basics	265
NMT measurement description	265
MechanoSensor and kinemyography (KMG).....	266
ElectroSensor and electromyography (EMG).....	266

Stimulation modes	266
How to interpret the NMT values	267
Train of four (TOF) mode	267
Double burst stimulation (DBS) mode	267
Post tetanic count (PTC) mode	267
Single twitch (ST) mode	268
NMT practicalities	268
Bispectral index	269
BIS safety precautions	269
BIS warnings	269
BIS cautions	270
BIS measurement description	271
BIS measurement displayed on the monitor screen	272
BIS module keys	272
BIS measurement limitations	273
BIS points to note	273
BIS measurement setup	274
BIS equipment to patient connection	274
Preparing the patient for BIS measurement	274
Checking the BIS measurement	274
Using the BIS measurement	274
Selecting the BIS waveform size	274
Selecting the EEG sweep speed	275
Selecting the BIS smoothing rate	275
Setting BIS filters	275
Using the manual BIS sensor check	275
Using the automatic BIS sensor check	275
Testing the BISx	276
Setting BIS alarm limits	276
Stopping the BIS measurement	276
How to interpret the BIS values	276
Data review tools	278
Patient data safety precautions	278
Patient data cautions	278
Patient data views	278
Graphic trends	279
Viewing graphic trends	279
Changing the graphic trend scales	279
Graphic trend resolution	279
Setting the graphic trend pages	280
Printing currently viewed graphic trends	280
Numeric trends	280

Viewing numeric trends.....	280
Changing the time interval of numeric trends	281
Printing numeric trends	281
Exporting numeric trends to USB disk.....	281
Snapshots.....	282
Description of snapshots.....	282
Snapshot configuration.....	282
Manually created snapshots	282
Automatically created snapshots	282
Viewing snapshots.....	283
Printing snapshots.....	283
Alarm history.....	283
Viewing alarm history.....	283
Printing alarm history.....	283
OxyCRG.....	284
OxyCRG description.....	284
Viewing the realtime OxyCRG.....	284
Viewing OxyCRG snapshot	284
Setup OxyCRG snapshot.....	284
Full Disclosure.....	285
Full Disclosure description.....	285
Viewing Full Disclosure.....	285
Go to Full Disclosure view for specific time.....	285
Setting the sweep speed of Full Disclosure	285
Time change during a patient admit.....	285
Erasing patient data.....	286
Clinical applications	287
Clinical applications safety precautions.....	287
Early Warning Score warning	287
Clinical applications description.....	287
Early Warning Score.....	287
Selecting the EWS type.....	288
Viewing EWS.....	288
Calculating EWS	288
Viewing EWS history	288
Viewing EWS clinical risk/patient risk.....	288
Viewing EWS guidance	289
Customized Notification	289
Setting customized notifications	289
Customized notification displays on monitor's screen.....	291
Viewing customized notification from menu	291
Viewing history instances.....	292
Viewing customized notification from notification bar	292

Printing	293
Printing description	293
Printing device selections.....	293
Selecting printer	293
Checking the print status	294
Setting the printer	294
Printing waveforms.....	295
Printing waveforms on alarms.....	295
Starting a waveform printout.....	295
Stopping a waveform printout.....	295
Setting the print delay.....	295
Setting the print speed	296
Setting the print duration.....	296
Selecting waveforms to print	296
Printing trends, snapshots, and alarm history	296
Exporting patient data to USB disk in PDF format	296
Printing format.....	297
Network laser printer print header	297
Recorder print header	297
Inserting recorder paper.....	298
Viewing other monitored patients	299
About viewing other monitored patients	299
Automatic view of remote beds in alarm.....	299
Selecting the alarm notification type	300
Selecting the notifying alarm priority level	300
Changing the settings for multiple beds	301
Next alarming remote bed to screen.....	301
Viewing remote patient beds	301
Audio pause for a remote patient bed alarms	302
Manual printing of remote bed waveforms	302
Periodic Maintenance	303
Maintenance safety precautions	303
Care warnings	303
Before any planned maintenance or regular checks	303
Planned maintenance for the monitor	303
Planned maintenance for the module	304
Recommended check schedules.....	304
Daily checks	304
Check every two months.....	304
Check every six months.....	304

Check every 24 months	304
Regular calibration checks	305
Calibrating airway gases	305
NIBP, IBP, and Temperature calibration checks	305
Water trap care instructions	306
About battery care	306
Monitor battery	306
Internal RTC battery	306
How to store devices	307
Disposal instructions	307
Cleaning and disinfection	308
About these instructions	308
About cleaning and disinfection	308
Cleaning warnings	308
Cleaning cautions	309
Cleaning points to note	309
Disinfection points to note	310
Visual inspection before cleaning and disinfection	310
Cleaning and disinfection frequency	310
Supplies needed for cleaning and disinfection	311
Permitted cleaning and disinfection agents	312
How to clean and disinfect	314
Before started	314
Cleaning during patient monitoring	314
Cleaning the monitor during monitoring	315
Cleaning and disinfection between patients	317
Cleaning and disinfecting the monitor between patients	317
Cleaning and disinfecting the B1X5-F2 frame between patients	321
Cleaning and disinfecting the B1X5-REC recorder between patients	326
Additional information	330
Troubleshooting	331
ECG troubleshooting	331
Pacemaker detection troubleshooting	331
Arrhythmia troubleshooting	332
Respiration troubleshooting	332
SpO ₂ troubleshooting	333
SPI troubleshooting	334
Basic SPI troubleshooting	334
Advanced SPI troubleshooting	335
NIBP troubleshooting	335
Invasive pressure troubleshooting	336

Temperature troubleshooting.....	338
C.O. troubleshooting	338
Airway gases troubleshooting.....	340
Spirometry troubleshooting.....	340
Entropy troubleshooting	341
NMT troubleshooting.....	341
Verifying measurement reliability.....	341
Faulty measurements with ElectroSensor	341
Faulty measurements with MechanoSensor.....	342
Troubleshooting other problems.....	343
BIS troubleshooting.....	344
Messages.....	345
Messages related to ECG measurement.....	345
Messages related to impedance respiration measurement.....	347
Messages related to SpO ₂ measurement.....	348
Messages related to SPI measurement by GE TruSignal.....	349
Messages related to NIBP measurement	350
Messages related to invasive pressures measurement.....	351
Messages related to temperature measurement	355
Messages related to C.O. measurement	355
Messages related to gases measurement	358
Messages related to spirometry measurement.....	360
Messages related to Entropy measurement	361
Messages related to NMT measurement.....	362
Messages related to BIS measurement.....	363
Messages related to trends, snapshots, OxyCRG, and full disclosure	365
Messages related to various situations.....	365
Abbreviations	370
List of abbreviations	370

Standards and Regulations

Standards compliance

The system complies with the following standards.

- IEC 60601-1/GB9706.1: General requirement for basic safety and essential performance
- IEC 60601-1-2/YY0505: EMC safety standard
- IEC 80601-2-49/YY0668: Particular safety standard for multifunction patient monitoring equipment
- IEC 60601-1-6: Usability safety standard
- IEC 62366-1: Application of usability engineering to medical device
- EN/ISO 14971: Application of risk management analysis to medical device
- IEC 62304: Software life cycle processes
- The alarm systems of the Monitor conforms to IEC 60601-1-8 and YY0709.
- The ECG parameter conforms to IEC 60601-2-27, AAMI EC57 and YY1079



NOTE

Moderate reduced bandwidths do not comply with all requirements of the IEC 60601-2-27 standard.

- The SpO₂ parameter conforms to ISO 80601-2-61 and YY0784.
- The NIBP parameter conforms to IEC 80601-2-30, YY0667, YY0670, and ANSI/AAMI/ISO 81060-2.
- The IBP parameter conforms to IEC 60601-2-34 and YY0783.
- The Temperature parameter conforms to ISO 80601-2-56 and YY0785.
- The Gases parameter conforms to ISO 80601-2-55 and YY0601.
- The Entropy parameter conforms to IEC 80601-2-26 and GB9706.26.
- The NMT parameter conforms to IEC 60601-2-40.
- The BIS parameter conforms to IEC 80601-2-26 and GB9706.26.

IEC 60601-1

Monitor

- Type of protection against electrical shock: Class I. Internally powered ME equipment.
- Degree of protection against electrical shock: applied parts are marked with a symbol indicating degree of protection.
- Degree of safety of application in the presence of flammable anesthetic mixture with air or with oxygen or nitrous oxide: Not suitable.
- Degree of protection against harmful ingress of water: IP22.
- Mode of operation: Continuous.

- Method(s) of sterilization or disinfection recommended by the manufacturer: see the User’s Manual.
- Portable monitor.

EU Medical Device Regulation

In accordance with the Regulation (EU) 2017/745 concerning Medical Devices: Class IIb

- The CE Mark CE-0197 indicating its conformity with the provisions of the Regulation (EU) 2017/745 concerning Medical Devices. The country of manufacture can be found on the equipment labeling.

CISPR 11

In accordance with the CISPR (International Special Committee on Radio Interference) 11: Group 1, Class A.

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

CE manufacturer and EU Representative

Manufacturer name and address	European authorized representative
 GE Medical Systems (China) Co., Ltd. No. 19, Changjiang Road, Wuxi National Hi-Tech Development Zone, 214028 Jiangsu, P.R. China	EC REP GE Medical Systems SCS 283 Rue de la Miniere 78530 BUC, France

CE marking application year

CE marking application year: 2025.

About this manual

Intended use of this manual

This manual is an integral part of the device and describes its intended use. It should always be kept in a place accessible to users, and information indicating that place should be available close to the equipment. Observance of the manual is mandatory for proper performance and correct operation and ensures patient and user safety. Information which refers only to certain versions of the product(s) is accompanied by the model number(s) of the product(s) concerned. The model number is given on the device plate of the product.

As the monitor configuration may vary, some menus, displays and functions described may not be available in the monitor you are using.

See the supplemental information manual for the technical specifications, default settings and compatibility information, including electromagnetic compatibility.

Intended audience of this manual

This manual is intended for clinical professionals. Clinical professionals are expected to have a working knowledge of medical procedures, practices and terminology required to provide patient care. Using the device should never replace nor impede the human intervention and required patient care provided by clinical professionals.

Manual conventions

This manual uses the following styles to emphasize text or indicate action.

Item	Description
Courier	Indicates hardware terms.
bold	Indicates software terms.
<i>italic</i>	Indicates terms for emphasis.
select	The word select means choosing and confirming.
supplemental information	Indicates information that appears in the Supplemental Information Manual or supplements provided.
NOTE	Note statements provide application tips or other useful information.

Acquisition module naming conventions

In this manual, the following naming conventions are used to refer to different modules and module categories:

- E-miniC: Single-width airway module
- E-sCO₂, E-sCAiO: CARESCAPE respiratory modules
- N-CAiO: Airway Gas Option

- E-modules: All modules with the prefix E-

Illustrations and names

This manual uses illustrations as examples only. Illustrations in this manual may not necessarily reflect all system settings, features, configurations, or displayed data.

Names of persons, institutions, and places and related information are fictitious; any similarity to actual persons, entities, or places is purely coincidental.

Related documents

- B155M-OR/B125M-OR/B105M-OR Patient Monitor Supplemental Information Manual
- B155M-OR/B125M-OR/B105M-OR Patient Monitor Technical Manual
- Supplies and accessories
- Service manuals for acquisition modules
- Patient Monitoring Network Configuration Guide
- CARESCAPE Central Station User's Manual
- HL7 Reference Manual
- Privacy and Security Manual

Ordering manuals

Paper copies of the medical device IFU will be provided within 7 days of receiving the request, at no additional cost. Contact your local GE representative and request the part number on the first page of the eIFU.

Accessing manuals online

To access manuals online,

1. Go to <https://www.gehealthcare.com/documentationlibrary>.
2. Enter **Customer Documentation Portal** site.
3. Select **Modality to Monitoring Solutions (MS)** and **Products** to related products you want to search. Launch the search.
4. Identify and download the IFUs.

The IFUs are in PDF format, make sure the device has software to open the PDF files (e.g. Adobe® Acrobat® Reader).

Accessing manuals on monitor

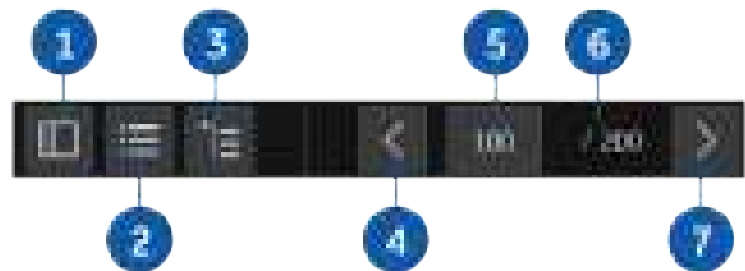
To access manuals on monitor:

1. Press the **On/Off** button (more than 3 seconds) to turn on the monitor.
2. Select  >  **E-Manual**.

- 3. Select related manuals.

Using E-manuals on monitor

The E-manual's navigation are on the top of the menu.



1.	Show/Hide bookmark view softkey	5.	Current page area
2.	Collapse bookmark view softkey	6.	Total page
3.	Expand bookmark view softkey	7.	Next page softkey
4.	Previous page softkey		

- 1. Swipe down and up to scroll the page.
- 2. Select < or > to turn pages.
- 3. Enter a page number to current page area can jump to this page.
- 4. Select  to display or hide the bookmark volume on the left.
- 5. Select  to collapse bookmark.
- 6. Select  to expand bookmark.

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Manufacturer responsibility

GE HealthCare is responsible for the effects on safety, reliability, and performance of the equipment only if:

- Assembly operations, extensions, readjustments, modifications, servicing, or repairs are carried out by authorized service personnel.
- The electrical installation of the relevant room complies with the requirements of the appropriate regulations.
- The equipment is used in accordance with the instructions for use.

Product availability

NOTE

Due to continual product innovation and design, specifications for these products are subject to change without notice.

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

Safety and intended use

Safety message signal words

Safety message signal words designate the severity of a potential hazard.

DANGER

Indicates a hazardous situation that, if not avoided, will result in death or serious injury.

WARNING

Indicates a hazardous situation that, if not avoided, could result in death or serious injury.

CAUTION

Indicates a hazardous situation that, if not avoided, could result in minor or moderate injury.

NOTICE

Indicates a hazardous situation not related to personal injury that, if not avoided, could result in property damage.

System safety

System safety messages apply to the entire system. Safety messages specific to parts of the system are found in the relevant section.

System warning safety messages

The following warning safety messages apply to this monitoring system.

Indications for use warnings

WARNING

PATIENT SAFETY.

Read all the safety information before using the device for the first time. This manual contains instructions necessary to operate this device safely and in accordance with its functions and intended use. This manual is intended for clinical professionals. Clinical professionals are expected to have a working knowledge of medical procedures, practices and terminology, as required for the monitoring of all patients.

WARNING**SINGLE PATIENT USE.**

This equipment is designed for use on one patient at a time. Using this equipment to monitor different parameters on different patients at the same time compromises the accuracy of data acquired.

WARNING**INSTRUCTIONS FOR USE.**

For continued safe use of this equipment, it is necessary that the listed instructions are followed. However, instructions listed in this manual in no way supersede established medical practices concerning patient care.

WARNING**INTRAHOSPITAL TRANSPORT.**

Vibrations during intrahospital transport may disturb SpO₂, ECG, impedance respiration, NIBP, and IBP measurements.

Accessories warnings

WARNING**PATIENT SAFETY.**

Single-use products are not designed to be reused. Reuse may cause a risk of cross-contamination, affect the measurement accuracy and/or system performance, and cause a malfunction as a result of the product being physically damaged due to cleaning, disinfection, re-sterilization and/or reuse.

WARNING**PATIENT SAFETY.**

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

WARNING**ELECTRIC SHOCK.**

Only use protected leadwires and patient cables with this device. The use of unprotected leadwires and patient cables creates the potential for making an electrical connection to ground or to a high voltage power source which can cause serious injury or death to the patient.

WARNING**PATIENT SAFETY.**

When using any supply or accessory, make sure that you are familiar with their use to avoid any risk to the patient. For detailed instructions and information regarding supplies and accessories, always refer to their own instructions for use.

Cables warnings

WARNING**CABLES.**

Route all cables away from patient's throat to avoid possible strangulation.

WARNING**CABLES.**

Route all cables in such a way that they are not under the patient to avoid the risk of possible pressure sores.

WARNING**PERSONAL INJURY.**

To avoid personal injury to users or any other persons moving in the vicinity of the cables or tubing, route all cables and tubing in such a way that they do not present a tripping hazard.

WARNING**SAFETY GROUND.**

Remove power cord from the mains source by grasping the plug. Do not pull on the cable.

Defibrillation warnings

WARNING**ELECTRIC SHOCK.**

To avoid the risk of electric shock, do not touch the patient, table, bed, instruments, or system parts during defibrillation.

WARNING**DEFIBRILLATOR PRECAUTIONS.**

Patient signal inputs labeled with the CF and BF symbols with paddles are protected against damage resulting from defibrillation voltages. To ensure proper defibrillator protection, use only the recommended cables and leadwires.

Electrical warnings

WARNING

POWER SUPPLY.

Always connect the device power cable to a properly installed power outlet with protective earth contacts before connecting any other interface cables. If the integrity of the protective earth conductor is in doubt, disconnect the monitor from the power line. If the installation does not provide for a protective earth conductor, disconnect the monitor from the power line after having disconnected all other interface cables. All devices of a system must be connected to the same power supply circuit. Devices which are not connected to the same circuit must be electrically isolated when operated.

WARNING

EXCESSIVE LEAKAGE CURRENT.

Do not use a multiple socket outlet or extension cord. A failure in a multiple socket outlet or extension cord may cause increased leakage current when many devices are sharing the same multiple socket outlet or extension cord.

WARNING

EXCESSIVE LEAKAGE CURRENT.

To avoid summation of leakage currents when interfacing the device with other equipment, the devices may only be interconnected with each other or to parts of the system when it has been determined by qualified biomedical personnel that there is no danger to the patient, the operator, or the environment as a result. In those instances where there is any element of doubt concerning the safety of the connected devices, the user must contact the manufacturers concerned (or other informed experts) for proper use. In all cases, safe and proper operation should be verified with the applicable manufacturer's instructions for use, and system standards IEC 60601-1 clause 16, and the requirements of the local authorities must be complied with.

WARNING

EXCESSIVE TOUCH CURRENT.

To avoid excessive patient leakage current, do not simultaneously touch the patient and the electrical connectors in the monitor, or within the module housing or frame.

WARNING

INTERFACING OTHER EQUIPMENT.

Connect only items that are specified as part of the system and as compatible. For more information, see the supplemental information provided.

WARNING**INTERFACING OTHER EQUIPMENT.**

Devices may only be interconnected with each other or to parts of the system when it has been determined by qualified biomedical personnel that there is no danger to the patient, the operator, or the environment as a result. In those instances where there is any element of doubt concerning the safety of the connected devices, the user must contact the manufacturers concerned (or other informed experts) for proper use. In all cases, safe and proper operation should be verified with the applicable manufacturer's instructions for use, and system standards IEC60601-1 must be complied with.

WARNING**ELECTRIC SHOCK.**

To avoid the risk of electric shock, do not under any circumstances remove the grounding conductor from the power plug. Always check that power cord and plug are intact and undamaged.

WARNING**PATIENT SAFETY.**

During intracardiac application of a device, a defibrillator and pacemaker whose proper functioning has been verified must be kept at hand to ensure timely intervention if necessary.

WARNING**EQUIPMENT DAMAGE.**

If liquid has accidentally entered the system or its parts, disconnect the power cord from the power supply and have the equipment serviced by qualified service personnel. Otherwise, there is a risk of damage to the equipment.

WARNING**DISCONNECTION FROM MAINS.**

When disconnecting the device from the power line, remove the plug from the wall outlet first. Then you may disconnect the power cord from the device. If you do not observe this sequence, there is a risk of coming into contact with line voltage by inserting metal objects, such as the pins of leadwires, into the sockets of the power cord by mistake.

WARNING**INTRACARDIAC APPLICATION.**

When applying devices intracardially, electrically conductive contact with parts connected to the heart (pressure transducers, metal tube connections and stopcocks, guide wires, etc.) must be avoided in all cases. To prevent electrical contact, we recommend the following:

- always wear isolating rubber gloves,
- keep parts that are conductively connected to the heart isolated from ground,
- if possible, do not use tube fittings or stopcocks made of metal.

EMC warnings

WARNING

EMC.

Other equipment may interfere with the system, even if that other equipment complies with CISPR emission requirements.

WARNING

ESD.

Pins of connectors identified with the ESD warning symbol should not be touched. Connections should not be made to these connectors unless electrostatic discharge (ESD) precautions are used.

WARNING**EQUIPMENT DAMAGE AND PATIENT SAFETY.**

Do not use the device in high electromagnetic fields (for example, during magnetic resonance imaging).

WARNING

EMC.

Magnetic and electrical fields are capable of interfering with the proper performance of the device. For this reason make sure that all external devices operated in the vicinity of the monitor comply with the relevant EMC requirements. X-ray equipment or MRI devices are a possible source of interference as they may emit higher levels of electromagnetic radiation. Changes or modifications to this device/system not expressly approved by GE may cause EMC issues with this or other equipment. This device/system is designed and tested to comply with applicable standards and regulations regarding EMC and needs to be installed and put into service according to the EMC information stated as follows: This device/system is suitable for use in all establishments other than domestic and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes. Mains power should be that of a typical commercial or hospital environment. Device is compliant to Class A.

WARNING**ERRONEOUS READINGS.**

The device/system should not be used adjacent to, or stacked with, other equipment. Consult qualified personnel regarding device/system configuration.

WARNING**DEGRADED PERFORMANCE.**

Do not use portable RF communications equipment (including peripherals such as antenna cables and external antennas) closer than 30 cm (12 inches) to any part of this device/system, including cables specified by the manufacturer. Otherwise, the performance of this device/system may degrade.

System warnings

WARNING**EXPLOSION.**

Do not use this system in the presence of flammable anesthetics, vapors or liquids.

WARNING**PATIENT SAFETY.**

If an error message appears during operation, it is the licensed medical practitioner's responsibility to decide whether the device is still suitable for patient monitoring. As a general rule, monitoring should only continue in extremely urgent cases and under the direct supervision of a licensed healthcare practitioner. The device must be repaired before being used again on a patient. If an error message appears after power-up, the device must be repaired before being used on a patient.

WARNING**EQUIPMENT DAMAGE.**

To avoid the risk of modules falling and getting damaged, always ensure that they are securely latched.

WARNING**PATIENT SAFETY.**

If the monitor, module, or frame is dropped, have them checked by qualified service personnel before taking them back into use.

WARNING**PATIENT SAFETY.**

To avoid risks to patient safety, never modify or alter the connectors on product or accessories in any way. Alterations or modifications may affect patient safety, performance, and accuracy.

Site requirement warnings

WARNING

BEFORE INSTALLATION.

Compatibility is critical to safe and effective use of this device. Verify the compatibility of all system components and device interfaces, including hardware and software versions, prior to installation and use.

Interfacing warnings

WARNING

INTERFACING OTHER EQUIPMENT.

Connect only items that are specified as part of the system and as compatible. For more information, see the supplemental information provided.

WARNING

PATIENT SAFETY.

If a ventilator and a gas acquisition module are connected to the same monitor, the monitor issues some respiratory alarms based on the module alarm limits and not those of the ventilator. Make sure that the alarm limits on the module are set to match the patient's ventilation requirements to avoid delayed or suppressed ventilator alarm annunciation at the central station and to ensure timely clinical response to important changes in the patient's condition or the ventilator's status.

WARNING

MISSED ALARMS.

The peripheral device's alarms must not be turned off or the volume reduced in any way to diminish the importance of the peripheral device as the primary alarm source for parameters monitored by the peripheral device.

System caution safety messages

The following caution safety messages apply to this monitoring system.

Indications for use cautions

CAUTION

PRESCRIPTION DEVICE.

U.S. Federal law restricts this device to sale by or on the order of a physician.

CAUTION**SUPERVISED USE.**

This equipment is intended for use under the direct supervision of a licensed healthcare practitioner.

Loss of data

CAUTION**LOSS OF DATA.**

Should the monitor at any time temporarily lose patient data, the potential exists that active monitoring is not being done. Close patient observation or alternate monitoring devices should be used until monitor function is restored. If the monitor does not automatically resume operation within 60 seconds, power cycle the monitor using the On/Off button. Once monitoring is restored, you should verify correct monitoring state and alarm function.

Electrical caution

CAUTION**POWER REQUIREMENTS.**

Before connecting the device to the power line, check that the voltage and frequency ratings of the power line are the same as those indicated on the device's label. If this is not the case, do not connect the system to the power line until you adjust the device to match the power source. In U.S.A., if the installation of this equipment will use 240V rather than 120V, the source must be a center-tapped, 240V, single-phase circuit. This equipment is suitable for connection to public mains as defined in CISPR 11.

EMC cautions

CAUTION**DEGRADED PERFORMANCE.**

Use of known RF sources, such as cell/portable phones, RFID, electronic article surveillance (EAS) systems, diathermy, or other radio frequency (RF) emitting equipment near the system may cause unexpected or adverse operation of this device/system. Consult qualified personnel regarding device/system configuration.

Site requirement cautions

CAUTION

LOSS OF MONITORING.

Leave space for circulation of air to prevent the device from overheating. The manufacturer is not responsible for damage to device caused by improperly vented cabinets, improper or faulty power, or insufficient wall strength to support device mounted on such walls.

Interfacing cautions

CAUTION

INSTALLATION.

Qualified technical personnel must connect the interface adapter to the peripheral device and make any necessary adjustments to the peripheral device (baud rate, parity, etc.) as described in the specific installation instructions for the interface adapter. Insert cabling from the connectivity device only into specified interface adapters and specified peripheral devices. To avoid inadvertent disconnection, route all cables in a way to prevent a stumbling hazard. Wrap and secure excess cabling to reduce risk of entanglement by patients and personnel. Do not install in a location where the device may drop on a person.

CAUTION

IMPROPER OPERATION.

The use of the wrong interface adapter may cause improper operation of the supported peripheral device.

CAUTION

TREATMENT.

Do not treat the patient based solely on the alarm messages and/or numerics presented on monitor. You must verify the accuracy of the alarm message and/or numerics at the peripheral device itself before initiating treatment, treatment should be based on the information presented at the peripheral device.

Disposal cautions

CAUTION

DISPOSAL.

At the end of its service life, the product described in this manual, as well as its accessories, must be disposed of in compliance with the guidelines regulating the disposal of each product. If you have any questions concerning disposal of a product, please contact GE or its representatives.

CAUTION**PACKAGING DISPOSAL.**

Dispose of the packaging material, observing the applicable waste control regulations.

Notice safety messages

The following notice safety message applies to this monitoring system:

NOTICE

The warranty does not cover damages resulting from the use of accessories and consumables from other manufacturers.

ESD safety precautions

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

Indications for use

Indications for use

The patient monitor products are portable multi-parameter patient monitors intended to be used for monitoring, recording, and to generate alarms for multiple physiological parameters of adult, pediatric, and neonatal patients in a hospital environment and during intra-hospital transport.

The patient monitor products are intended for use under the direct supervision of a licensed health care practitioner.

The patient monitor products are not intended for use during MRI.

The patient monitor products can be stand-alone monitors or interfaced to other devices via network.

The patient monitor products monitor and display: ECG (including ST segment, arrhythmia detection, ECG diagnostic analysis and measurement), invasive blood pressure, heart/pulse rate, oscillometric non-invasive blood pressure (systolic, diastolic and mean arterial pressure), functional oxygen saturation (SpO2) and pulse rate via continuous monitoring (including monitoring during conditions of clinical patient motion or low perfusion), temperature with a reusable or disposable electronic thermometer for continual monitoring Esophageal/Nasopharyngeal/Tympanic/Rectal/Bladder/Axillary/Skin/Airway/Room/ Myocardial/Core/Surface temperature, impedance respiration, respiration rate, airway gases (CO₂, O₂, N₂O, anesthetic agents, anesthetic agent identification and

respiratory rate), Cardiac output (C.O.), Entropy and neuromuscular transmission (NMT), Bispectral Index (BIS) and Surgical Pleth Index (SPI).

**NOTE**

Surgical Pleth Index (SPI) is excluded from 510(k) countries and Japan.

SPI indications for use

The Surgical Pleth Index (SPI) is indicated for monitoring the patient's response to surgical stimuli and analgesic medications. SPI is a physiologic parameter derived from hemodynamic information in the photoplethysmographic waveform obtained from a patient's finger using GE SpO₂ modules and sensors.

The SPI is indicated for unconscious and fully anesthetized adults over 18 years of age. The SPI measurement is to be used as an adjunct to other physiological parameters.

The SPI is indicated for use by qualified medical personnel only.

E-COP indications for use

The Cardiac Output module, E-COP and accessories are intended for monitoring cardiac output (C.O.), right ventricular ejection fraction (REF), and invasive blood pressure of hospitalized patients. The device is indicated for use by qualified medical personnel only.

E-sCO₂, E-sCAiO, N-CAiO modules' indications for use

The CARESCAPE Respiratory Modules (E-sCO₂, E-sCAiO) and Airway Gas Option (N-CAiO) are indicated for use with a host device for monitoring respiratory parameters (CO₂, O₂, N₂O, anesthetic agents, anesthetic agent identification, and respiratory rate) of adult, pediatric, and neonatal patients.

When monitoring neonatal or other patients that have high respiration rate or low tidal volume, these modules shall be used within the limits of respiration rates and tidal volumes to ensure specified measurement accuracy.

These modules are intended for use by qualified medical personnel only.

E-miniC indications for use

The Single-Width airway module, E-miniC, and accessories are indicated for monitoring CO₂ and respiration rate of all hospital patients. E-miniC is indicated for monitoring patients weighing more than 5 kg (11 lbs). The device is indicated for use by qualified medical personnel only.

E-Entropy indications for use

The GE Entropy module, E-ENTROPY, and accessories are indicated for adult and pediatric patients older than 2 years within a hospital for monitoring the state of the brain by data acquisition of electroencephalograph (EEG) and frontal electromyograph (FEMG) signals. The spectral entropies, Response Entropy (RE) and State Entropy (SE), are processed EEG and FEMG variables. The Entropy measurement is to be used as an adjunct to other physiological parameters.

In adult patients, Response Entropy (RE) and State Entropy (SE) may be used as an aid in monitoring the effects of certain anesthetic agents, which may help the user titrate anesthetic drugs according to the individual needs of adult patients. Furthermore in adults, the use of Entropy parameters may be associated with a reduction of anesthetic use and faster emergence from anesthesia.

The Entropy module is indicated for use by qualified medical personnel only.

E-NMT indications for use

The NeuroMuscular Transmission Module, E-NMT, is a single width plug-in parameter module for monitoring with accessories neuromuscular transmission (NMT) and determining the correct needle tip position from a local nerve in plexus procedures of hospitalized patients. The device is indicated for use by qualified medical personnel only.

BIS indications for use

The BIS module is intended for use by personnel trained in its proper use. It is intended for use on adult and pediatric patients within a hospital or medical facility providing patient care to monitor the state of the brain by data acquisition of EEG signals. The Bispectral index (BIS), a processed EEG variable, and one component of the BIS module, may be used in adults as an aid in monitoring the effects of certain anesthetic agents. The Bispectral index is a complex technology, intended for use only as an adjunct to clinical judgement and training. In addition, the clinical utility, risk/benefit, and application of BIS have not undergone full evaluation in the pediatric population.

B1X5-F2 frame intended use

B1X5-F2 frame is a two-slot single width frame which is intended for use with patient monitor to support more E-modules to improve parameter acquisition capability.

B1X5-REC recorder intended use

The B1X5-REC recorder is intended for use with patient monitor for data printing.

Clinical benefit

Clinical benefit

- Use of patient monitoring device systems for the acquisition of, transfer, and analysis of patient data benefits the patient in that this method is efficient for medical staff to use.
- Provides real time information on physiological parameters that can be used in assessing the patient's condition and to be used to aid in diagnostic purposes, monitoring the effects if the treatment &/or disease progression.
- Secure and accurate transmission of patient data between patient monitor and clinical information systems.
- Access to assist the physician with clinical decision support for the treatment of patients.
- The physician or nurse has access to monitoring data at bedside that can be displayed in customized layout or logically grouped manner on one screen.

Clinical benefits of the applicable E-modules

E-COP module clinical benefit

The E-COP module enables cardiac output, right ventricular ejection fraction (REF), and invasive blood pressure monitoring during patient care. Cardiac output, right ventricular ejection fraction (REF), and invasive blood pressure measurement data can help the clinical professional evaluate the patient's hemodynamic condition and aid in timely patient care decisions when needed.

Gas measurement modules clinical benefit

Respiratory Clinical Benefits:

- E-sCO₂, E-sCAiO, and N-CAiO modules enable CO₂, O₂, N₂O, anesthetic agent, and respiration rate monitoring during patient care. Oxygenation, anesthetic agent, capnography, and respiration rate monitoring can help the clinical professional evaluate the patient's respiratory condition and aid in timely patient care decisions when needed.

E-miniC modules enable capnography and respiration rate monitoring during a patient case. Capnography and respiration rate monitoring can help the clinical professional evaluate the patient's respiratory condition and aid in timely patient care decisions when needed.

E-Entropy module clinical benefit

The E-ENTROPY module enables electroencephalography (EEG) and frontal electromyography (FEMG) monitoring during patient care. The Response Entropy (RE) and State Entropy (SE) data can help the clinical professional evaluate the patient's neurophysiological condition, which reflects the consciousness level of the patient, and aid in timely patient care decisions when needed.

E-NMT module clinical benefit

The E-NMT module enables monitoring of neuromuscular transmission (NMT) data, which reflects the level of neuromuscular blockade. NMT data can help the clinical professional evaluate the level of relaxation of the patient and aid in timely patient care decisions when needed.

E-BIS module clinical benefit

The E-BIS module enables processed electroencephalography (EEG) monitoring of the brain during patient care. The processed EEG data can help the clinical professional evaluate the patient's neurophysiological status and aid in timely patient care decisions when needed.

B1X5-F2 frame clinical benefit

Support more E-module to improve GE HealthCare monitoring equipment parameter acquisition capability.

B1X5-REC recorder clinical benefit

Enables local printing capability with GE HealthCare monitoring equipment for patient monitoring data review or medical record keeping.

Intended users

The device is intended for use under the direct supervision of a licensed healthcare practitioner.

The device is intended to be serviced by qualified biomedical engineers or other qualified service engineers.

Contraindication

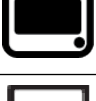
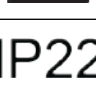
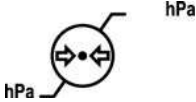
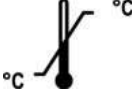
Do not use the device in high electromagnetic fields (for example, during MRI).

Equipment symbols

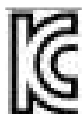
For user interface keys and symbols, please refer to “Monitoring basics” chapter.

	General warning sign.
	Caution. Highlights the fact that there are specific warnings or precautions associated with the device.
	Follow instructions for use.
	Consult operating instructions.
	Consult electronic instruction for use.
	Instructions For Use are supplied in electronic format.
	Electrostatic sensitive device. Connections should not be made to this device unless ESD precautionary procedures are followed.
	Non-ionizing electromagnetic radiation. Interference may occur in the vicinity of this device.
	Type BF (IEC 60601-1) protection against electric shock. Isolated (floating) applied part suitable for intentional external and internal application to the patient, excluding direct cardiac application.
	Type BF (IEC 60601-1) defibrillator-proof protection against electric shock. Isolated (floating) applied part suitable for intentional external and internal application to the patient, excluding direct cardiac application.
	Type CF (IEC 60601-1) protection against electric shock. Isolated (floating) applied part suitable for intentional external and internal application to the patient, including direct cardiac application.

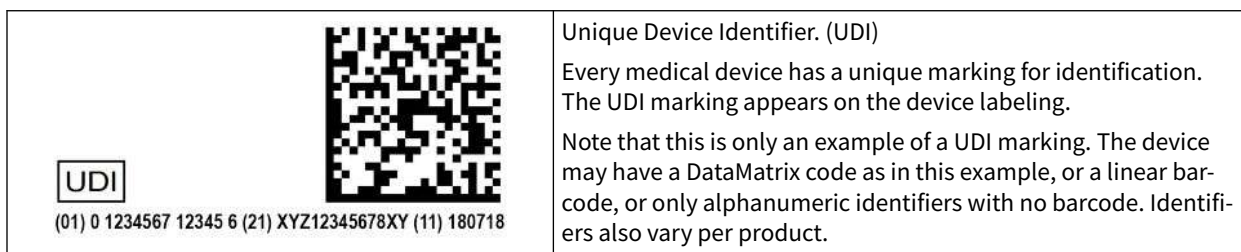
	Type CF (IEC 60601-1) defibrillator-proof protection against electric shock. Isolated (floating) applied part suitable for intentional external and internal application to the patient including direct cardiac application.
	Power On/Off key.
	On the front cover: power indicator. On the back cover: alternating current.
	On the front cover: battery indicator.
	Equipotentiality. Connect device to a potential equalization conductor.
X1	Recorder connector.
X3	B1X5-F2 connector (On B1X5-F2 Frame).
X4	Nurse call connector.
X5	Serial port.
X6	Defibrillator connector.
X7	B1X5-F2 connector (On monitor).
	USB connector.
	Ethernet connector.
HDMI	HDMI connector.
	Audio pause from gesture (On monitor front panel).
	Gesture sensor area: wave hand to gesture sensor area.

	Gas inlet.
	Gas outlet.
	Mini D-fend: Add date.
	Recorder (On B1X5-REC recorder).
	Recorder paper install direction.
	B1X5-F2 communication indicator.
	Fuse. Replace with identical type and rating fuse (On B1X5-F2 Frame).
IP22	Degree of ingress protection (On monitor).
IP21	Degree of ingress protection (On B1X5-F2 Frame).
	Date of manufacture. This symbol indicates the date of manufacture of this device. YY = year, MM = month, DD = day.
	Manufacturer name and address.
	Catalogue or orderable part number.
	Device serial number.
	Every device has a unique marking for identification. The UDI marking appears on the device label.
	Swiss authorized representative.
	Atmospheric pressure limitations.
	Temperature limitations.

	Humidity limitations.
	Keep dry. Protect from rain.
	Fragile. Handle with care.
	This way up.
	This symbol indicates that the waste of electrical and electronic equipment must not be disposed as unsorted municipal waste and must be collected separately. Please, contact an authorized representative of the manufacturer for information concerning the decommissioning of your equipment. The separate collection symbol is affixed to a battery, or its packaging, to advise you that the battery must be recycled or disposed of in accordance with local or country laws. To minimize potential effects on the environment and human health, it is important that all marked batteries that you remove from the product are properly recycled or disposed. For information on how the battery may be safely removed from the device, please consult the service manual or equipment instructions.
	Recycled materials or may be recycled.
	Recyclable Lithium-Ion.
	European authorized representative.
	European Union Declaration of Conformity.
Rx Only U.S.	Prescriptive Device. USA only. For sale by or on the order of a Physician.
	Eurasian Economic Union countries only. Eurasian Conformity mark. Conformity to applicable technical regulations of Customs Union.
	Underwriters Laboratories product certification mark.

ANATEL	Brazil only. Approved under ANATEL (Agência Nacional de Telecomunicações) requirements.																														
CMIIT ID	China only. China Ministry of Industry and Information Technology identification number for Radio Transmission Equipment Type Approval.																														
	Australia and New Zealand only. Regulatory Compliance Mark (RCM). Indicates compliance with electrical safety, EMC, electromagnetic energy, and telecommunications requirements applicable to each product.																														
<table><tr><td>BE</td><td>BG</td><td>CZ</td><td>DK</td><td>DE</td><td>EE</td><td>IE</td><td>EL</td><td>ES</td><td>FR</td></tr><tr><td>HR</td><td>IT</td><td>CY</td><td>LV</td><td>LT</td><td>LU</td><td>HU</td><td>MT</td><td>NL</td><td>AT</td></tr><tr><td>PL</td><td>PT</td><td>RO</td><td>SI</td><td>SK</td><td>FI</td><td>SE</td><td>UK</td><td></td><td></td></tr></table>	BE	BG	CZ	DK	DE	EE	IE	EL	ES	FR	HR	IT	CY	LV	LT	LU	HU	MT	NL	AT	PL	PT	RO	SI	SK	FI	SE	UK			This product is restricted to indoor use, Restricted Member States as below: Belgium (BE), Bulgaria (BG), Czech Republic (CZ), Denmark (DK), Germany (DE), Estonia (EE), Ireland (IE), Greece (EL), Spain (ES), France (FR), Croatia (HR), Italy (IT), Cyprus (CY), Latvia (LV), Lithuania (LT), Luxembourg (LU), Hungary (HU), Malta (MT), Netherlands (NL), Austria (AT), Poland (PL), Portugal (PT), Romania (RO), Slovenia (SI), Slovakia (SK), Finland (FI), Sweden (SE) and United Kingdom (UK).
BE	BG	CZ	DK	DE	EE	IE	EL	ES	FR																						
HR	IT	CY	LV	LT	LU	HU	MT	NL	AT																						
PL	PT	RO	SI	SK	FI	SE	UK																								
	Japan only. Approved under Japan TELEC requirements.																														
	Korea only. Approved under KCC (Korea Communications Commission) requirements. This device has been evaluated to use in a business environment, and there is a risk of radio interference if used in a home environment.																														
	Philippines only. The product comply the NTC (National Telecommunications Commission) requirements.																														
	South Africa only. Approved under ICASA (Independent Communications Authority of South Africa) requirements.																														
	Brazil only. INMETRO certificate.																														
	MR Unsafe. Indicates that the device is not intended for use in an MR environment.																														
	This product is a medical device.																														

Unique Device Identifier (UDI)



The characters used in the UDI marking represent specific identifiers. In the example above:

Device identifier:

- (01) = GS1 global trade item number (GTIN) of the device.
- 01234567123456 = Global trade item number.

Production identifiers:

- (21) = GS1 application identifier for the serial number of the device.
- XYZ12345678XY = Serial number.
- (11) = GS1 application identifier for the manufacturing date of the device.
- 180718 = Manufacturing date: year-month-day (YYMMDD).

Note that for some product types, the production identifier can have other elements instead of the ones listed above:

- (10) = GS1 application identifier for the batch or lot number, followed by the batch or lot number.
- (17) = GS1 application identifier for the expiration date of the device, followed by the expiration date.

Country of origin

Country of origin: refer to the device label.

Serious incident reporting

Any serious incident related to the use of this GE device, should be reported to both the manufacturer and the health authority/competent authority where the device is installed.

To report to GE:

- Either contact your local service representative
- Or report to: ln-box.complaints@ge.com

Please provide the following information:

- The catalogue number or the model designation of the device as stated on its identification plate affixed on the device
- The System ID/serial number/lot number of the device
- Date of incident
- Description of incident, including any patient or user impact/injury

- Your contact information (facility, address, contact name, title, and telephone number)

Training requirements

No product-specific training is required for the use of this device.

Residual risks

There are no specific residual risks for this device. The risk mitigations such as instructions, warnings, and cautions provided within the product manuals have disclosed the risks properly and allow for safe and effective use of the device.

System introduction

System safety precautions

System warnings

WARNING

PATIENT SAFETY.

Never install the equipment above the patient to avoid the risk of any part of the equipment falling on the patient.

WARNING

INACCURATE RESULTS.

Do not use or store the equipment outside the specified temperature, humidity, or altitude ranges, or outside the specified performance range. Using or storing the equipment outside the specified operating environment or outside the specified performance range may cause inaccurate results.

WARNING

PHYSICAL INJURY.

Take care when mounting devices to an IV pole. If a device is mounted too high, the IV pole may become unbalanced and tip over.

WARNING

EXCESSIVE LEAKAGE CURRENT.

A display or printer that is a non-medical grade device and is used within the patient environment, must always be powered from an additional transformer providing at least basic isolation (isolating or separating transformer). Using without an isolating transformer could result in unacceptable enclosure leakage currents.

WARNING**EXCESSIVE LEAKAGE CURRENT.**

Laser printers are UL 60950/IEC 60950/IEC 62368-1 certified equipment, which may not meet the leakage current requirements of patient care equipment. This equipment must not be located in the patient environment unless the medical system standard IEC 60601-1 clause 16 is followed. Do not connect a laser printer to a multiple socket outlet supplying patient care equipment. The use of multiple socket outlet for a system will result in an enclosure leakage current equal to the sum of all the individual earth leakage currents of the system if there is an interruption of the multiple socket outlet protective earth conductor. Consult your local service representative before installing a laser printer.

WARNING**ELECTRIC SHOCK.**

Do not touch the electrical connector located within the module housing or frame to avoid the risk of electric shock.

WARNING**ELECTRIC SHOCK.**

Always unplug the grounded data cables when not in use. Leaving them connected could result in an electric shock from the ground contact in the other end.

WARNING**EXPLOSION OR FIRE.**

Using non-recommended batteries could result in injury/burns to the patients or users. Only use batteries recommended or manufactured by GE. The warranty can be voided if non-recommended batteries are used.

WARNING**EXPLOSION HAZARD.**

Do not incinerate a battery or store at high temperatures. Serious injury or death could result.

WARNING**MISSED ALARMS.**

Do not connect a single-color display to the monitor. Visual alarm indicators may not appear properly.

WARNING**EQUIPMENT DAMAGE.**

To prevent liquids from entering the monitor, do not tilt the monitor.

WARNING**MISSED ALARMS.**

Secondary displays will not sound the audible alarms. Keep the patient under close surveillance.

System caution

CAUTION**RF EXPOSURE.**

To comply with the FCC RF exposure requirements, the monitor with the wireless network (WLAN) option must be operated with a separation distance of 20 cm or more from a person's body.

Short description of the equipment

The device is modular multi-parameter patient monitor intended for use in multiple hospital environment and intra-hospital transport within a professional healthcare facility.

There are several types of acquisition modules to choose from based on care requirements and patient needs. Measurement values are displayed as graphic or numeric values, like waveforms and numbers, and when applicable, also as alarm messages.

The user interface is used with a touchscreen. The most important and commonly used functions have soft keys on the main menu. The menu structure design allows access to all functions needed by the clinical user with just a few taps.

The monitor can transfer the measurement data to central stations and to the hospital EMR. It communicates with a variety of other bedside medical devices and monitoring systems.

For all physical and performance specifications, refer to the supplemental information provided.

Product models

The following table shows features for different product models:

√: support

O: optional

Feature	B105M-OR	B125M-OR	B155M-OR
Host			
3/5-lead ECG	√	√	√
12-lead ECG	O	O	O
Impedance respiration	√	√	√
GE SpO₂	√	√	√
Masimo SpO₂	O	O	O
Nellcor SpO₂	O	O	O
NIBP	√	√	√

Feature	B105M-OR	B125M-OR	B155M-OR
Integrated IBP	√	√	√
Temperature	√	√	√
Wi-Fi ^{*1}	O	O	O
Integrated RACK	√	√	√
B1X5-REC Connector	√	√	√
B1X5-F2 Connector	√	√	√
Defibrillator Connector	√	√	√
Nurse Call Connector	√	√	√
RS232 Connector	√	√	√
Mounting Plate	√	√	√
Basic Battery	O	O	O
High Capacity Battery	O	O	O
Gesture Sensor		√	√
Back Cover Alarm Light		√	√
E-Module			
E-miniC	O	O	O
E-sC(Ai)O	O	O	O
N-CAiO	O	O	O
E-Entropy	O	O	O
E-BIS	O	O	O
E-COP	O	O	O
E-NMT	O	O	O
Software Function			
SPI	O	O	O
AM Connection	O	O	O
Full Disclosure	O	O	O
Bed-to-Bed View and AVOA	O	O	O
Full Arrhythmia	O	O	O
SPV and PPV	O	O	O
EWS	O	O	O
OxyCRG	O	O	O
Unity	O	O	O
HL7	O	O	O
Remote Service	O	O	O
Customized Notification	O	O	O
N-CAiO Support	√	√	√
E-Entropy Support	√	√	√

Feature	B105M-OR	B125M-OR	B155M-OR
E-BIS Support	√	√	√
E-COP Support	√	√	√
E-NMT Support	√	√	√
*1 Wi-Fi is not available in Europe.			

System components

All components listed below can be used within the patient environment as long as an additional transformer providing at least basic isolation is used with non-medical grade secondary displays and printers.

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



NOTE

It is not recommended the system be connected to other non-isolated monitoring equipment or communication networks. In this event it is the end user's responsibility to ensure compliance with IEC60601-1 or other IEC standards.



1.	B105M-OR	4.	Acquisition modules
2.	B125M-OR	5.	B1X5-F2 Frame
3.	B155M-OR	6.	B1X5-REC Recorder

Front view



1.	Gesture detection area	4.	On/Off key
2.	Alarm light	5.	Power LED
3.	Ambient brightness detection area	6.	Battery LED

Left side view



1.	Transportation handle	5.	SpO ₂ connector
2.	Parameter acquisition module	6.	ECG and impedance respiration connector
3.	IBP connector	7.	NIBP connector
4.	Temperature connector		

Right side view



1.	USB connector	5.	Guide rail for recorder
2.	HDMI connector	6.	Battery compartment
3.	Ethernet connector	7.	Mounting plate
4.	X1 recorder connector		

Back view



1.	Receptacle for power cord	5.	X6 Defibrillator connector
2.	Equipotential connector	6.	2 USB connectors
3.	X4 Nurse call connector	7.	X7 B1X5-F2 Frame connector
4.	X5 Serial port	8.	Back cover alarm light

Acquisition modules

You can use different types of acquisition modules with the monitor. They provide connection to the patient, process patient data signals, and send patient data signals to the monitor.

Module compatibility limitations

For detailed information regarding module compatibility, see the supplemental information provided.

Identical acquisition modules

WARNING

PATIENT SAFETY.

Do not use identical acquisition modules or modules that map a measurement to the same channel or parameter window. If such modules have been connected, remove both modules and reconnect the new module after five seconds. In some cases, using identical modules may lead to misinterpretations and therefore compromise the patient safety.

The following modules are considered identical and should not be used simultaneously in the same monitoring system.

Module	Simultaneous use
E-sCAiO E-sCO N-CAiO E-miniC	Only one per system.
E-COP	Only one per system.
E-ENTROPY	Only one per system.
E-NMT	Only one per system.
E-BIS	Only one per system.

E-COP module



1.	Module's key
2.	IBP connector
3.	C.O. connector

E-miniC module



1.	Water trap
2.	Sample gas inlet
3.	Gas outlet

E-sCAiO, E-sCO and N-CAiO module



E-sCAiO

E-sCO

N-CAiO

1.	Water trap release/locking latch
2.	Gas sampling line connector (sampling gas in)
3.	Water trap container
4.	Gas exhaust line connector (sampling gas out)

E-Entropy module



1.	Module's key
2.	Entropy connector

E-NMT module



1.	Module's key
2.	NMT connector

E-BIS module



1.	Module's key
2.	BIS connector

B1X5-F2 Frame

The B1X5-F2 Frame provide an interface between the monitor and E-modules. The frame allow additional parameters to be monitored.

The B1X5-F2 Frame has 2 module slots that support E-module acquisition modules.



1.	Communication indicator	4.	Power connector
2.	Power indicator	5.	Equipotential connector
3.	X3 (15-pin connector): connect to monitor		
6.	Guide rail for GCX mounting		

B1X5-REC recorder



1.	Recorder door	4.	Symbol indicates the paper install direction
2.	Tab for removing recorder	5.	9-pin connector: connect to monitor
3.	Power on indicator: Illuminates when connected to power		

Monitor battery

The device is designed to operate on battery power when used in transport or whenever AC power is interrupted. The lithium-ion battery is a rechargeable battery containing lithium-ion cells.

For information regarding the operation and charging time of the batteries, see the supplemental information manual.

The LED indicators on the monitor's front panel indicate whether the monitor is being used on battery or mains power, and also whether the battery is charging, full or missing:

Front panel indicator	Meaning
 Power LED	Monitor is operating on mains power.
 Battery LED	Green lit. Monitor is operating on battery power.
	Orange flashing. Battery failure.
	Orange lit. Battery is charging. The indicator goes off when the battery is fully charged.

Checking the battery charge with monitor software

You can check the monitor battery status using the monitor software:

1. Select the  >  **Battery**.
2. Check the battery status that appears.



NOTE

You can check the **Maximum Capacity** and current **Capacity Percent** in this menu. When the battery charge completes, the **Capacity Percent** may not reach to 100%.

Monitor battery charge symbols on screen

You can check the battery charge level from the monitor battery symbol on the right upper corner of the display.

Screen symbol	Meaning
	Monitor battery is full.
	Monitor battery is less than 87.5% capacity.
	Monitor battery is less than 62.5% capacity.
	Monitor battery is less than 37.5% capacity.
	Monitor battery is empty when there is less than 12.5% capacity.
	Monitory battery failure or missing battery.
	Monitor battery is charging. There is a white bar inside the symbol.

Other devices

Other devices	Description
	External display The monitor has the HDMI port for the commercial display, which resolution should be 1280*800 or 1366*768.

Other devices	Description
	USB storage device (file system: FAT32) To save and load the logs, settings, trends, patient data in PDF format. NOTE  Don't insert multiple USB storage devices, the system only support one USB storage device.
	Barcode reader Barcode reader is used to scan patient information by scanning the barcode when you admit a patient for care. Barcode reader is pre-configured. Do not change its configurations, or it cannot function properly for the monitor.
	Network laser printer You need to connect the device and printer to the same network.

Central station

The device can have communication with CARESCAPE MC network and allow the transmission of patient data to the optional CARESCAPE Central Station. For operation instructions, see CARESCAPE Central Station User's Manual.

Peripheral device

The device can be connected to the anesthesia machine. The parameter waveform and data of the anesthesia machine can be intensively displayed on the monitor. And this device can load these data to CARESCAPE MC Network or HL7 Network.

InSite RSvP

InSite RSvP provides a set of software applications to manage, diagnose, and track system at customer sites by using the Internet for secure communications between the customers' and GE's firewalls. InSite RSvP consists of Enterprise Server, which resides at GE's support center, and Remote Service Agent that resides on a system at the customer site (or on a PC controlling the system(s) at the customer site).

Monitoring basics

Operation safety precautions

Operation warnings

WARNING

PATIENT SAFETY.

After transferring or reinstalling the device, always check that it is properly connected and all parts are securely attached. Otherwise, there may be a risk of something falling on the patient and causing injury.

WARNING

EQUIPMENT DAMAGE.

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

WARNING

ACCURACY.

If the accuracy of any value displayed on the monitor, central station, or printed on a graph strip is questionable, determine the patient's vital signs by alternative means. Verify that all equipment is working correctly.

WARNING

PATIENT SAFETY.

If you accidentally drop any of the system parts, have them checked by qualified service personnel prior to clinical use. Using damaged equipment may lead to risks of erroneous readings, missed alarms, or misinterpretation of monitoring data, and therefore result in compromised patient safety.

WARNING

PATIENT SAFETY.

Do not use the monitor without manufacturer approved mounting attached. Otherwise, there may be a risk of the monitor falling on the patient and causing injury, or falling on the floor and getting damaged.

WARNING**INACCURATE RESULTS.**

After transport or storage of the device outside the specified operating temperature range, always allow the device to stabilize back to operating temperature range before applying power to it. Using the device outside the specified operating environment may result in inaccurate results.

Monitor installation points to note

- To avoid electrostatic charges building up, it is recommended to store, maintain and use the equipment at a relative humidity of 30% or greater. Floors should be covered by ESD-dissipative carpets or similar ESC-dissipative products. Non-synthetic clothing should be used when working with the component.
- Choose a location that affords an unobstructed view of the display and easy access to the operating controls, including power cord, connectors at the monitor or remotely via View on Alarm or remote devices like central stations. Position the equipment so that access to disconnection via appliance coupler or mains plug is easy and unobstructed.
- Set up the monitor in a location that affords sufficient ventilation. The ventilation openings of the device must not be obstructed (by equipment, walls, or blankets, for example).
- The environmental operating conditions specified in the technical specifications must be ensured at all times.
- The system is designed to comply with the requirements of IEC 60601-1.
- Using the power cord supplied with the device, connect it to the power line. Use only the original cord.
- For measurements in or near the heart, we recommend connecting the system to the potential equalization system (IEC 60601-1) to ensure equal potential levels between the devices in the system. Use the green and yellow potential equalization cable and connect it to the pin labeled with the equipotential symbol: .
- For instructions regarding unpacking and how to proceed if the packaging has been damaged, unintentionally opened, or exposed to environmental conditions outside those specified, see the service manuals.

Connecting and removing parts

Connecting B1X5-F2 module

1. Using the F2 connector line, connect **X3** and **X7**.
2. Using power cord connect B1X5-F2 to the wall outlet.
3. Check whether power LED lit .
4. Turn on the monitor, check whether communication LED lit .



Connecting E-module

To use the E-module, your device need to be pre-configured with the integrated rack or connect the B1X5-F2 frame.

1. With the module properly oriented (module release latch facing down), align the insertion guide slot in the module with the insertion guide in the rack or frame.
2. Push the module into the rack or frame until it clicks.

Removing E-module

1. Press the release latch at the bottom of the module.
2. While pressing the release latch, grasp the module firmly and pull out.



NOTE

It is recommended to insert the E-Blank module after removing E-module, to avoid dust and liquid into rack or B1X5-F2 frame.



From rack



From B1X5-F2 Frame

Connecting the B1X5-REC recorder

Please make sure the monitor is pre-configured with recorder fixing plate.

1. Using the recorder connector line, connect the recorder connector to **X1**.
2. When the monitor is power on, make sure the power indicator on recorder is lit.



Inserting the B1X5-REC recorder

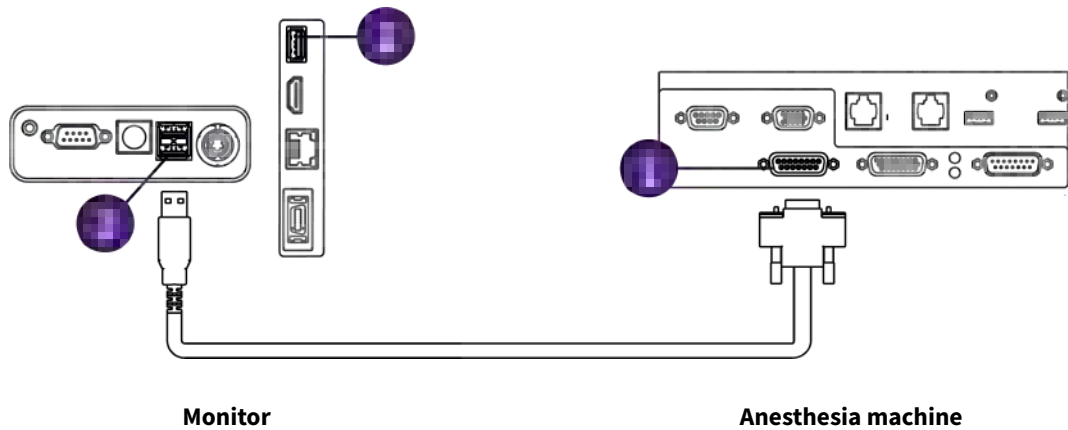
- 1. Align the recorder to the insertion guides.
- 2. Push down the recorder until it clicks.

Removing the recorder

- 1. Pull the recorder outwards by the tab. Make sure not to drop it when it comes out.



Connecting the anesthesia machine



1.	15-pin serial port on the Anesthesia machine.
2.	USB connector on the monitor.

1. Use a anesthesia connection cable (PN: 5890224), connect to the 15-pin serial port of anesthesia machine.
2. Connect the converter cable to one of the USB connectors on the monitor.

The default connector is USB3 connector (at the bottom).



If you not connect to this port, please configure the connector selection through  > 
Service(password protected) > **Service** tab > **Page 3** vertical tab > **S5/Anesthesia**.

For more information, see the technical manual.

Connecting to the mains power

1. Connect power cords to a wall outlet and to the mains power supply inlet on all system components that require AC mains power input.
2. Secure all power cords by routing through the retaining clips, as applicable.



NOTE

Before taking the monitor into use for the first time, the battery should be fully charged. Keep the monitor connected to the mains until the battery charge symbol disappears.

User interface keys

Various functions of the monitor can be accessed through the monitor's soft keys on screen.

	Home • Close all menus displayed on the monitor and back to the normal screen.
	Trends Open Trends menu to: • View, setup and print trends • View and print snapshot • View and print alarm history • View and setup full disclosure
	Layout Switch • Open menu to switch layout.
	Take Snapshot • Take up snapshot, which is a set of measured data for this moment.
	Print (Soft key field, All ECG Waveforms menu) • Start to print waveforms.
	Stop Print • Stop printing waveforms or trends.

	IBP Zero Zero all invasive pressure channels. This does not apply to ICP.
	Manual NIBP Start or stop a manual NIBP measurement.
	Standby Enter standby mode.
	Audio Pause Audio pause active alarms.
	More Display more quick access soft keys.
	Lock Lock the touch screen.
	Alarm Reset Reset active alarms.
	Admit / Discharge Open Admit/Discharge menu, you can : - Enter/load patient information, to admit a patient. - Discharge a patient - Select a mode
	Other Patients Open Other Patients menu to: - View other monitored patients - Setup receive alarms from remote.
	EWS Open National Early Warning Score 2 menu to: - Calculate and view EWS - View EWS history - View EWS risk - View EWS guidance, (NEWS2 only)
	Customized Notifications Open Customized Notifications menu to: - View instance and related trends - Setup customized groups
	OxyCRG Open OxyCRG menu to: - View realtime OxyCRG - View OxyCRG Snapshot - Setup OxyCRG

	Alarm Setup Open Alarms Setup menu to: • Use default limits or Auto limits • Adjust alarm volume • Audio off alarms or activate alarms • Setup alarm priorities • Setup alarm light
	Parameter Setup Open Parameter Setup menu to: • Enter each parameter's menu for settings
	Export Patient Data • Open Export Patient Data menu to export patient data to USB disk in PDF format.
	Night Mode • Open Night Mode menu to setup and enter night mode.
	Sound Volumes • Open Sound Volumes menu to adjust auditory information signals.
	Screen Brightness • Adjust monitor screen brightness.
	Screen Setup Open Screen Layout Setup menu to: • Setup the screen layout
	Printing Setup Open Printing Setup menu to: • Setup and print waveforms • Setup the print devices
	Service • Open Install/Service menu to setup clinical and service settings.
	E-Manual • Open the E-Manual menu to review the product's documentations.
	Battery • Open Battery Information menu to display battery status.
	Monitor Info • Open Monitor Information menu to display the version information and network status.
	Trends Switch (in Trends menu) • Shift between graphic trends and numeric trends.

	Trends Print (in Trends menu, Trends, Snapshot, Alarm History tabs) - Start to print numeric and graphic trends. - Start to print snapshot - Start to print alarm history
	Trends Setup (in Trends menu) Enter numeric trends, graphic trends or full disclosure setup menu.
	Goto a Snapshot for specific alarm (in Alarm History menu) Goto the snapshot for one alarm history.
	Goto a Full Disclosure for specific alarm (in Alarm History menu) Goto the Full Disclosure for one alarm history.
	Goto a Full Disclosure for specific time (in Full Disclosure menu) Goto the Full Disclosure for specific time.
	Refresh the EWS (in EWS menu) Refresh parameter values enter and calculation.
	Next patient view (in bed to bed view) Goto next patient view in bed to bed field.
	Audio Pause (in bed to bed view) Audio pause the remote alarms.
	Show/hide bookmark (in E-manual view) Show or hide the bookmark of the current manual
	Collapse bookmark (in E-manual view) Collapse the bookmark of the current manual
	Expand bookmark (in E-manual view) Expand the bookmark of the current manual
	Delete (in Customized Notification menu) Delete the selected notification group or selected group condition
	Edit (in Customized Notification menu) Edit the selected notification group name
	Add (in Customized Notification menu) Add a notification group or add a group condition
	Zoom in (in Notification instance menu) Adjust the trends scale
	Zoom out (in Notification instance menu) Adjust the trends scale

User interface symbols

The following symbols appear in the software user interface.	
	Alarm off indicator - Displays in the upper right corner of the digit field when physiological alarms for this parameter are turned off. The symbol may not display at the central station.
	Audio alarms off indicator - Displays in the upper left corner of the message field when physiological audible alarms are turned off.
	Alarm pause indicator - Displays in the upper left corner of the message field and indicates that alarms are audio paused.
	Alarms audio pause indicator. Displays in the upper left corner of each alarm message and indicates that alarm audio pause has been activated.
	Low-level alarms audio off indicator - Displays in the upper left corner of the message field and beside the low-level alarm volume option. It indicates that the low-level alarm volume has been set to 0.
	General warning sign. Displays in the alarm priorities setup menu, indicate the priority setting deviates from the recommendation of international alarm safety standards.
	General information sign. Displays in the upper left corner of the message field, when the priority setting deviates from the recommendation of international alarm safety standards.
	Default alarm limits indicator - Displays in the alarm setup menu.
	Auto alarm limits indicator - Displays in the alarm setup menu.
	Alarm limits changed indicator - Displays in the alarm setup menu.
	Unread notification instances indicator - Displays in the notification bar.
	Alarm volume indicator - Displays beside the alarm volume setup option.
	Displays in the remote alarm message. Indicate that more remote alarms existing in other remote beds. To check more remote alarms:  >  Other Patients , and select the unit and Show to Notification Patients Only .

The following symbols appear in the software user interface.	
	Unity network is connected.
	Network (WLAN) signal strength. The number of green segments corresponds to the signal strength: four segments indicate strong signal, one segment weak signal.
	Network (WLAN) is failed.
	Remote service is enabled, but Field Force Automation (FFA) is not connected.
	Remote service is enabled, and FFA is connected.
	Monitor battery is full.
	Monitor battery is less than 87.5% capacity.
	Monitor battery is less than 62.5% capacity.
	Monitor battery is less than 37.5% capacity.
	Monitor battery is empty when there is less than 12.5% capacity.
	Monitor battery failure or missing battery.
	Monitor battery is charging.
	Night mode indicator. Indicates the monitor is on the night mode.
	Snapshot indicator. Indicates the event has an associated snapshot.
	Beat volume icon. Adjust the volume of the QRS beep tone. Also the beat source indicator. Displays next to the selected beat source.
	Respiration indicator. Indicates a breath is detected by the impedance respiration algorithm.
	Lock indicator. Indicates the screen has been locked.
	Unlock indicator. Swipe down to unlock the screen.

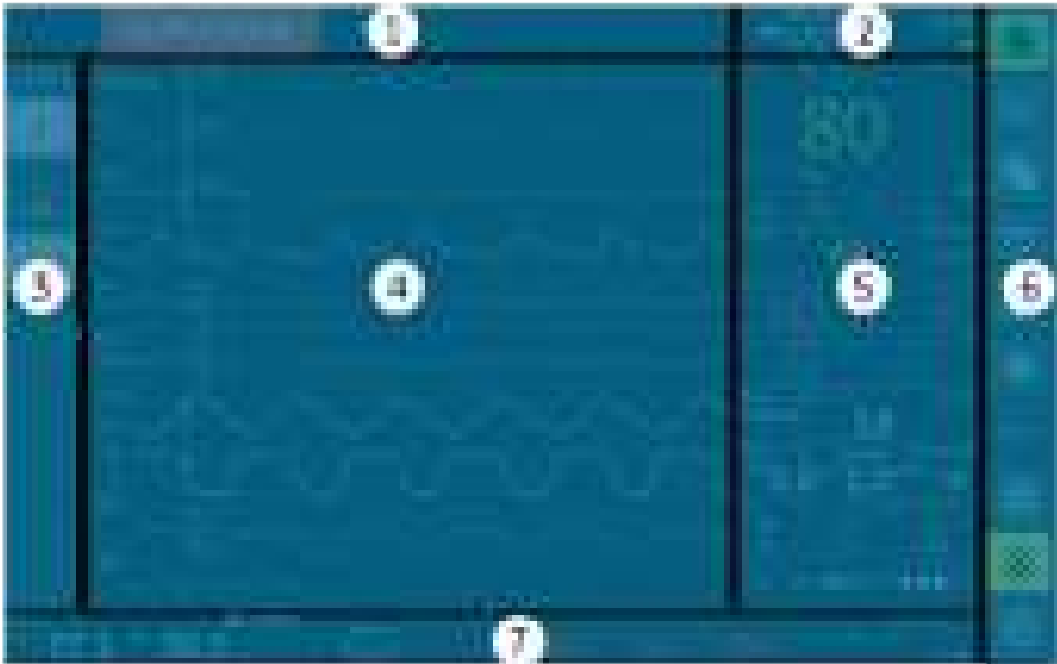
The following symbols appear in the software user interface.	
	Masimo SpO ₂ only. SpO ₂ signal strength indicator. Indicates the signal strength, with three asterisks indicating the strongest signal.
	NIBP progress bar. Indicates the amount of time remaining until the next automatic measurement.
	NMT progress bar. Indicates the amount of time remaining until the next automatic measurement.
	Patient discharge indicator.
	Indicates patient has been admitted.
	Indicates no patient admitted.

Main screen layout

The main screen displays alarms, information, trends, waveforms, digits, and the main menu in pre-defined areas.

When the information area of the screen is selected, it opens the **Admit/Discharge** menu and provides access to settings related to patient and administrative information, mode selections, unit and bed setup.

Waveform layout



1.	Message field	Select the alarms in message field, can view the Quick Help about possible causes and suggested actions for current alarms.
2.	Information area	Select this area, can enter Admit/Discharge menu.
3.	Notifications bar	Select instance, can review the trends around the instance happened. The notification bar also can be hidden or unhidden by left and right swiping the bar on screen.
4.	Waveform field	Displays up to 12 waveforms. Select a waveform can open a quick pop-up menu of this parameter.
5.	Upper digit field	Displays parameter digits correspond with waveforms. Select a digit field can open the setup menu of this parameter
6.	Soft key field	Select soft key can trigger related functions.
7.	Lower digit field	Displays up to 4 parameter digits. Select a digit field can open the setup menu of this parameter



NOTE

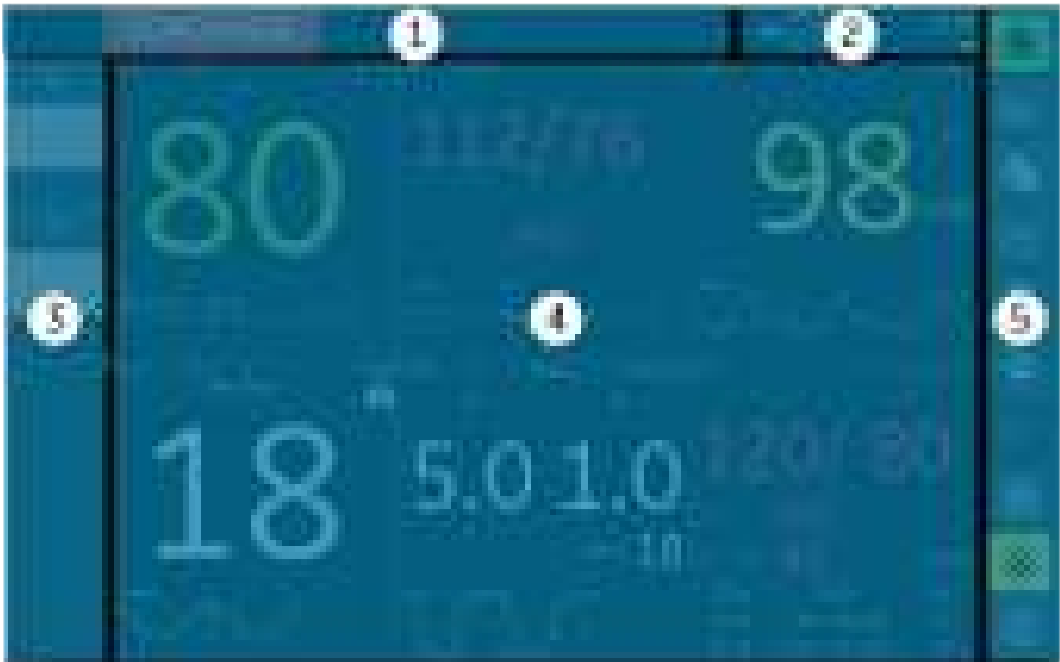
The monitor displays up to 11 waveforms and 4 lower digit fields at a time, or displays up to 12 waveforms.

The information area of the screen displays the following information, selecting this area can enter the **Admit/Discharge** menu:

- Patient name (if entered).
- Bed name and care unit.
- Mode name
- Current time.

- Battery status icon
- WLAN signal symbol (if connected to the wireless network).
- Network symbol (if connected to the MC Network).
- Night mode symbol (if enter to night mode).

Large number layout



1.	Message field	Select the alarms in message field, can view the Quick Help about possible causes and suggested actions for current alarms.
2.	Information area	Select this area, can enter Admit/Discharge menu.
3.	Notifications bar	Select instance, can review the trends around the instance happened. The notification bar also can be hidden or unhidden by left and right swiping the bar on screen.
4.	Large number field*	Displays up to 6 large number parameters with 1 waveform of this parameter (except the parameters, which not have waveform, such as NIBP). Select a digit field can open the setup menu of this parameter. Select a waveform can open a quick pop-up menu of this parameter.
5.	Soft key field	Select soft key can trigger related functions.

*The large number layout have 2 options, display 4 parameters, or 6 parameters.

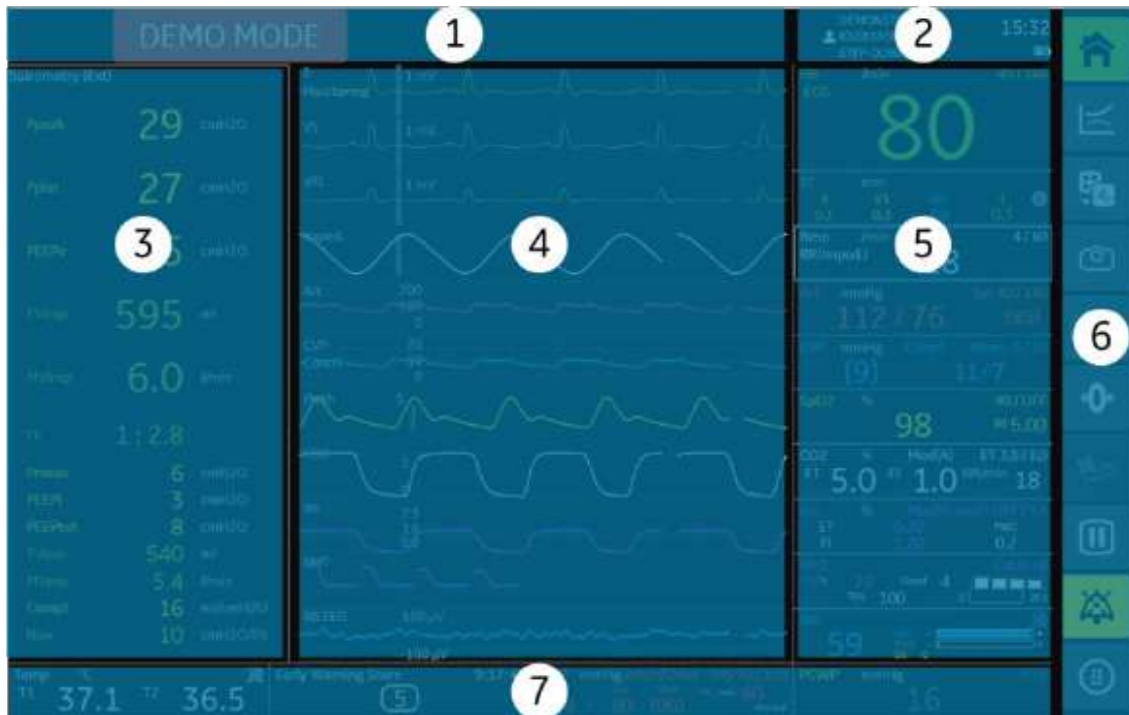
Split screen and bed to bed view layout

Split screen and bed to bed view area is on the left side of the screen.

**NOTE**

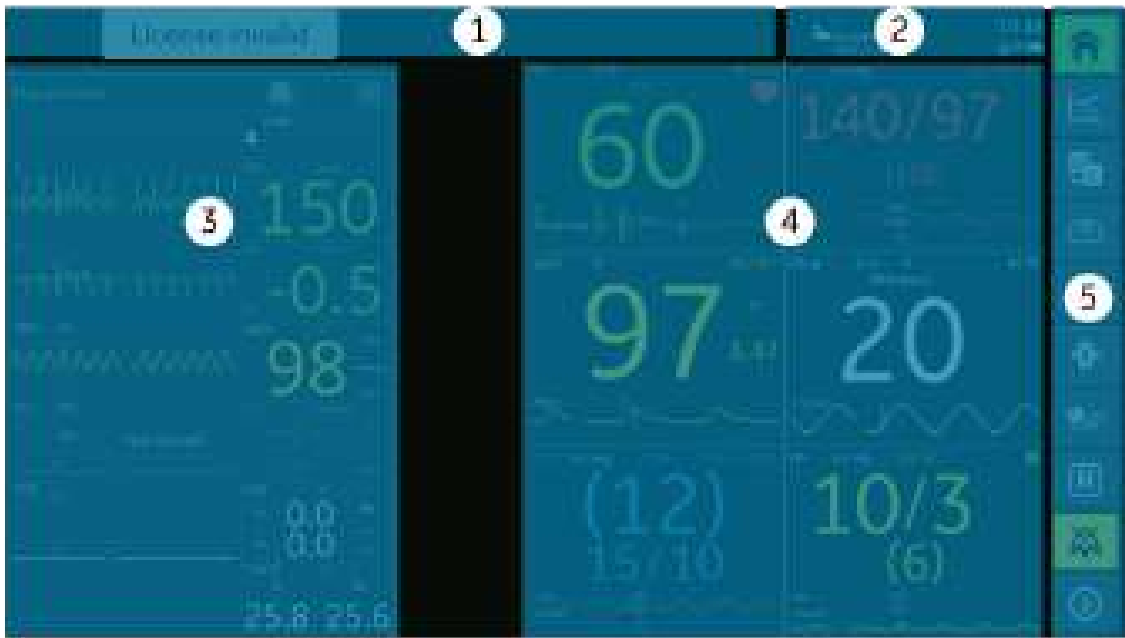
The bed to bed view area, split screen, and notification bar cannot appear simultaneously.

- Bed to bed view is the first priority, when it open, split screen and notification bar can't display.
- For split screen and notification bar, when open one of them, another will be replaced.



1.	Message field	Select the alarms in message field, can view the Quick Help about possible causes and suggested actions for current alarms.
2.	Information area	Select this area, can enter Admit/Discharge menu.
3.	Split screen and bed to bed view area	Displays split screen or bed to bed view.
4.	Waveform field	Displays up to 12 waveforms. Select a waveform can open a quick pop-up menu of this parameter.
5.	Upper digit field	Displays parameter digits correspond with waveforms. Select a digit field can open the setup menu of this parameter
6.	Soft key field	Select soft key can trigger related functions.
7.	Lower digit field	Displays up to 4 parameter digits. Select a digit field can open the setup menu of this parameter

Or:



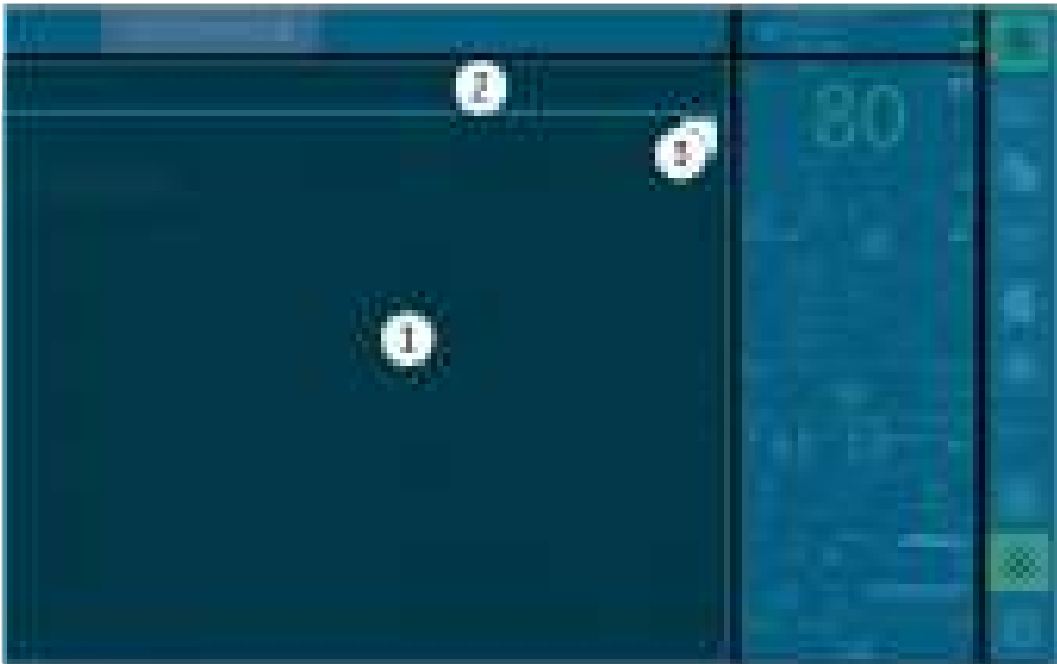
1.	Message field	Select the alarms in message field, can view the Quick Help about possible causes and suggested actions for current alarms.
2.	Information area	Select this area, can enter Admit/Discharge menu.
3.	Bed to bed view area	Displays bed to bed view.  NOTE Split screen can't display with large number layout together.
4.	Large number field*	Displays up to 6 large number parameters with 1 waveform of this parameter (except the parameters, which not have waveform, such as NIBP). Select a digit field can open the setup menu of this parameter. Select a waveform can open a quick pop-up menu of this parameter.
5.	Soft key field	Select soft key can trigger related functions.

*The large number layout have 2 options, display 4 parameters, or 6 parameters.

Menu layout

Normal menu layout

When you open the normal menu, ECG 1 waveform and upper digit filed still can be shown on the screen. If main screen is large number layout, the parameters configured in large number field will be shown on the upper digit field. If main screen is waveform layout, the parameters configured in upper digit field and the right most lower digit field will be shown on the upper digit field.



1.	Normal menu
2.	ECG 1 Waveform
3.	Exit key: select to close current menu.

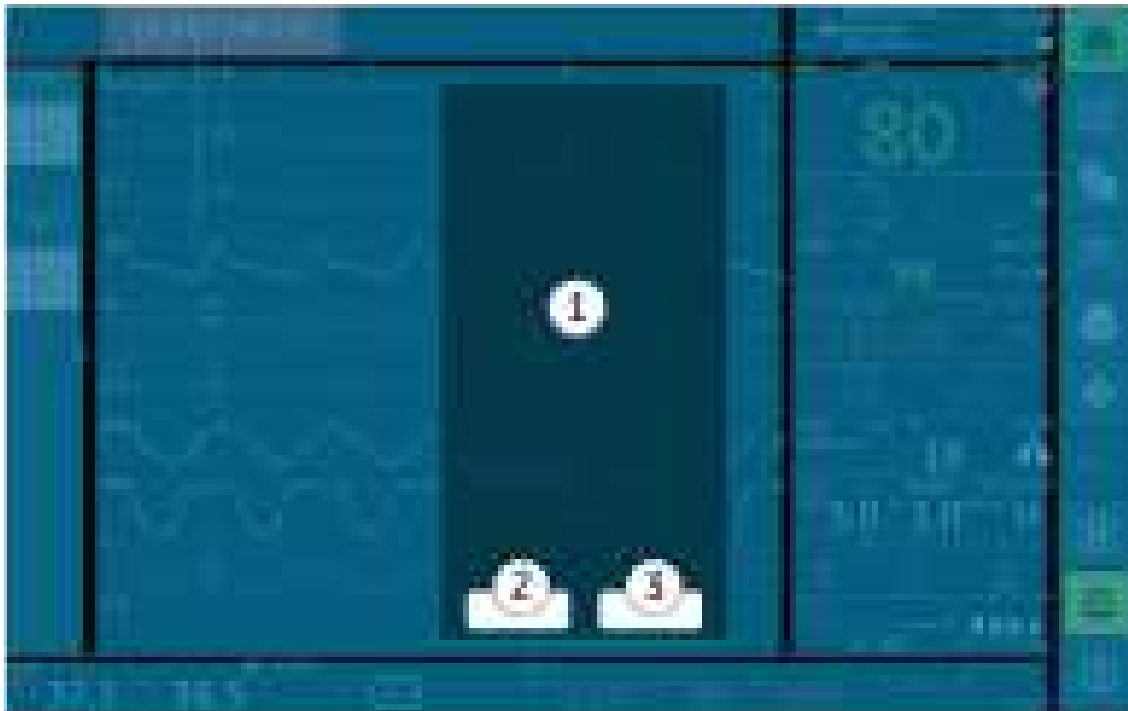


NOTE

Other areas on screen are still active. If you select, still can access to related functions.

Quick pop-up menu layout

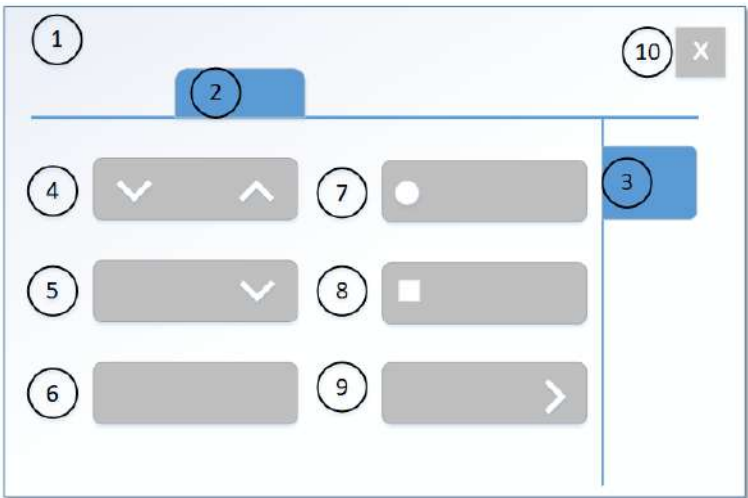
When you select a waveform, will open a quick pop-up menu of this parameter, help you to adjust parameter settings conveniently.



1.	Quick pop-up menu: displays frequently used parameter settings.
2.	More... : open the full parameter setup menu.
3.	Close : close the quick pop-up menu.

An example of a menu

The following is an example of a menu illustrating some of the components and how they are referred to in this manual:



1.	Menu title (for example, ECG)
2.	Horizontal tab (for example, Alarms)
3.	Vertical tab (for example, HR, Lethal, Ventri cular)
4.	Arrow selector spinner for increasing/decreasing a value
5.	Selection lists: when selecting the arrow, a list of options appears
6.	Button for initiating a actionable function
7.	Radio button for selecting or deselecting a feature from the available options
8.	Check box for selecting or deselecting a feature
9.	Further menu selections
10.	Exit key (for example, Close, Previous Menu)

NOTE
Not all menus have these same components.

Menu options

- To reach the system settings, select the soft key to open the related menu.
- To reach the parameter settings, three ways as follow:
- Select the digit field to open each parameter’s setup menu.
 - Select the waveform field to open the related shortcut menu. The parameter’s quick popup menu will display.
- For more settings, you can select **More...** to open the related parameter’s setup menu.
- Select  >  **Parameter Setup** to open the all parameter’s setup menu.

Selecting menu options with a touchscreen

NOTE

Do not use pencils, pens, or other sharp objects to activate the touchscreen. The touchscreen will not function properly if tape, paper, or liquid is stuck to the display surface.

1. Touch the menu option with your finger.
2. The highlight on screen moves to this option.
3. Lift your finger off the screen, and the selected function is performed (e.g., a list opens).

Entering data

When data entry is required, the monitor automatically displays an on-screen keyboard for you to use.

1. Select the desired data field.
2. Enter data:
 - Select the characters with the touchscreen.

Locking the screen

You can set the touchscreen feature off when you need to clean the screen.

1. Select  >  **Lock**.
2. To unlock the screen:
 - Swipe down the  scroll bar on the right column of the screen.

Turning the monitor on/off

The monitor is preset at the factory for a specific AC voltage. Before applying power, be sure that the power requirements match your power supply. Refer to the label on the device for voltage and current requirements.

1. Ensure all cables are properly connected.
2. Turn on the power:

Press the **On/Off** button (more than 3 seconds) located on the keypad.

The welcome screen will appear with a status bar indicating the progress of the startup procedure.

3. Turn off the power:

Press the **On/Off** button (more than 3 seconds).

The message “**Monitor is shutting down...**” will appear on the screen.

Automatically turn off the monitor

When the monitor is not connected to the mains AC power, and the battery remaining time is less than 3 minutes, the monitor will automatically turn off.

Before turning off the monitor:

- Stop NIBP, C.O., PCWP, NMT measurement.
- Stop the printing activity.
- Return main menu to home.

Password management

Setup password at first time to use

When first time turn on the monitor, the password setup wizard will be displayed on the screen. You need to setup all the monitor's passwords.

There are 2 ways to setup password: from USB disk to import setting file, or setup manually.

Import settings from USB at first time to use

The setting file can be exported from other monitor, refer to [Exporting settings on page 90](#).

1. Select **Settings Activation from USB Disk** tab.
2. Select the related setting file from **Setting Files** list.
3. Enter the decryption **Key for the File**.
4. Select **Activate & Restart**.

The monitor's settings and password have been setup, and the monitor will restart.

Setup password manually

1. Select **Set Password Manually** tab.
2. Enter and retype the passwords for **Clinical** and **Service**.
The passwords are case sensitive. 8 digits at least.
3. If necessary, select the checkbox, and select the value for **Password expired duration(month)**.
You have to change passwords after the month you selected.
4. If necessary, export password recovery key:

The recovery key is used to reset password when you forget.



NOTE

Make sure the file system format for USB storage device should be FAT32.

- 4.1. Insert USB disk to monitor.
- 4.2. Select the checkbox **Export Password Recovery Key to USB Disk**

5. Select **Activate & Restart**.

The password have been setup, and the monitor will restart.

Changing passwords

Each account can change the password for itself and the lower level access.



NOTE

Username and password are case sensitive. You can view and change **Password Policy**.

1. Select the  >  **Service** > enter **Username** and **Password**.
2. Select **Change Password**.
3. Select **Clinical** or **Service** radio button as required.
4. Enter and retype the new passwords, then select **Confirm**.

Setup the password policy

You can setup the password policy to enhance the security of the device.

1. Select the  >  **Service** > enter **Username** and **Password**.
2. Select **Change Password** > **Password Policy**
3. Setup the following items for **Basic Policy**, if necessary.
 - **Password Minimum Length**: Configure minimum allowed password length.
 - **Uppercase characters Minimum number**: Configure minimum number of uppercase letters (A ~ Z) in password.
 - **Lowercase characters Minimum number**: Configure minimum number of lowercase letters (a ~ z) in password.
 - **Digit Minimum number**: Configure minimum number of numeric characters (0 ~ 9) in password.
 - **Special characters Minimum number**: Configure minimum number of special characters in password.
4. Select **Advanced Policy** tab, select the check box and setup the following items, if necessary.
 - **Maximum repeating character length**: Configure number of forbidden repeated characters in password.
 - **Maximum monotonic sequence length**: Configure number of forbidden sequential characters in password.
 - **Password history**: Configure number of historical passwords be checked when set new password.
 - **Maximum error attempts**: Configure password lockout attempts. The username will be locked after error attempts reach the setup time. You should reset the password.
 - **Password expired duration(month)**: Configure password lifetime duration.

Bad password

When you set password, please avoid to use bad password as follow:

- **BAD PASSWORD: It is too simple**, for example "12345678"
- **BAD PASSWORD: It is based on a word in the forbidden list**, for example "Change Me", "Password"
- **BAD PASSWORD: It contains less than 5 different characters**, for example "aaaaaaa"

Password expired

After password expired, if user try to use old password **Login**, the monitor will go to **Change Password** menu automatically.

To change password is the necessary process. It is recommended you to change password immediately.



NOTE

If give up to change password, user still can return to the normal screen. But can't enter **Clinical** or **Service** menu.

Generate and export recovery key

You can generate and export the recovery key to USB disk. The recovery key is used to reset password when you forget.



NOTE

Make sure the file system format for USB storage device should be FAT32.

1. Insert the USB disk to monitor.
2. Select the  >  **Service** > enter **Username** and **Password**.
3. Select **Change Password** > **Generate Recovery Key**.
4. Select **Generate**.

The recovery key have been generated and exported to USB disk.

Reset passwords

You can reset the password when forget. There are two ways for resetting passwords:

- Via activation code, which contact GE service to get
- Via recovery key, which saved in USB disk

Resetting password via activation code

1. Connect GE service to get the Expiration Date and Activation Code.
2. Select the  >  **Service** > enter **Username** and **Password**.
3. Select **Reset Password**.
4. Enter the **Expiration Date (YYYYMMDD)** and **Activation Code**.
5. Select **Confirm**.

Enter the **Change Password** menu to setup new password.

Resetting password via recovery key in USB

If you have generated recovery key in USB before, you can use the recovery key to reset password.

1. Insert USB disk with recovery key files to the monitor.
2. Select the  >  **Service** > enter **Username** and **Password**.
3. Select **Reset Password**.
4. Select **Confirm** in **Option 2** section.

Enter the **Change Password** menu to setup new password.

Performance check

After turning on the monitor, and during operation, the monitor runs automatic self-tests. If a malfunction is detected, the monitor displays a message or an alarm, depending on the severity of the malfunction.

Mains supply interruption

If the mains supply to the equipment is interrupted, the monitor keeps the patient data and the latest user-made settings. If not, contact authorized service personnel.

Downloading logs to USB disk

You can download the system logs, and diagnostic logs to an USB storage device for service use.



NOTE

Make sure the file system format for USB storage device should be FAT32.

1. Discharge the patient first.
2. Select the  >  **Service** > enter **Username** and **Password**.
3. Select **USB Import/Export** > **Export logs to USB Disk**.
4. Enter an encryption **Key** for the logs file, the length of key shall be at least 6.
This key will be used when open the logs.
5. Select **Export logs to USB Disk**.
When finish to download logs, a message “**Export logs successfully.**” displays on the menu.
6. To remove the USB disk, select **Safe to remove USB Disk**.

Setting up the monitor before use

Waveform field safety precautions

WARNING

MISINTERPRETATION.

Always make sure that the waveform size is sufficient for the care environment to ensure that the waveforms can be interpreted correctly and no details are missed.

CAUTION

PATIENT SAFETY.

The waveform autoscaling feature of certain parameters automatically updates the display from the best possible signal amplitude. Always make sure that the waveform display scale is correctly understood and does not lead to delayed patient treatment.

Normal screen

You can return to the normal screen any time during the monitoring.

- Select the  to return to the normal screen.

When monitoring begins, the main page appears automatically. This preconfigured page is called the normal screen. Any changes you make to the screen setup during monitoring will change this normal screen. These changes are not permanent unless they are saved to a mode. They are valid until the patient is discharged.

Adjusting sound volumes

You can adjust various sound volumes according to your care environment needs. While you are adjusting the volume, you will hear a corresponding sound that will guide you in determining a suitable level. All volumes other than **Alarm Volume** can be set to 0 if required.

1. Select the  >  **Sound Volumes**.
2. Adjust following sound volumes with the arrows.

- **Alarm Volume**



NOTE

After selecting  >  **Service** (password protected) > **Alarm Options** > **Audio of Alarms** > **Alarm Volume Control** > **Separate for Low**, there are two options: **High & Medium Alarm Volume** and **Low Alarm Volume**.

- **Beat Volume**
- **Completed NIBP Volume**

Adjusting the display brightness

You can set the display brightness level according to your needs. When **Brightness Type** is set to **Auto**, the display adjusts screen brightness automatically according to the ambient light.

1. Select the .
2. Select the  **Screen Brightness**.
3. Select the **Brightness Type**.
4. When the **Brightness Type** is set to **Manual**, adjust the **Screen Brightness** with the arrows.

Screen setup modifications

The monitor provides pre-configured layouts: 2 waveform layouts and 2 large number layouts.

You can select layouts between waveform and large number during monitoring.

- Using the  to select pre-configured layouts.
- Select  on the right upper corner of the menu to configure the pre-configured layout.

Waveforms layout



NOTE

The monitor displays up to 11 waveforms and 4 lower digit fields at a time, or displays up to 12 waveforms.

Waveforms are always evenly distributed to fill the entire waveform area. Whenever there are fewer waveforms configured on the screen, the remaining waveforms are enlarged. Changing a displayed waveform to another waveform also will update the associated digit field that is displayed to the right of the waveform.

If the **Lower Area** is turned off, up to 12 waveforms can be displayed.

Depending on your configuration, if you use the same measurement in the lower digit field that is currently in the waveform field, the waveform field disappears.

Large number layout

The large number layout displays up to 6 fields at a time. Each field displays large number of digit field and one waveform for each parameter, if applicable.

Setting waveforms layout

1. Select the  >  **Screen Setup**.
2. Select the **Layout 1** or **Layout 2** tab > **Upper Area** vertical tab.
3. Select the parameters for related waveforms.
4. Select the **Lower Area** vertical tab.

5. Check that the **Lower Area** is turned on.
6. Select the parameters for related digit fields.

**NOTE**

If you turn off the **Lower Area**, the parameter selections for digit fields are gray. And on the **Upper Area** vertical tab, you can set 12 waveforms.

Selecting the display mode for IBP waveforms

You can select the invasive pressure waveforms to be shown as individual waveforms, or in a combined view.

1. Select the > **Screen Setup**.
2. Select the **Layout 1** or **Layout 2** tab.
3. Select the **Combine Pressures** checkbox to combine up to three adjacent IBP waveforms in one field.

The new waveform field will use the combined height of the original fields.

Setting large number layout

1. Select the > **Screen Setup**.
2. Select the **Layout 3** or **Layout 4** tab.
3. Select the parameters for related fields.

Setting the split screen

To view the measured graphic and/or numerical values selected as well as the waveform and digit field, you can set a split screen display bar on the left side of the screen.

1. Select the > **Screen Setup**.
2. Select the **Split Screen** vertical tab.
3. Select a split screen display type from the **Show** list. Choices are:
 - **None:** No split screen is displayed.
 - **Spirometry:** Spirometry measurement data is displayed. The option is activated when a compatible anesthesia machine is connected.
 - **AoA:** SPI, Entropy values, mini trend graphic menu and NMT parameter window are displayed. The display contents depend on the module and option you are using. The option is only applicable for OR mode.

Setting parameters

1. Select the > **Parameter Setup**.
2. Select the **Others** tab for more parameters, if necessary.
3. Select each parameter to adjust the settings.

You can also select each parameter's digit field or waveform field to open the setup menu.

For details about the settings, refer to the parameter's chapter.

Setting up printing options

You can check that the printing options for waveforms are set according to your needs when you start monitoring a patient.

1. Select the  >  **Printing Setup**.
2. Check the settings by going through the different options and change if necessary.

For more information, see the "Printing" chapter.

Other setup changes

All other setup changes require a password.

- Alarm options
- Snapshot
- Parameter settings (Units, Colors, and Others)
- Roving
- Gesture Control
- Save Modes
- Time and date
- Time zone
- USB import/export
- EWS (Early Warning Score type)
- Printer

For more information, see the supplemental information manual.

Transferring settings from a monitor to another

Exporting settings

You can save the user settings to the USB storage device.



NOTE

Make sure the file system format for USB storage device should be FAT32.

1. Discharge the patient. Insert the USB storage device to the USB port of the monitor.
2. Select the  >  **Service** > enter **Username** and **Password**.
3. Select **USB Import/Export** > **Export settings to USB Disk**.

4. Enter an encryption **Key** for the settings' file, the length of key shall be at least 6. (This key will be used when import settings).
5. Select **Export settings to USB Disk**.
When finish to export settings, the screen returns and a message "**Export settings successfully.**" displays on the screen.
6. To remove the USB disk, select **Safe to remove USB Disk**.

Importing settings

You can import the saved user settings from the USB storage device when:

- first time to use the monitor, refer to [Import settings from USB at first time to use on page 83](#) for more details.
 - other time, see following instruction.
1. Discharge the patient. Insert the USB storage device to the monitor's USB port.
 2. Select the  >  **Service** > enter **Username** and **Password**.
 3. Select **USB Import/Export** > **Import settings from USB Disk**.
 4. Select the settings' file from **Import Setting file list**.
 5. Enter the decryption **Key** for the settings' file.
 6. Select **Import settings from USB Disk**.
When finish to import settings, the screen returns and a message "**Import settings successfully. Please restart the monitor.**" displays on the menu.
 7. To remove the USB disk, select **Safe to remove USB Disk**.
 8. Restart the monitor.

Starting and ending monitoring

Starting and ending safety precautions

Starting and ending warnings

WARNING

LOSS OF MONITORING AND MISSED ALARMS.

When starting to monitor a patient, always make sure that you are in the normal monitoring mode and not in the DEMO mode. Ensure that there is no **DEMO MODE** text in the message field. If the DEMO mode is active when you start monitoring, there is a risk of loss of monitoring and missed alarms. Consult a qualified service personnel to exit the Demo Mode.

Starting and ending caution

CAUTION

DISCHARGE TO CLEAR PATIENT DATA.

When admitting a new patient, you must clear all previous patient data from the system. To accomplish this, disconnect the patient sensors, then discharge the previous patient.

About the user default settings

User default settings mean those settings (Default Mode) that the user has saved into the monitor to replace the factory default settings. If there are no user default settings, factory default settings are used.

About user modes

When start monitoring a patient, you can use the default mode or select another mode. The device has seven user modes to choose. Mode controls many settings, including parameter defaults, alarm detection limits, and screen display.

You can:

- save the current settings to target mode.
- revert the target mode to factory default settings.
- choose the default mode.

Reach these selections through  >  **Service** > **Save Modes**, and they are password protected.

For more information, see the supplemental information manual.

Selecting a mode

The monitor starts with the default mode, but you can select another mode according to your needs. You can also change the mode while monitoring a patient without losing any patient data.

1. Select the information area.
2. Select the **Select Mode** tab.
3. Select a mode from the **Select Mode** list.
4. You can return to the previous mode by selecting **Return to previous mode:**.

If you make changes to mode settings and need to return to its previous settings, first select another mode and then re-select the one you were using.

Pre-monitoring checklist

Before you start monitoring a patient, check the following:

- Acquisition module is firmly in place.
- Accessories are intact and properly connected.
- Monitor is displaying the monitoring screen.
- No messages are displayed indicating the monitor is not functioning.
- Desired parameters are selected to view on the screen.
- Alarm signals are working and can be seen and heard in your care environment.
- Required parameter calibrations are completed.

Starting monitoring

A patient is automatically admitted when the monitor detects any of the following vital signs: ECG, Art, ABP, NIBP, SpO₂, CO₂, Entropy, or BIS.

A patient is manually admitted when any patient information is entered or loaded. Patient information can be entered locally using the monitor, loaded from the CARESCAPE Gateway server over the CARESCAPE Network, or entered remotely using a central station.

When a patient is admitted and the monitor is connected to the network, patient data will display at the central station.

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

The following are generic instructions listing the basic steps for starting monitoring. Parameter-specific instructions are more detailed and should always be followed as well.

1. Connect the patient to the monitor according to the measurement setup requirements. The alarms and parameter settings become active.
2. If the default mode is not suitable, select another mode.
3. Enter patient demographics, or load the data.
4. Start the measurement.
5. Zero invasive pressure lines.

6. If required, change the parameters on screen.
7. Check alarm limits and adjust if necessary.

Entering patient data

Patient data privacy protection

Patient data and patient information are invisible in the clinical logs or the setting file you downloaded. The patient trend can be download, but needs encryption.

Entering patient data with the monitor

1. Select the information area.
2. Edit or enter the **First Name**, **Last Name**, and **MRN** by selecting the areas you can edit.
3. Select the **Patient Type** from the list. Choices are:
 - **Adult/Pediatric**
 - **Neonatal**



NOTE

When you select **Patient Type** to **Neonatal**:

- The mode will automatically become **NEONATAL**.
- The **OxyCRG** will be activated.

4. Enter **Demographics** menu, and select following values with the arrows:
 - **Date of Birth: Day, Month, Year**
 - **Age**, Age unit options
 - **Gender**
 - **Height** and **Weight**



NOTE

The **BSA** is automatically calculated.



NOTE

Date of Birth is related with **Age** that **Age** is automatically calculated from **Date of Birth**. **Age** can be set manually, but the settings of **Date of Birth** will be cleared when no match is found with **Date of Birth**.

5. Reconfirm the patient data you have entered.

Entering patient data with barcode scanner

You can scan the patient data in the barcode if the function is activated during monitor configuration.

1. Select the information area.

2. Select **Scan from Barcode**.
You can select **Cancel Scan** to cancel the scanning.
3. Use barcode to scan the code.
4. The patient data will be displayed. Check and select **Confirm** to accept data entering.

**NOTE**

If you want to admit a new patient, please discharge the current patient first. Or else, the new entered patient data will be regarded as a modification of current patient information, but not admit a new patient.

Loading patient information from the CARESCAPE Network

In the CARESCAPE Network, patient information can be loaded from the CARESCAPE Gateway server. You cannot merge data between the monitor and the CARESCAPE Gateway server.

1. Select the information area.
2. Select the **Load Patient** tab.
3. Select **Find Patients**.
4. Enter the **MRN** and/or **Last Name** information you have available.
You can also add the **First Name** information but the search does not function with this information only.
5. Select **Find**.
6. When the patient list appears, select the patient.
7. Select **Load Patient Information** to load the data from the CARESCAPE Gateway server.

About standby

When you remove the patient temporarily from the monitor, you can use the standby option.

**NOTE**

When the patient is discharged, the standby mode is not allowed to start.

Starting standby

1. Select .
- If patient cables are still connected and the monitor is receiving physiological data, a text message will be displayed, indicating that audio alarms have been paused.
2. Disconnect patient cables and stop NIBP automatic measurements to start the standby.
If you do not disconnect the cables and physiological data is still present after the audio pause time expires, the standby is canceled. You can also select  to cancel entering standby immediately.

The screen will go blank and the **Standby** text appears.

End of standby

The monitor ends the standby state automatically when any of the following conditions occurs:

- Any physiological data is detected.
- The touchscreen is pressed.
- Discharge a patient remotely.



NOTE

When user presses the **ON/OFF** less than 3 seconds, the monitor will still be in standby state. When pressing the **ON/OFF** more than 3 seconds, the monitor will turn off.

After that, a continue menu will open, the options are:

- **Continue Current: Continue monitoring of previous patient.**
- **Discharge Patient: Discharge will erase all the patient data in this device.**
- **Standby: Enter Standby mode.**



NOTE

The menu will not appear when the patient is discharged remotely.

About the roving functionality

Roving functionality allows you to move, or rove the monitor to fit the patient's acuity needs, rather than moving the patient to a monitored room. When you move the monitor to a new location in the CARESCAPE Network, you can update the unit and/or bed names from lists, or add new names manually. Available selections depend on what has been allowed in configuration.

These settings are configured through  >  **Service > Roving** and they are password protected.

Roving between units

If roving between units is allowed, you can update the unit name when moving the monitor to a new location.

1. Select the information area.
2. Select the **Unit & Bed** tab.
3. Select the **Unit Name** from the list.

Changing the **Unit Name** will also update the contents of the **Bed Name** list.

You can also change the name manually through **New Unit & Bed** if it has been allowed.

Roving between beds

If roving between beds is allowed, you can update the bed name when needed.

1. Select the information area.
2. Select the **Unit & Bed** tab.
3. Select the **Bed Name** from the list.

The new name appears in the upper right corner of the display. The unit name is given first.

You can also change the name manually through **New Unit & Bed** if it has been allowed.

Adding new units and beds (manual roving)

If manual roving between beds and/or units is allowed, you can also enter their names manually.

1. Select the information area.
2. Select the **Unit & Bed** tab.
3. Select **New Unit & Bed**.
4. Select the **Unit Name** or the **Bed Name** field and type the new name.

The maximum number of characters for the **Unit Name** is seven, and for the **Bed Name** is five.

5. Select **Confirm** to ensure that the names you entered are valid.

Selecting the printing device

You can select the printing device from remote or local during roving.

1. Select the information area.
2. Select the **Unit & Bed** tab.
3. Select **Printing**.

You can reach the same menu from  >  **Printing Setup** > **Devices** tab.

About night mode

The night mode feature allows the patient to sleep or rest without being disturbed. In the night mode, the screen brightness, the volume can be set separately. Alarms are logged and trended. If the monitor is connected to the network, alarms and parameter data will continue to be sent over the network.

When in night mode, a  symbol will appear on the information area.

Setting and entering night mode

1. Select  >  **Night Mode**.
2. Select **Setup** tab and adjust the following settings if needed.

While you are adjusting the volume, you will hear a corresponding sound that will guide you in determining a suitable level.

- **Alarm Volume** : Alarm volume



NOTE

After selecting  >  **Service** (password protected) > **Alarm Options** > **Audio of Alarms** > **Alarm Volume Control** > **Separate for Low**, there are two options: **High & Medium Alarm Volume** and **Low Alarm Volume**.

- **Beat Volume** : HR beat volume

- **Completed NIBP Volume:** NIBP complete beep
- **Screen Brightness:** Monitor display brightness
- **Silence ALL:** Turns off all audible alarms except some high priority alarms defined as breakthrough alarms.

**NOTE**

This setting not available if **Alarm Options > Audio of Alarms > Audio Off Allowed** set to **NO**, it is password protected.

- **Alarm Light** (not for VSP 3.0 upgrade device): Alarm light brightness
3. Select **Enter** tab.
 4. Select the check box of **Scheduled** if you want to create a scheduled time span for the device automatically entering the night mode. The schedule time can be set with the **From** and **To** arrows.
 5. Select **Enter Night Mode**.

The night mode symbol  appears on the information field.

Exiting night mode

1. Select  >  **Night Mode**.
2. Select **Exit Night Mode** to exit.

If **Scheduled** check box is selected. the night mode will automatically exit when out of time.

The night mode symbol  is removed from the information field.

About Demo Mode

The Demo Mode is designed for training and demonstration of primary operations before use. Under Demo Mode, the monitor displays the main vital signs values and waveforms. No accessories, central station or any other peripheral equipment are needed while in Demo Mode.

The Demo Mode menu is under the service menu of the monitor and requires a password to enter. Please consult qualified service personnel to enter the Demo Mode.

Shut down the monitor to end Demo mode.

If restart is needed during Demo mode, and you still want to continue demo after restart, perform Restart DEMO mode from the service menu. This feature is password protected. Please consult qualified service personnel.

**NOTE**

All the values and waveforms on the monitor's display are fictional.

**NOTE**

The Demo Mode is only designed for training and demonstration of primary operations. It is not intended for clinical use or patient monitoring and diagnosis.

About patient discharge

Discharging a patient deletes all patient information in the monitor. This also happens when the monitor is in the DEMO mode.

The patient can be discharged remotely using a central station provided that this option has been enabled.

Discharging a patient



NOTE

Before discharging a patient, please consider to print necessary data for backup.

1. Disconnect patient sensors.
2. Select the information area.
3. Select **Discharge Patient** > **Confirm**.

Parameter settings, including alarm limits, return to the default settings. All patient data is removed from the monitor.

About continuing monitoring

The **Continue/Discharge** menu opens when a decision must be made about continuing or discharging a patient case. The menu remains open until you select one of the available options.

Alarms

Alarm safety precautions

Alarm warnings

WARNING

PATIENT SAFETY.

When the alarms are off or while alarm audio is paused either temporarily or indefinitely, observe the patient frequently to avoid the risk of not identifying important changes in the patient status that might lead to compromised patient safety.

WARNING

MISSED ALARMS.

Always make sure that the audio alarm volume level is adequate in your care environment to avoid missing alarms or not recognizing them due to too low a volume. Audio levels that are less than ambient levels may lead to unrecognized or missed alarms.

WARNING

MISSED ALARMS.

Always make sure that the alarm light brightness is adequate in your care environment to avoid missing any alarms.

WARNING

PATIENT SAFETY.

Always make sure that necessary alarm limits are active and set according to the patient's clinical condition when you start monitoring a patient to avoid any risks to the patient safety caused by erroneous or no alarms.

WARNING

PATIENT SAFETY.

Verify that the alarm processing is active and check the patient to ensure no arrhythmias occurred during a power interruption. Otherwise, there is a risk of compromised patient safety.

WARNING**MISSED ALARMS.**

Always check the alarm status after a prolonged power interruption to avoid missing any alarms.

WARNING**PATIENT SAFETY.**

Alarms do not sound, alarm histories are not stored, alarm graphs do not print, and alarms are not sent to the network when the alarms are turned off. Observe the patient frequently to avoid the risk of not identifying important changes in the patient status that might lead to compromised patient safety.

WARNING**MISSED ALARMS.**

Alarms do not sound and alarms are not sent to the CARESCAPE Network during Audio Pause. As this may lead to missed alarms, observe the patient frequently.

WARNING**MISSED ALARMS.**

The audible alarm signal may be paused temporarily from a central station or remote monitor. Always pay attention to the alarm signal status and observe the patient frequently.

WARNING**MISSED ALARMS.**

To avoid missed detection of critical alarms, always inform personnel dependent on the monitor alarms of remote alarm silencing or pausing interactions.

WARNING**MISSED ALARMS.**

The peripheral device's alarms must not be turned off or the volume reduced in any way to diminish the importance of the peripheral device as the primary alarm source for parameters monitored by the peripheral device.

WARNING**PATIENT SAFETY.**

There are no alarm indications until parameter-specific alarm prerequisites have been met. Keep the patient under close surveillance when starting the monitoring.

WARNING**MISSED ALARMS.**

Do not use automatic view on alarm (AVOA) as a replacement for a primary alarm source or as a central station as this may lead to missed alarms. To avoid missing any alarms and to ensure alarm delivery between AVOA and bed-to-bed monitors, configure the monitors to send and receive alarms to and from each other.

WARNING**PATIENT SAFETY.**

Only the most recent, highest priority alarm is sent to remote devices on the CARESCAPE Network. Therefore, less recent alarms of equal or lower priority may not be displayed or may not be indicated with their associated priority remotely. Observe the patient frequently to avoid the risk of not identifying important changes in the patient status that might lead to compromised patient safety.

WARNING**PATIENT SAFETY.**

Alarm messages may not be visible on the alarm display area when three higher priority alarms are active. Observe the patient frequently to avoid the risk of not identifying important changes in the patient status that might lead to compromised patient safety.

WARNING**MISSED ALARMS.**

Equipment malfunctions, network disconnection, other remote alarm system disconnection, and alarm volume settings may result in missed alarms. Always keep the patient under close surveillance.

WARNING**PATIENT SAFETY.**

Latched alarms are not retained through a monitor reset if the alarm condition has been removed. Observe the patient frequently to avoid the risk of not identifying important changes in the patient status that might lead to compromised patient safety.

WARNING**PATIENT SAFETY.**

The secondary alarm system shall not be relied upon for receipt of alarm signals.

WARNING**MIXED ENVIRONMENT.**

A hazard can exist when the same type of monitors in the same care area are using different monitoring modes and default configuration settings.

WARNING**MISSED ALARM.**

Do not rely on receipt of certain alarm conditions at a central station, remote bedside, or alarm notification device when connected to the CARESCAPE Network. Notification of any of these alarms will only be given when it is the most recent, highest priority active alarm coming from the bedside monitor. This applies to those limit alarms and technical alarms that are defined as broadcast only alarms in this manual.

WARNING**MISSING CRITICAL EVENTS.**

Reducing the physiological alarms' priority levels lower than the default level can lead to missed detection of critical or serious events and therefore to adverse patient outcome. If you adjust the priority levels for the alarms lower than the default value, keep the patient under close surveillance.

WARNING**MISSED ALARMS.**

Do not connect a single-color display to the monitor. Visual alarm indicators may not appear properly.

WARNING**MISSED ALARMS.**

Reducing the technical alarms' priority levels lower than the default level can lead to missed detection of critical events and therefore to adverse patient outcome. If you adjust the priority levels for ECG lead off, ECG Leads off, Arrhythmia paused, SpO2 probe off alarms lower than the default value, keep the patient under close surveillance.

Alarm overview

Alarm types

There are two types of alarm settings, system and patient-specific. System alarm settings are set globally across an entire care environment. They are configured at the time of installation and are password protected. Examples of system alarm settings are:

- Minimum alarm volume
- Audio off allowed
- Alarm tones

Patient-specific alarm settings are individualized, based on a patient's current condition. Examples of patient-specific alarm settings are:

- Parameter alarm limits
- Alarm priority settings

Alarm conditions

- Physiological alarm conditions are triggered by a patient measurement that is outside the parameter limits, by apnea, or by an arrhythmia condition.
- Technical alarm conditions are triggered by an electrical, mechanical, or other failure of the equipment, or by failure of a sensor or component. Technical alarm conditions may also be caused when an algorithm cannot classify or interpret the available data. The visual manifestation of a technical alarm is active as long as the reason for that alarm exists.

Broadcast only alarms

Alarms are sent to the CARESCAPE Network and displayed on the central station.

For more information, see the supplemental information manual.

Checking alarm function

1. Set a parameter alarm limit outside of the current measured patient values. For example, connect the SpO₂ sensor and adjust the SpO₂ high limit under measured SpO₂ values.
2. Confirm that the following alarm notifications occur:
 - The audible alarm sounds the correct priority tone.
 - The alarm light illuminates.
 - The alarm message displays in the message field.
 - The SpO₂ numeric value flashes in the digit field with the correct priority color.
 - An alarm printout (if enabled) is initiated.
3. Audio pause the alarms and confirm that the audible alarms are paused.
4. Return the parameter alarm limit to the original value.

Visual alarm indications

Alarm icons on the screen

For more information for the on screen alarm icons, see User interface symbols.

Description of alarm and information messages

Alarm and information messages can be displayed in three areas:

- The digit field
- The waveform field
- The message field (upper part of the screen)

In the message field, up to three alarms or information messages may be displayed from left to right, from the newest highest priority alarm to the oldest lowest priority alarm.

Alarm messages are stored in the **Alarm History**. You can access through . The alarm messages stored in the **Alarm History** include:

- Time of occurrence
- Alarm or information message text
- Label for the parameter, if available
- Current value if a limit alarm
- Snapshot, if available
- Full Disclosure, if available

Setting alarm light brightness

1. Select  >  **Alarm Setup**.
2. Select **Visual** tab.
3. Select **Alarm Light Type**.
4. When **Alarm Light Type** is set to **Manual**, adjust **Alarm Light** brightness with arrows.

The larger the value, the brighter the alarm light.

When the equipment is on the **Night Mode**:

- the  symbol appears next to the option
- the **Alarm Light Type** fixes to **Manual**
- the **Alarm Light** brightness settings range is differ from the settings under normal mode



NOTE

You can set the range of alarm light brightness adjusted through  >  **Service** (password protected) > **Alarm Options**.

- Select **0%(OFF) Allowed**: Range is 0~100%.
- Unselect **0%(OFF) Allowed**: Range is 40~100%.

About alarm message functionality

Alarm messages have alarm icon or message field with touchable functionality.

	Select the icon, to view the list of alarm priority setting deviate from the recommendation of international alarm safety standards.
Alarms in message field	Select the alarms in message field, to view the Quick Help about possible causes and suggested actions for current alarms. There are also shortcut for Alarm Reset , Alarm Setup , and View User's Manual .
Remote alarms in message field	Select the remote alarms in message field, to open the bed to bed view window.

Visual alarm signals and priority levels

Alarm signals indicate that an alarm condition is present. The alarm priority levels are indicated by visual and audible signals. The visual and audible alarm signals assume that the patient monitor and the operator are within the patient environment (1.5 meters).

The following table lists alarm signals for different alarm priority levels:

Signal	Priority level			
	High	Medium	Low	Informational
Digit field physiological data values	Black text flashes inside a red box.	Black text flashes inside a yellow box.	Not applicable.	Not applicable.
Message field	White text inside a red box.	Black text inside a yellow box.	White text inside a cyan (blue) box.	Black text inside a grey box.
Waveform field messages	Text	Text	Text	Text
Alarm light indicator	Flashes red Frequency: 1.667 Hz ±10%	Flashes yellow Frequency: 0.625 Hz ±10%	Solid cyan Constantly on	No effect

Audible alarm indications

Audible alarm signals

When more than one alarm occurs at the same time, the monitor will sound an alarm tone for the highest priority alarm. Any lower priority audible alarm tones are suppressed by the higher priority alarm tone.

The most recent of the alarms that has the highest priority level at this moment is the alarm that is broadcast on the network. For example, if there is one medium-priority alarm and a low-priority alarm appears, the medium-priority alarm is broadcast, not the most recent (low-priority) alarm. If there is one medium-priority alarm and another medium-priority alarm appears, the latest alarm that appeared is broadcast. Physiological alarms always take precedence over technical alarms.

Alarm tones

The alarm tones can be configured to sound in one of four different tone patterns: **General**, **IEC**, **ISO**, or **ISO2**.

The low priority alarm tone can be configured to **Single** or **Repeat** sound.

The AVOA audible alarm tone pattern can be configured to match the local monitor's audible tone pattern, or be turned off.

For more information, see the supplemental information manual.



NOTE

To avoid user confusion with alarm tones, configure all related monitors to the same type of audible alarm tones used in your clinical environment.

Adjusting the alarm volume

1. Select  >  **Alarm Setup**.
2. Select **Audio** tab.
3. Adjust the value. (The menu has difference according to setup):
 - **Alarm Volume**: adjust volume for all alarms.
 - **High & Medium Alarm Volume** and **Low Alarm Volume**: separately to adjust volume for High & Medium priority alarms, and Low priority alarms.

The lower the number, the quieter the alarm volume.

When the equipment is on the **Night Mode**, the  symbol appears next to the option, and the configured volume differs from the setting under normal mode.

When **Low Alarm Volume** is set to 0, the  appears beside the option.



NOTE

You can set the alarm volume control and minimum allowed alarm volume levels, through

 >  **Service** (password protected) > **Alarm Options** > **Audio of Alarms**.

For more information, see the supplemental information manual.

Auditory information signals

The monitor performs a self-diagnostic procedure at startup and generates an auditory test signal. There are also other auditory information signals indicating the status of some parameter measurements.

- Start-up sound
- HR beat beep
- Completed NIBP volume
- Reminder beep

Parameter alarms

Setting parameter alarm limits

Parameter alarm limits are set in **Alarm Setup** menu, or the parameter menus' own **Alarms** tab. Alarm limits should not be set beyond reasonable physiological boundaries in order to maintain patient safety. Parameter settings outside of reasonable boundaries would cause the alarms to be ineffective.

1. Select the  >  **Alarm Setup**.
2. Select parameter group in the header of table if need.

- Adjust the parameter alarm limits with arrows.
- Select alarms **ON** or **OFF**.

**NOTE**

A blue point will be display in the first column if anything adjust. You can check your changes before apply.

- Select **Apply** for the changes.

You can also select the parameter menu's **Alarms** tab where you can select alarms on or off, and set their limits also.

Setting alarm limits automatically

When selected, the auto limits feature automatically sets new high limit and low limit values, based upon the current physiological value. The auto limits feature should only be used for patients whose currently measured values are considered safe.

- Select the > **Alarm Setup**.
- Select **Auto Limits**. You still can do the necessary manual adjustment base on the auto limits.
- Select **Apply** for the changes.

If you need to undo these changes and return to the previous alarm limit settings, select **Cancel** before closing the menu.

Auto alarm limits

The following table is about how to calculate auto alarm limits by system.

Parameter	High limit	Low limit
HR/PR parameters (ECG, SpO ₂ , UAC, Art, ABP)	Value*1.25 (rounding)	Value*0.75 (rounding)
PVC	PVC +10	Not applicable
SVC	SVC +10	Not applicable
RR	RR*1.25+2	RR*0.75-2
SpO ₂	SpO ₂ +5%	SpO ₂ -5%
NIBP	Sys/Dia/Mean: Value*1.25+10 mmHg (1.3 kPa)	Sys/Dia/Mean: Value*0.75-10 mmHg (1.3 kPa)
Art, ABP, IBP1, RVP, UAC, UVC, PA	Sys/Dia/Mean: Value*1.25+10 mmHg (1.3 kPa)	Sys/Dia/Mean: Value*0.75-10 mmHg (1.3 kPa)
CVP, RAP, LAP, ICP, IBP2, IBP8	Sys/Dia/Mean: Value*1.25+5 mmHg (0.67 kPa)	Sys/Dia/Mean: Value*0.75-5 mmHg (0.67 kPa)
Temperature, Tblood	Tx+1°C (1.8°F)	Tx-1°C (1.8°F)
EtCO ₂	EtCO ₂ +1%	EtCO ₂ -1%

Returning the default alarm limits

1. Select the  >  **Alarm Setup**.
2. Select  **Default Limits**.
3. Select **Apply** for the changes.

If you need to undo these changes and return to the previous alarm limit settings, select **Cancel** before closing the menu.

For more information about the factory default alarm limits, see the supplemental information manual.

Alarm priorities and escalation

Alarm priority levels

Physiological and technical alarms are categorized by priority level:

- High priority alarms require an immediate response.
- Medium priority alarms require a prompt response.
- Low priority alarms require you to be aware of this condition.
- Informational priority messages provide information you should know.

NOTE

Informational messages are not sent to the network.

Alarm priority escalation

An escalating alarm starts at a designated priority level (low or medium) and will escalate to the next higher priority level (after a set number of seconds) if the alarm condition has not been resolved. It is important to note that the alarms escalate up to the next level but will not reset until the condition has been resolved.

NOTE

Alarm priority escalation affects the currently ongoing alarm condition, not any future alarms of the same type. Any new alarms will alarm at their designated priority level, not at the escalated level.

For more information, see the supplemental information manual.

Selecting parameter alarm priority levels

The parameter alarm priorities can be selected. The alarm priority is based on clinical considerations.

The allowed priorities for different alarms are defined in **Alarm Options** and they are password protected.

For more information, see the supplemental information manual.

1. Select  >  **Alarm Setup** > **Priorities** tab.
2. Select the related vertical tab for parameters.
3. Select the alarm priority from the list.

If the selected alarm priority deviates from the recommended levels of alarm safety standard, the symbol  will display.

Select the **Note** vertical tab, the screen list the alarm priority settings with risk. And a warning text displays as follow:

"The following alarm priority settings deviate from the recommendation of international alarm safety standards."

Setting arrhythmia alarms

You can set the arrhythmia alarms from **Alarms Setup** menu or from the **ECG** menu.

1. Select the HR digit field > **Alarms** tab.

Or, select  >  **Alarm Setup** > **Priorities** tab.

2. You can select the vertical tabs for the **Lethal**, **Ventri cular** and **Atrial** alarms.
 - **Lethal**: You can select the **Create Snapshot** options, the alarm priority for lethal alarms is always high.
You can setup the **V Tach** alarm condition.
 - **Ventri cular**: You can select the alarm priority or turn off **Create Snapshot** options.
 - **Atrial**: You can select the alarm priority or turn off **Create Snapshot**, and setup **Pause Interval** options.
You can setup the SVT settings.

Pausing and silencing alarms

Audible alarms off behavior

Depending on the **Audio Off Allowed** default settings configured during installation, you can turn audible alarms on or off.

For more information, see the supplemental information manual.

When audible alarms are turned off:

- All audible alarms are turned off except for any high priority alarms configured to breakthrough the audio off setting.
- The audio off bell icon  displays in the upper left corner of the display screen.

Turning audible alarms on/off

You can turn on/off the audible physiological alarm tones for an alarm group or for all alarms.

1. Select  >  **Alarm Setup**.
2. Select the **Audio** tab.
3. Select an alarm group. Choices are:
 - **None**: No audible alarms are turned off.
 - **Silence Apnea**: Turns off audible alarms for Apnea (Imped. and CO₂), EtCO₂, FiCO₂, respiration rate limit alarms (Imped. and CO₂).
 - **Silence ECG**: Turns off audible alarms for all HR source limit, arrhythmia, ST, PVC, and SVC alarms.
 - **Silence Apn&ECG**: Turns off audible alarms for all HR source limit, arrhythmia, ST, PVC, SVC, Apnea (Imped. and CO₂), EtCO₂, FiCO₂, respiration rate limit alarms (Imped. and CO₂).
 - **Silence ALL**: Turns off all audible alarms except some high priority alarms defined as breakthrough alarms.
4. To turn on all audible alarms again, select **Activate All Audible Alarms**, or select **None** as instructed above.

NOTE

If alarms are turned off for any of the defined alarm groups and an alarm occurs within the alarm group, a beep tone will sound every 2 minutes as a reminder that audible alarms are turned off. The **Reminder Volume** can be adjusted through **Alarm Options** (password protected) > **Audio of Alarms**.

**NOTE**

France only: The **Reminder Volume** menu is not available. A reminder beep tone sounds every 2 minutes when audible alarms are turned off.

Pause audio and alarm reset behaviors

When monitor is on the network, alarms can also be audio paused at the central station.

Selection	Result	Indicator
Select  (audio pause) once	• Start a 2 minute audio pause state for all alarms except the specified breakthrough alarms*¹. • Remove all latched alarms*² (including message and light).	• Alarm light: Yes • Alarm message: Yes and display the audio pause countdown icon • Alarm audio: No, except the breakthrough alarms
Second selection of  (audio pause) during the 2 minute pause	• Cease the audio pause state. • Deactivate some alarms in list below.	• Alarm light: Yes • Alarm message: Yes • Alarm audio: Yes
Select  >  Alarm Reset	• Start a 2 minute alarm silence for all current active alarms. • Remove all latched alarms (including message and light). • Does not silence any new alarms. • Cease the audio pause state, if available.	• Alarm light: Yes • Alarm message: Yes, with audio pause symbol in the message block • Alarm audio: No

Selection	Result	Indicator
*1	For more information about breakthrough alarms, see the supplemental information manual.	
*2	For details about latched alarms, refer to “Latched alarms” paragraph below.	

Alarms' deactivation with the pause audio key

Certain alarms can be deactivated by second selection of audio pause key.

- Physiology alarms:
 - **NIBP DIA high/NIBP SYS high/NIBP MAP high**
 - **NIBP DIA low/NIBP SYS low/NIBP MAP low**
- Technical alarms:
 - **Lead off**
 - **Leads off**
 - **Entropy cable off**
 - **Entropy sensor off**
 - **Entropy sensor check failed**
 - **No Entropy sensor**
 - **NMT cable removed**
 - **Block recovery**
 - **No SpO2 probe**
 - **SpO2 probe off**
 - **Check SpO2 probe**
 - **No SpO2 pulse**
 - **Zero ICP separately**
 - **NIBP cuff loose**
 - **NIBP cuff occlusion**
 - **Check NIBP**
 - **Weak pulsation**
 - **Long measurement time**
 - **NIBP manual**
 - **NIBP cuff overpressure**
 - **NIBP call service error**
 - **NIBP measurement removed**
 - **Recorder module removed**
 - **Gas measurements removed**
 - **Alarm volume changed**
 - **Recorder: cover open**
 - **Recorder: input voltage high**

- **Recorder: input voltage low**
- **Recorder: out of paper**
- **Recorder system error**
- **Recorder thermal array overheat**
- **Printing**
- **Printing Alarm**
- **Saving**
- **ECG measurements removed**
- **STP measurements removed**
- **SpO2 measurement removed**
- **Entropy measurement removed**
- **C.O. measurement removed**
- **NMT measurement removed**
- **Monitor disconnected**
- **All monitors disconnected**
- **No more space Full disclosure disabled**
- **No storage Full disclosure disabled**
- **Storage fail Full disclosure failure**
- **Condition battery**
- **No battery backup**
- **Replace battery**
- **No Px transducer**
- **Art disconnect**
- **ABP disconnect**
- **UAC disconnect**
- **Network down**
- **Network down: HL7**
- **No patients found**
- **CS Gateway communication failure**
- **No BIS sensor**
- **BIS sensor check failed**
- **BIS measurement removed**
- **BIS Apply sensor**
- **High BIS impedance**
- **Place SpO2 probe on finger for SPI measurement**
- **Anesthesia interface removed**

- **Anesthesia incompatible device**
- **Agent Mixture**
- **Multiple agents present**
- **Invalid barcode configuration**
- **Barcode too long**
- **Incorrect barcode value**
- **Barcode scanned**
- **Printer error**
- **Saving PDF failed**

Audible alarms' deactivation with gesture

Alarm audio pause is available with gesture. The gesture sensor locates at the upper left corner of monitor. The alarms will audible pause when you wave hands:

- in front of the gesture sensor area
- with a distance of 5-30 cm from the monitor
- forth and back wave, twice in 2 s at least.



Action	Result	Indicator
Wave hand to gesture sensor area, when there has active alarm and it's not paused or silenced.	Start 2 minute audio pause state for all alarms except the specified breakthrough alarms^{*1}.	- Alarm light: Yes - Alarm message: Yes and display the audio pause countdown icon - Alarm audio: No, except the breakthrough alarms
^{*1} For more information about breakthrough alarms, see the supplemental information manual.		



NOTE

You can enable or disable the gesture function and set its disabled time periods through



> **Service** (password protected) > **Gesture Control**.

Breakthrough alarms

The breakthrough alarms feature allows some alarms to “breakthrough” (interrupt) an alarm audio off or a 2 minute alarm audio pause state.

The **Breakthrough Alarm** settings is configured in **Alarm Options** and it is password protected.

For more information, see the supplemental information manual.

Breakthrough alarms list

The following alarms will breakthrough when escalated to or activated at high priority alarm condition regardless of the alarm audio off or 2 minute audio pause:

User action	Alarm	Condition
Alarm audio off is active	FiO2 low	Escalates to high
		Activates as high
	EtO2 low	Escalates to high
		Activates as high
	FiN2O high	Activates as high
2 minutes alarm audio pause is active	Ppeak high	Escalate to high
	Asystole	Activates as high
	V Tach	Activates as high
	V Fib / V Tach	Activates as high
	Brady ^{*1}	Escalates to high
		Activates as high
	FiO2 low	Activates as high
	EtO2 low	Activates as high
	FiN2O high	Activates as high
	Ppeak high	Escalate to high
*1 The Brady alarm will breakthrough only when Breakthrough Alarm option is selected as Peds .		

Latched alarms

Alarms can be configured to latch or not. The **Latching Alarms** setting is configured in the **Alarm Options** and it is password protected. When alarms are latched, the visual message remains after the alarm condition no longer exists. You will also hear a reminder beep every 10 seconds.

For more information, see the supplemental information manual.

To clear the information field and beep of the no longer active alarm messages:

- Select , Or
- Select  >  **Alarm Reset**.

Remote management of alarms

The remote alarm settings are defined in the **Alarm Options > Remote Alarms** tab, and they are password protected. The following settings are available:

- **From Remote Location:** Selecting which remote locations are allowed to pause audio alarms on this monitor
- **For Remote Bed:** Enabling or disabling audio pausing remotely for another monitor.
- **Allow Remote Pausing of:** Selecting alarm priorities that can be paused remotely.

- **Remote Alarm Light:** Use of the alarm light also for a remote alarm.
- **Show Remote Patient Name** (check box): Enabling or disabling the display of the remote patient name.
- **Remote Alarm Tone:** Selecting the remote alarm tone.
- **Remote Bed Selections** (check box) : Enabling or disabling the restoring of the remote bed selections after discharge.

For more information, see the supplemental information manual.

Nurse call

The nurse call settings are defined in the **Alarm Options** and they are password protected. You can select whether nurse call can be turned on according to the nurse call system electrical level in the hospital.

- **Normal Open:** high electrical level is exported from the nurse call connector when there is medium or high priority alarm.
- **Normal Close:** low electrical level is exported from the nurse call connector when there is medium or high priority alarm.

For more information, see the supplemental information manual.

Alarm settings after a power loss

If the monitor loses power, the alarm settings that were in effect before the power loss are restored automatically.

Stored alarm data during a power cycle or power loss

If the monitor goes through a power cycle or loss power, the stored alarm data in the Alarm log will not be affected. The alarm data remains stored in the Alarm log until the monitor automatically clears the oldest stored data to allow new data to be stored.



NOTE

The Alarm log is a service level function and it is password protected.

ECG

ECG safety precautions

ECG warnings

WARNING

ELECTRIC SHOCK.

To avoid the risk of electric shock caused by the leadwire set clips or snaps that may conduct electricity, make sure that they do not touch any other electrically conductive material including ground.

WARNING

BURNS.

When using an electrosurgery unit, note that the measurement cables do not incorporate means to protect against burns in case of a defective ESU return electrode. To avoid burns at the monitor measurement sites, ensure the following:

- Proper contact of the ESU return electrode to the patient.

- ESU return electrode near the operating area.

- Measurement electrodes, leadwires and probes far from the surgical site and the ESU return electrode.

WARNING

MISINTERPRETATION.

This device is intended to record electrocardiograms from surface ECG electrodes. It is not meant for positioning (floating) temporary pacemaker leadwires, performing pericardiocentesis, or other internal applications. Using the device in ways other than its intended use may lead to misinterpretation of measurement data.

WARNING

MISINTERPRETATION.

This device uses a computerized 12 lead ECG analysis program, which can be used as a tool in generating ECG records that provide ECG measurements and interpretative statements from the ECG recordings. The interpretive statements are only significant when used in conjunction with clinical findings. All ECG records should be over read by a qualified physician. To ensure accuracy, use only the ECG records for physician interpretation.

WARNING**MISSED ALARMS.**

When transitioning from a 10-lead cable to a 5-, or 3-lead cable, select the **Update Lead Set** option to clear the **Lead off** message from the display.

WARNING**MISSED ALARMS.**

Disconnected electrodes or loose electrode connections can lead to missed critical severity ECG alarms. If the device reports **Leads off** after selecting **Update Lead Set** option, always check the electrode connections to the patient.

WARNING**CONDUCTIVE CONNECTIONS.**

Extreme care must be exercised when applying medical electrical equipment. Many parts of the human/machine circuit are conductive, such as the patient, connectors, electrodes, transducers. It is very important that these conductive parts do not come into contact with other grounded, conductive parts when connected to the isolated patient input of the device (e.g. electrodes, SpO₂ sensor). Such contact would bridge the patient's isolation and cancel the protection provided by the isolated input.

WARNING**ARTIFACT ALARM.**

The **Artifact** alarm indicates that the system is no longer monitoring ECG and there may be no **Tachy** or **Brady** alarms. If you adjust the alarm priority level lower than the default value, keep the patient under close surveillance.

WARNING**PATIENT SAFETY.**

The default alarm priority for **V Tach** alarm is high, but you may also select another priority level. If you adjust the alarm priority level lower than the default value, keep the patient under close surveillance. **V Tach** high alarm priority escalation rules only apply when the alarm is active.

WARNING**ARRHYTHMIA PAUSED ALARM.**

The **Arrh paused** alarm indicates that the system is no longer monitoring ECG and there may be no **Tachy** or **Brady** alarms. If you adjust the alarm priority level lower than the default value, keep the patient under close surveillance.

WARNING**ELECTRODES.**

Whenever patient defibrillation is a possibility, use non-polarizing (silver/silver chloride construction) electrodes for ECG monitoring. Polarizing electrodes (stainless steel or silver constructed) may cause the electrodes to retain a residual charge after defibrillation. A residual charge will block acquisition of the ECG signal.

WARNING**DEFIBRILLATOR PRECAUTIONS.**

Patient signal inputs labeled with the CF and BF symbols with paddles are protected against damage resulting from defibrillation voltages. To ensure proper defibrillator protection, use only the recommended cables and leadwires. Using other cables or leadwires may result in damage to the equipment and compromise patient and user safety.

WARNING**HEART RATE ALARM INTERFERENCE.**

Poor cable positioning or improper electrode preparation may cause line isolation monitor transients to resemble actual cardiac waveforms and thus inhibit heart rate alarms. To minimize this problem, follow proper electrode placement and cable positioning guidelines provided with this device.

WARNING**ERRONEOUS READINGS.**

To assure accurate 12 lead analysis when using a 10-leadwire patient cable, you must verify that the correct leadwire block is plugged into the appropriate side of the cable. The V2 through V6 leadwire block is color-coded brown (AHA) or white (IEC). Otherwise, there is a risk of erroneous readings.

ECG cautions

CAUTION**SKIN IRRITATION.**

The patient's skin may become irritated after prolonged contact with electrode gel or adhesive. To avoid skin irritation, periodically check the patient and avoid too long measurement periods if possible.

CAUTION**CONDUCTIVE CONNECTIONS.**

The improper grounding may lead to vibrations in ECG and Screen Flickering.

ECG measurement description

The electrocardiogram (ECG) is the primary patient monitoring parameter. It provides heart rate measurement, 3-, 5-, 10-lead ECG monitoring, arrhythmia analysis, pacemaker detection, and ST analysis.

ECG measurement displayed on the monitor screen



1.	Monitoring (Monitoring): Waveform filter	6.	ECG (ECG): Heart rate from ECG
2.	Pacer hidden (Pacer hidden): Pacemaker status	7.	QRS indicator
3.	II (II): ECG lead label for waveform	8.	HR alarm limits
4.	ECG waveform size bar (1 mV reference)	9.	ST digit field
5.	ECG waveform	10.	Art (Art) or others: Heart rate from 2nd source, or PVC

ECG measurement limitations

- The monitor will display a **Leads off** message in an input overload condition, or upon disconnection of electrode leadwires.

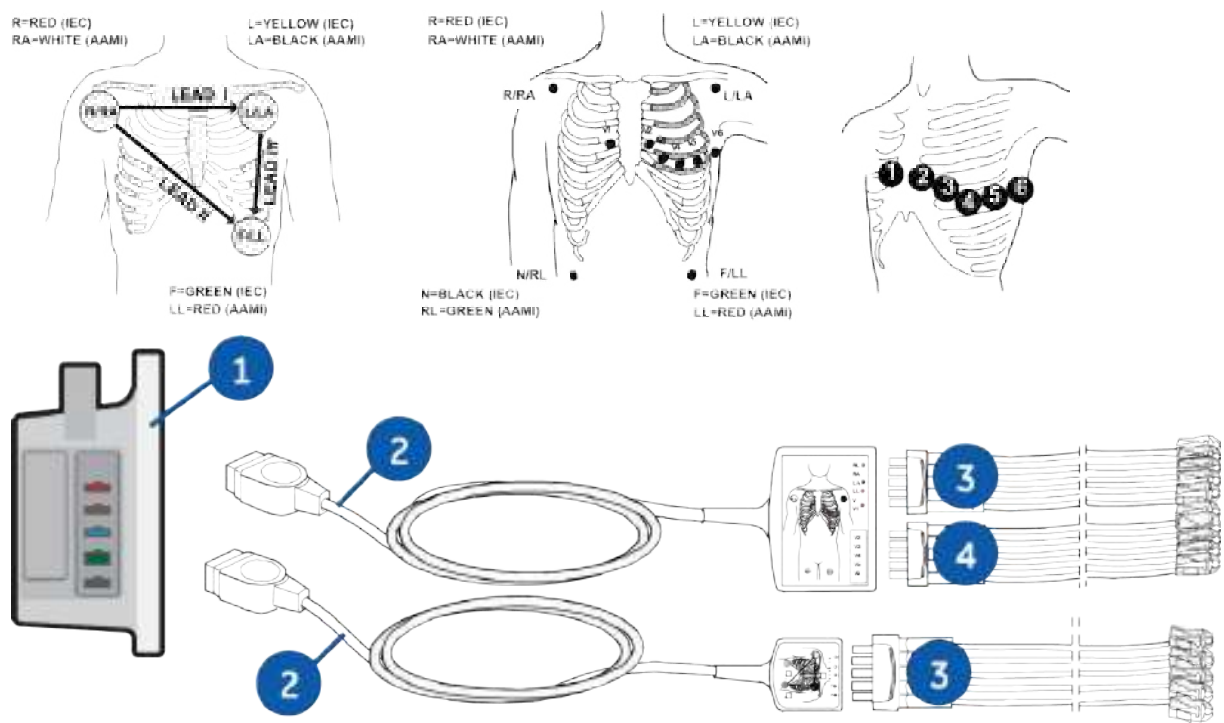
ECG points to note

- This equipment is suitable for use in the presence of electrosurgery, as tested according to IEC 80601-2-49 clause 202.8.102 Disturbances from HF Surgical Equipment.
- For information on materials used in accessories and their biocompatibility, refer to the instructions for use in the accessory package.
- Defibrillator discharge may affect the ECG measurement. Defibrillation recovery time after discharge is < 5 seconds.
- Pre-gelled ECG electrodes are recommended. Check the expiration date.
- Make sure the electrode gel is moist.
- Make sure the electrodes have good skin contact.

- Replace all electrodes at least every 24 to 48 hours.
- Use the Multi-Link electrosurgical unit (ESU) ECG patient cable when using the monitor in the presence of an electrosurgical unit. This cable, with a built-in ESU filter, helps reduce electrosurgical noise detected on the ECG signal.
- Don't use the electrodes with dissimilar metals.
- Select the HR digit field > **Deactivate ECG Leads off** to remove a **Leads off** message from the display when a cable is off.

ECG measurement setup

ECG equipment to patient connection



1.	The monitor	2.	Multi-Link 3/5-lead, or 10-lead ECG cable
3.	3-leadwire, 5-leadwire set	4.	Precordial leads leadwire set

Preparing the patient's electrode sites

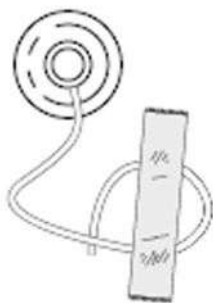
Excessive body hair or skin oil reduces electrode contact with the skin and decreases the quality of electrode signal. When preparing the electrode sites, avoid bones close to skin, obvious layers of fat and major muscles.

1. Shave any hair from the electrode site.
2. Gently rub the surface of the skin to increase capillary blood flow.

3. Clean the skin with alcohol or a mild soap and water solution to remove skin oil and dead or abraded skin cells.
4. Dry the skin completely before applying the electrodes.

Applying the electrodes to the patient

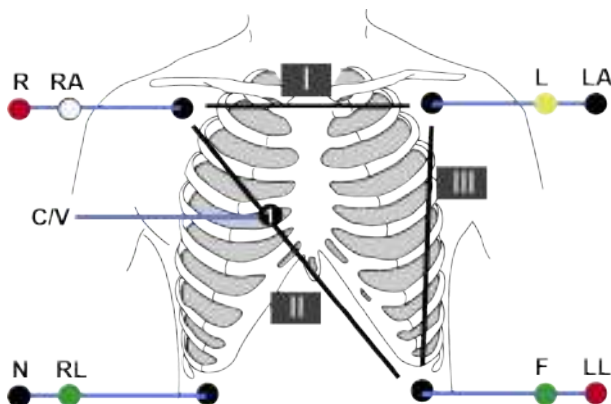
1. Place the electrodes on the prepared sites.
2. Stabilize the electrode and leadwire with a leadwire stress loop near the electrode.
3. Tape the stress loop to the patient (excluding neonates).



A secured stress loop prevents leadwire rotation about the electrode snap, leadwire tugging at the electrode, and ECG artifact.

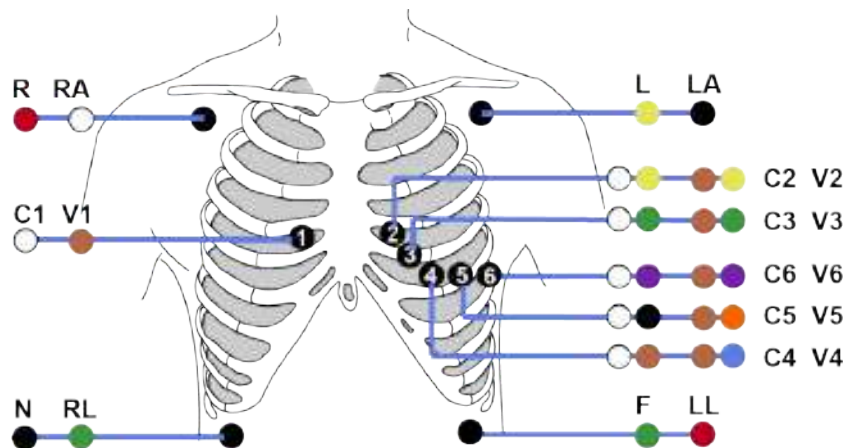
3-lead or 5-lead ECG electrode placement

For a 3-leadwire electrode placement, the R/RA, L/LA, and F/LL electrodes should be used.



IEC	AAMI/AHA	Electrode placement
R (red)	RA (white)	Just below the right clavicle.
L (yellow)	LA (black)	Just below the left clavicle.
C (white)	V (brown)	For the 5-lead placement, place the precordial electrode according to the physician's preference.
N (black)	RL (green)	Lower right edge of the rib cage.
F (green)	LL (red)	Lower left edge of the rib cage.

10-lead ECG electrode placement for cardiac monitoring



IEC	AAMI/AHA	Electrode placement
R (red)	RA (white)	Just below the right clavicle.
L (yellow)	LA (black)	Just below the left clavicle.
N (black)	RL (green)	Lower right edge of the rib cage.
F (green)	LL (red)	Lower left edge of the rib cage.
C1 (white)	V1 (brown)	4 th intercostal space, right sternal border.
C2 (white/yellow)	V2 (brown/yellow)	4 th intercostal space, left sternal border.
C3 (white/green)	V3 (brown/green)	Midway between C2/V2 and C4/V4.
C4 (white/brown)	V4 (brown/blue)	5 th intercostal space, mid-clavicular line.
C5 (white/black)	V5 (brown/orange)	Left anterior axillary line at C4/V4 level.
C6 (white/purple)	V6 (brown/purple)	Mid-axillary line at C4/V4 and C5/V5 levels.

Checking the ECG measurement

1. Check that the waveforms and parameter values are displayed when the cable is connected to the patient.

Using the ECG measurement

Setup the parameter to normal screen, if need:  >  **Screen Setup.**

ECG leads settings

You can choose the order of the ECG waveforms displayed in the ECG waveform area.

Lead selection depends on the type of ECG cable used.

The **ECG1 Lead** setting affects arrhythmia detection.

If **ECG1 Lead**, **ECG2 Lead**, or **ECG3 Lead** are changed manually and the lead becomes inactive due to a disconnection, the monitor looks for lead II, then lead I, and lastly lead III. Later, if the manually selected lead becomes available again, the monitor will change back to this lead.

Selecting the first displayed ECG lead

The **ECG1 Lead** is the first ECG lead displayed in the ECG waveform area.

1. Select the HR digit field.
2. Select a lead from the **ECG1 Lead** list.

Selecting the second displayed ECG lead

The **ECG2 Lead** is the ECG lead displayed after the **ECG1 Lead** in the ECG waveform field.



NOTE

For 3-lead ECG, the **ECG2 Lead** and **ECG3 Lead** can't select the lead. The menu is gray. They are fixed to **Cascade**.

1. Select the HR digit field.
2. Select a lead from the **ECG2 Lead** list.

If your selection is **Cascade**, the displayed **ECG1 Lead** waveform continues into the **ECG2 Lead** waveform area. The **Cascade** text is shown by the left side of the waveform.

Selecting the third displayed ECG lead

The **ECG3 Lead** is the ECG lead displayed after the **ECG2 Lead** in the ECG waveform field.



NOTE

For 3-lead ECG, the **ECG2 Lead** and **ECG3 Lead** can't select the lead. The menu is gray. They are fixed to **Cascade**.

1. Select the HR digit field.
2. Select a lead from the **ECG3 Lead** list.

If your selection is **Cascade**, the displayed **ECG2 Lead** waveform continues into the **ECG3 Lead** waveform field. The **Cascade** text is shown by the left side of the waveform.

Selecting the V ECG lead position

With 5-leadwire and 10-leadwire ECG, one V lead is measured according to the placement of the V lead electrode.

1. Select the HR digit field.
2. Select a lead from the **V Lead** list.

Changing to an ECG cable with fewer leadwires

This selection will update the measurement mode among 3-, 5-, and 10-lead mode when changing to fewer leadwires.

1. Select the HR digit field.
2. Select **Update Lead Set**.

Deactivating the ECG leads off alarm

The selection is available when there are not enough leads connected for arrhythmia detection. This selection will acknowledge the **Leads off** alarm, but it will not change the measurement mode to fewer leads.

1. Select the HR digit field.
2. Select **Deactivate ECG Leads off**.

Selecting the ECG waveform size

This selection adjusts the size of the displayed ECG waveform.

1. Select the HR digit field.
2. Select a value from the **Size** list.

The selections are **0.5x**, **1x**, **2x**, **4x**. The smaller the value, the smaller the waveform.

NOTE

The **Size** setting affects arrhythmia detection and heart rate calculation sensitivity. Normal waveform size/QRS detection sensitivity is **1x**. Size **2x** and greater increases the QRS detection sensitivity. This may be helpful for low amplitude QRS waveforms. Use with caution since baseline artifact may be detected as a QRS complex.

Selecting the hemodynamic waveform sweep speed

NOTE

This setting adjusts the waveform speed for all of the hemodynamic parameters.

1. Select the HR digit field.
2. Select a numeric value from the **Hemodynamics Sweep Speed** list.

The smaller the value, the slower the sweep speed.

Setting the beat volume



NOTE

This setting adjusts beat volume for both of ECG and SpO₂ parameters.

You can adjust the volume of heart/pulse beat sound. The beat tone depends on HR source to calculate.

1. Select the HR digit field.
2. Set the beat tone volume with the **Beat Volume** arrows.

The range is 0 (volume off) to 10.

Selecting the ECG waveform filter

You can select how the waveform appears on the display and on the printout.

1. Select the HR digit field.
2. Select the **Advanced** tab.

3. Select a filter from the **Waveform Filter** list. Choices are:
 - **Monitoring:** Use Monitor filter for poor ECG signal.
0.5 to 40 Hz
 - **ST filter:** Use ST filter for optimal ST analysis.
0.05 to 40 Hz
 - **Diagnostic:** Use Diagnostic filter for waveform analysis. This filter is sensitive to artifacts.
0.05 to 145 Hz
 - **Moderate:** Use Moderate filter to reduce high frequency interference.
0.5 to 20 Hz

Setting the QRS width

NOTE

This setting affects the arrhythmia detection sensitivity.

1. Select the HR digit field.
2. Select the **Advanced** tab.
3. Select a setting from the **QRS Width** list. Choices are:
 - **Narrow:** Intended for use with all neonates and the pediatric patient with a QRS complex width of 100 ms or less.
 - **Normal:** Intended for ECG rhythms that have QRS complex widths of approximately 70 ms or wider (for example, almost all adult patients and any patient with electronic ventricular pacing).

Setting the primary HR source

The primary heart rate can be calculated from the ECG leads, SpO₂ measurement, or invasive pressure waveform.

NOTE

This setting adjusts the primary heart rate source for all of the hemodynamic parameters.

1. Select the HR digit field.
2. Select the **Advanced** tab.
3. Select a parameter from the **Primary HR Source** list.

Showing a second HR value

You can display a second heart rate source in the HR digit field.

1. Select the HR digit field.
2. Select the **Advanced** tab.
3. Select a setting from the **Display with Primary HR** . The choices are:
 - **None**
 - **2nd HR Source**

- If the primary HR source is **ECG**, the secondary HR source displayed in this priority: **Art**, **ABP**, **UAC**, **Pleth**.
 - If the primary HR source is anything else than mentioned above, the secondary HR source is always **ECG**.
- **PVC**

Displaying the ECG grid

You can have a reference grid in the **ECG1**, **ECG2**, and **ECG3** waveform areas. The grid points will be at 200 ms horizontally and 0.5 mV vertically.

1. Select the HR digit field.
2. Select the **Advanced** tab.
3. Select the check box of the **ECG Grid** to display the grid.

Viewing and printing all ECG waveforms

1. Select the HR digit field > **Advanced** tab.
2. Select **All ECG Waveforms** to view all ECG waveforms.
3. Select  to print all ECG waveforms.
4. You can stop printing by selecting .

Relearning the patient's QRS pattern

During ECG monitoring, you may need to use the **Relearn** feature when a dramatic change in the patient's ECG pattern has occurred. Allowing the monitor to learn the new ECG pattern may correct false arrhythmia alarms and heart rate values, and restores the ST measurements.

Relearning typically takes 30 seconds or less. This relearn key will turn to gray and display **Learning** while the monitor relearns the QRS pattern. During this time, arrhythmia detection may not be available. If the monitor is not able to relearn due to a low amplitude QRS, for example, an **Arrhythmia Paused** alarm is triggered.

1. Select the HR digit field.
2. Select the **Advanced** tab.
3. Select **Relearn**.

Automatic relearning takes place when:

- The measurement mode changes between a 3-lead mode and any other lead mode.
- The **ECG1 Lead** selection is changed in the 3-lead mode.
- The V lead selection is changed in the 5-lead mode, and 10-lead modes.



NOTE

Don't relearn QRS pattern during V Tach conditions, or else the V Tach alarm may not display in future.

ECG alarm limits

From the **Alarms** tab, you can set

- One common HR limit for multiple sources (e.g., ECG, Pleth, Art).
- Arrhythmia alarm settings.
- The PVC alarm limits.
- The SVC alarm limits.

Setting the HR alarm limits

1. Select the HR digit field.
2. Select the **Alarms** tab.
3. Check that the **Alarm** is turned on.
4. Adjust the alarm limits with the arrows. Limits are adjust in increments of 5 bpm per step.

**NOTE**

If you want the HR alarm off, select from the **Alarm** list.

Setting PVC alarm limits

1. Select the HR digit field.
2. Select the **Alarms** tab.
3. Select the **PVC** vertical tab.
4. Check that the **Alarm** is turned on.
5. Adjust the PVC alarm limit with the arrows.

**NOTE**

If you want the PVC alarm off, select from the **Alarm** list.

Setting SVC alarm limits

The SVC value displays in the menu also.

1. Select the HR digit field.
2. Select the **Alarms** tab.
3. Select the **SVC** vertical tab.
4. Check that the **Alarm** is turned on.
5. Adjust the SVC alarm limit with the arrows.

**NOTE**

If you want the SVC alarm off, select from the **Alarm** list.

ECG measurement practicalities

Alternate pulse rate source

The alternate pulse rate source allows clinicians to acquire a pulse rate from a source other than ECG (Art, ABP, UAC or Pleth). The following circumstances may warrant the use of an alternate pulse rate source:

- Excessive artifact due to an electrical interference from equipment (e.g., electrosurgical device).
- Excessive patient movement causing significant artifact (e.g., seizure activity).
- Inability to use standard lead placement (e.g., burns).

Auto algorithm

The monitor use the AUTO algorithm. **AUTO** selects the first available heart rate source based on a pre-defined parameter priority:

1. ECG
2. Art
3. ABP
4. UAC
5. Pleth

Pacemaker detection

Pacemaker detection warnings

WARNING

PACEMAKER PATIENTS.

Rate meters may continue to count the pacemaker rate during occurrences of cardiac arrest and some arrhythmias. Do not rely entirely upon the heart rate meter alarms. Keep pacemaker patients under close observation. See the supplemental information provided for disclosure of the pacemaker pulse rejection capability of this device.

WARNING

FALSE CALLS.

False low heart rate indicators or false Asystole calls may result with certain pacemakers because of pacemaker artifact such as electrical overshoot of the pacemaker overlapping the true QRS complexes.

WARNING**MONITORING PACEMAKER PATIENTS.**

The monitoring of pacemaker patients can only occur with the pace program activated.

WARNING**PACEMAKER INDICATION.**

Pacemaker activity is indicated on the electrocardiogram through the display of a different colored pacemaker marker pulse. All pacemaker marker pulses appear upright and uniform and should not be used for diagnostic interpretation.

WARNING**PATIENT HAZARD.**

A pacemaker pulse can be counted as a QRS during Asystole when pacemaker detection is on. Keep pacemaker patients under close observation.

WARNING**PATIENT HAZARD.**

Asystole may not be detected if the patient has a pacemaker that produces high-amplitude pacer spikes and pacemaker detection is on. Keep pacemaker patients under close observation.

Pacemaker detection points to note

- Pacemaker detection is on by default. If you turn pacemaker detection off, you should turn it back on for patients with pacemakers. Pacemaker detection must be used whenever the monitored patient has a pacemaker.
- The following leads are used for pacemaker detection:
 - 5-lead mode: Leads R/RA, L/LA, F/LL, and C/V
 - 10-lead mode: Leads R/RA, F/LL, C1/V1, and C5/V5
- Pacemaker detection is done on leads I, II, and V simultaneously.
- If the patient has an atrial pacemaker, ST calculations can be performed if the pacer spike does not coincide with the ISO point's adjustment range.
- The V lead plays a critical role in pacemaker detection.

Selecting the pacemaker detection

1. Select the HR digit field.
2. Select the **Advanced** tab.
3. Select a value from the **Pacemaker Detection** list.

Choices are:

- **Show**: Displays pacemaker spikes on the ECG waveform.

- **Hide:** Hides the pacemaker spikes on the ECG waveform.
An indicator will display on the left side of the waveform, when the selection is **Hide**.
- **Sensitive:** Increases pacemaker detection sensitivity and displays the pacemaker spikes on the ECG waveform. By selecting this option you can improve the detection of small amplitude pacemakers. However, this mode is also more sensitive to false pacemaker detections.

Arrhythmia monitoring

Arrhythmia monitoring warnings

WARNING

MISSED ALARMS.

V Fib/V Tach should not be considered a substitute for the V Tach arrhythmia alarm. Efforts to lower the V Tach alarm level can result in missed ventricular tachycardia alarms.

WARNING

LOSS OR DETERIORATION OF ARRHYTHMIA DETECTION.

Automated arrhythmia analysis programs may incorrectly identify the presence or absence of an arrhythmia. A physician must therefore interpret the arrhythmia information in conjunction with other clinical findings. Please take special note of the following ECG waveform conditions:

Noisy waveforms. Noisy portions of ECG waveforms are typically excluded from analysis. The exclusions are necessary to reduce the occurrence of inaccurate beat interpretations and/or rhythm alarms. If the excluded noisy portions of the ECG waveform contain true arrhythmia events, those events may remain undetected by the system.

Beat amplitude and duration. Accurate detection and interpretation of beats becomes increasingly difficult as the amplitude and/or duration of those beats approach the design limits of the analysis program. Thus, as beats become extremely wide or narrow, or especially as beats become small, arrhythmia interpretation performance may degrade.

Other morphology considerations. Automated arrhythmia detection algorithms are designed fundamentally to detect significant changes in QRS morphology. If an arrhythmia event is present and does not exhibit a significant change from the patient's predominant morphology, it is possible for those events to remain undetected by the system.

WARNING**PAUSED ANALYSIS.**

Certain conditions pause arrhythmia analysis. When paused, arrhythmia conditions are not detected and alarms associated with arrhythmias do not occur. Conditions causing paused arrhythmia analysis include arrhythmia paused, leads off, alarm pause, all alarms off, and discharged patient. Always keep the patient under close surveillance.

WARNING**FAILURE TO DETECT LETHAL ARRHYTHMIA.**

Always monitor ECG for arrhythmia detection purposes. HR calculated from pulsatile SpO₂ waveform may differ significantly from ECG HR measured values. Users should be aware that the **SpO2 probe off** and **No SpO2 pulse** alarms escalate no higher than a Medium priority.

WARNING**FAILURE TO DETECT LETHAL ARRHYTHMIA.**

The SpO₂ parameter pulsatile heart rate measurement is based on the optical detection of a peripheral flow pulse and therefore may not detect certain arrhythmias. The pulse oximetry parameter should not be used as a replacement or substitute for ECG based arrhythmia analysis.

WARNING**ARRHYTHMIA PAUSED ALARM.**

The **Arrhythmia Paused** alarm indicates that the system is no longer monitoring arrhythmia or heart rate from ECG. If you adjust the alarm priority level lower than the default value, keep the patient under close surveillance.

Arrhythmia detection description

When an ECG signal is detected at the start of monitoring, the arrhythmia detection algorithm begins acquiring and analyzing QRS complexes in the leads used for arrhythmia detection. This phase is known as learning. Once learning is complete, the dominant QRS complex is stored as a reference template. Reference template is used as a normal morphology of that patient and it is compared with incoming beats to identify possible arrhythmias.

The EK-Pro arrhythmia detection algorithm is used. EK-Pro simultaneously analyzes leads I, II, III, and V. Once learning is complete, the dominant QRS complex becomes the template.

The algorithm uses continuous correlation, incremental template updating and contextual analysis. Continuous correlation attempts to find the best match between each incoming complex and the set of stored (learned) templates. If no match is found with the existing template, a new template is stored for the identified new QRS shape. Incremental template updating allows information from each beat, that correlates over time, to be reflected in the associated template. Contextual analysis uses information from neighboring QRS complexes along with existing template measurements to make the best possible decision regarding the beat's origin (e.g., early, wide).

Arrhythmia measurement limitations

- Since the arrhythmia detection algorithm sensitivity and specificity is less than 100%, sometimes there may be some false arrhythmias detected and also some true arrhythmia events may not be detected. This is especially true when the signal is noisy.
- The ECG size and QRS width settings affect arrhythmia detection and heart rate calculation sensitivity.
- If QRS amplitude is low, the monitor might not be able to calculate HR and false Asystole may occur.
- If learning phase takes place while arrhythmia is already occurring, it may affect the subsequent arrhythmia detection.
- During the learning phase of the algorithm, arrhythmia detection may not be available. As a result, the patient condition should be closely monitored during the learning phase and for several minutes after the learning phase to allow the algorithm to reach optimal detection performance.

Setting arrhythmia alarms

You can set the arrhythmia alarms from **Alarms Setup** menu or from the **ECG** menu.

1. Select the HR digit field > **Alarms** tab.

Or, select  >  **Alarm Setup** > **Priorities** tab.

2. You can select the vertical tabs for the **Lethal**, **Ventri cular** and **Atrial** alarms.
 - **Lethal**: You can select the **Create Snapshot** options, the alarm priority for lethal alarms is always high.
You can setup the **V Tach** alarm condition.
 - **Ventri cular**: You can select the alarm priority or turn off **Create Snapshot** options.
 - **Atrial**: You can select the alarm priority or turn off **Create Snapshot**, and setup **Pause Interval** options.
You can setup the SVT settings.

Setting the V Tach alarm conditions

This setting determines the conditions to trigger V Tach alarm. The selection is shown only if the **V Tach Event Duration Criteria** has been allowed during configuration through  >  **Service** > **Alarm Options** > **Alarm Delays**. This setting is password protected.

For more information, see the supplemental information manual.

1. Select the HR digit field.
2. Select the **Alarms** tab.
3. Select the **Lethal** vertical tab.
4. Select the following conditions:
 - **Minimum HR/min** : Select the minimum HR value to trigger V Tach alarm.
 - **Event Duration**: Select how long time is needed to trigger V Tach alarm.

- **AND/OR:** Select both of above conditions needed to trigger V Tach alarm, or only one.

About V Tach criteria

If **V Tach Event Duration Criteria** has been allowed during configuration through  >  **Service** > **Alarm Options** > **Alarm Delays**, you can individualize the V Tach alarm to a specific patient condition. The alarm history at the bedside monitor may not match that of the central station when conditions have been adjusted to other than the default setting (**Minimum HR/min** = 100 and **Event Duration** = Off). You can always check the complete patient history from the central station full disclosure. You can check the current values through HR digit field > **Alarms** tab > **Lethal** vertical tab.

Setting the alarm pause interval

You can set the time interval between the two adjacent beats before the pause alarm condition is annunciated.

1. Select the HR digit field.
2. Select the **Alarms** tab.
3. Select the **Atrial** vertical tab.
4. Select a value from the **Pause Interval** list.

Setting the SVT length

This setting determines how many consecutive SVCs are needed to trigger the **SV Tachy** alarm.

1. Select the HR digit field.
2. Select the **Alarms** tab.
3. Select the **Atrial** vertical tab.
4. Select a value from the **SVT Length** list.

Setting HR for SVT

This setting determines the minimum value for the HR to trigger the **SV Tachy** alarm.

1. Select the HR digit field.
2. Select the **Alarms** tab.
3. Select the **Atrial** vertical tab.
4. Select a value from the **HR for SVT /min** list.

Arrhythmia alarm messages

NOTE

A clinician must analyze the arrhythmia information in conjunction with the other clinical findings.

Table 1 HR alarms

Alarm message	Arrhythmia detection criteria
Brady	HR below the HR alarm limit.

Table 1 HR alarms (Table continued)

Alarm message	Arrhythmia detection criteria
Tachy	HR over the HR alarm limit.

Table 2 Lethal alarms

Alarm message	Arrhythmia detection criteria
Asystole	HR decreased to zero, or beat detection has not occurred in the last 5 seconds.
V Fib / V Tach	ECG waveform indicates a chaotic ventricular rhythm.
V Tach	A run of PVCs is detected with a run length of six beats or more and the effective HR and V Tach duration meet the user defined criteria.

Table 3 Ventricular alarms

Alarm message	Arrhythmia detection criteria
VT > 2	A run of PVCs is detected with a run length of more than two beats but less than six beats. In addition at least two consecutive RR intervals in the run must have an effective HR that is equal to or exceeds the V Tach Minimum HR/min .
R on T	Isolated PVC is detected within 100 ms of the peak of the T-wave of the patient's predominant normal beat.
V Brady	Run of PVCs are detected with a run length of at least three beats. In addition, at least two consecutive RR intervals in the run must have an effective heart rate less than 50 bpm (60 bpm in Neonatal mode).
Couplet	Two consecutive PVCs are detected between normal beats, N-V-V-N. The coupling interval between the PVCs must be less than 600 ms.
Bigeminy	Every other beat is PVC (N-V-N-V-N-V).
Accel. Ventric.	Accelerated ventricular rhythm - Run of PVCs with a run length of at least six beats and the requirements for user defined V Tach Criteria or V Brady are not met.
Trigeminy	Every third beat is PVC (N, N, V, N, N, V, N, N, V).
Multifocal PVCs	Within 16 previous beats two or more PVCs with different morphologies are detected.

Table 4 Atrial alarms

Alarm message	Arrhythmia detection criteria
A Fib Not available in NEONATAL mode.	Absence of P-waves and irregular RR-interval.
Irregular NEONATAL mode only.	Six consecutive normal RR intervals vary by 100 ms or more.
Missing Beat Not available in NEONATAL mode.	Actual RR interval more than 1.8 times the average RR interval.
Pause	Coupling interval between two beats exceeds: 1 to 5 seconds (configurable)
SV Tachy	A run of SVCs is detected with a run length of at least the set SVT Length and the heart rate is at least the set HR for SVT /min .

Table 5 PVC alarm

Alarm message	Arrhythmia detection criteria
Frequent PVCs	PVC count over the PVC alarm limit.

Table 6 SVC alarm

Alarm message	Arrhythmia detection criteria
Frequent SVCs	SVC count over the SVC alarm limit.

ST detection

About the ST analysis

ST analysis starts automatically after the ECG leads have been connected and QRS detection has started. Once the program has completed the learning phase, ST values and QRS complexes are updated every 10 seconds.

During the learning period, the algorithm uses the isoelectric reference and the J+ reference points to calculate the ST values. The algorithm automatically searches for the J and ISO points. These settings can be adjusted for the current patient.

In order to get the better ST analysis, it is recommended to setup **ST filter** for **Waveform Filter**.

- Select the ECG digit field > **Advanced** tab > **Waveform Filter** > **ST filter**.

ST detection measurement limitations

- ST values may be affected by such factors as some drugs or metabolic and conduction disturbances.
- Since ST is often calculated with a fixed delay from the J point, changes in heart rate may affect ST.
- The ST algorithm has been tested for accuracy of the ST segment data. The significance of the ST segment changes needs to be determined by a physician.

Adjusting the ST point manually

- The device automatically set the ST point according to the heart rate. Manual adjustments may be required if the following automatic settings are not adequate for example when QT time is short:
 - If the heart rate is greater than or equal to 120 bpm, then the ST point is set to J + 60 ms.
 - If the heart rate is less than 120 bpm, then the ST point is set to J + 80 ms.

Manually adjusting the ST Point, ISO Point, or J Point overrides the automatic detection of the ST point. As a result, you are responsible for monitoring the patient ST levels with new adjustments and required to make further setting adjustments as necessary according to changes in the patient's rhythm.

1. Select the ST digit field > **ST** tab > **Adjust ST** vertical tab.
2. Select a value from the **ST point** list.

Adjusting the isoelectric measurement (ISO) point

The device automatically set the isoelectric point. Manual adjustments may be required if, for example, a P-wave is attached to the QRS-wave.

1. Select the ST digit field > **ST** tab > **Adjust ST** vertical tab.
2. Click **Set ISO point**, adjust the bar with the arrows.

When the ISO point is adjusted, also the ST point changes accordingly and its automatic setting is stopped.

Adjusting the J point

1. Select the ST digit field > **ST** tab > **Adjust ST** vertical tab.
2. Click **Set J point**, adjust the bar with the arrows.

When the J point is adjusted, also the ST point changes accordingly.

Setting alarm limits for lead groups

1. Select the HR digit field > **ST** tab.
2. Select **ST Alarm** vertical tab.
3. Check that the **Alarm** is turned on.
4. Set the related alarm limits with arrows.

The limit settings affect all leads in the lead group, which list in the menu.

Impedance respiration

Respiration safety precautions

Respiration warnings

WARNING

ELECTRIC SHOCK.

To avoid the risk of electric shock caused by the leadwire set clips or snaps that may conduct electricity, make sure that they do not touch any other electrically conductive material including ground.

WARNING

ERRONEOUS READINGS.

The impedance respiration measurement is inherently very sensitive as it measures very small physiological signals (changes of impedance of the patient's chest area). Electromagnetic interference may cause erroneous measurements at various frequencies, for example interference with the signal/ waveform, leading to respiration rate readings inconsistent with the patient's true respiration rate. If you notice this, use another form of respiration monitoring, for instance end-tidal CO₂.

WARNING

APNEA EVENTS.

The device may not detect all episodes of inadequate breathing, nor does it distinguish between central, obstructive, and mixed apnea events.

WARNING

BURNS.

When using an electrosurgery unit, note that the measurement cables do not incorporate means to protect against burns in case of a defective ESU return electrode. To avoid burns at the monitor measurement sites, ensure the following:

- Proper contact of the ESU return electrode to the patient.

- ESU return electrode near the operating area.

- Measurement electrodes, leadwires and probes far from the surgical site and the ESU return electrode.

**WARNING****DEFIBRILLATOR PRECAUTIONS.**

Patient signal inputs labeled with the CF and BF symbols with paddles are protected against damage resulting from defibrillation voltages. To ensure proper defibrillator protection, use only the recommended cables and leadwires. Using other cables or leadwires may result in damage to the equipment and compromise patient and user safety.

WARNING**ELECTRODE CONFIGURATION.**

Impedance respiration monitoring is not reliable when ECG electrodes are placed anywhere but on the chest.

WARNING**ELECTRODES.**

Whenever patient defibrillation is a possibility, use non-polarizing (silver/silver chloride construction) electrodes for ECG monitoring. Polarizing electrodes (stainless steel or silver constructed) may cause the electrodes to retain a residual charge after defibrillation. A residual charge will block acquisition of the ECG signal.

Respiration cautions

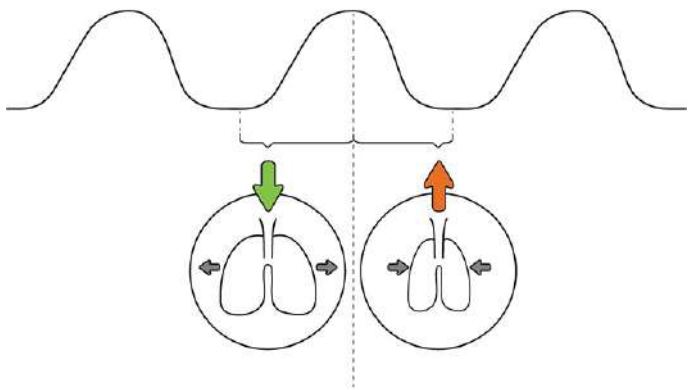
CAUTION**PATIENT SAFETY.**

The impedance respiration measurement may cause rate changes in Minute Ventilation Rate Responsive Pacemakers. Turn off the impedance respiration measurement on the monitor to avoid risks to the patient.

Respiration measurement description

Respiration measurement is based on the variation of the bio-impedance of the patient's thorax and abdomen. To measure impedance, the respiration sensor sends a small electric current to the patient through the electrodes placed on the torso. Air flowing in and out, as well as changes in geometry, change the electrical properties of the body. The impedance respiration waveform reflects those changes.

The following graphic illustrates how inhalation and exhalation are reflected in the respiration waveform:



Respiration measurement displayed on the monitor screen



1.	Imped. (Imped.): waveform label	6.	II (II): Measurement lead
2.	Waveform size bar	7.	Alarm limits, alarm status, or other messages
3.	Impedance respiration waveform	8.	RR(Imped.) (RR(Imped.)): Impedance respiration rate
4.	Resp (Resp): parameter label	9.	Respiration indicator
5.	/min (/min): unit		

Respiration measurement limitations

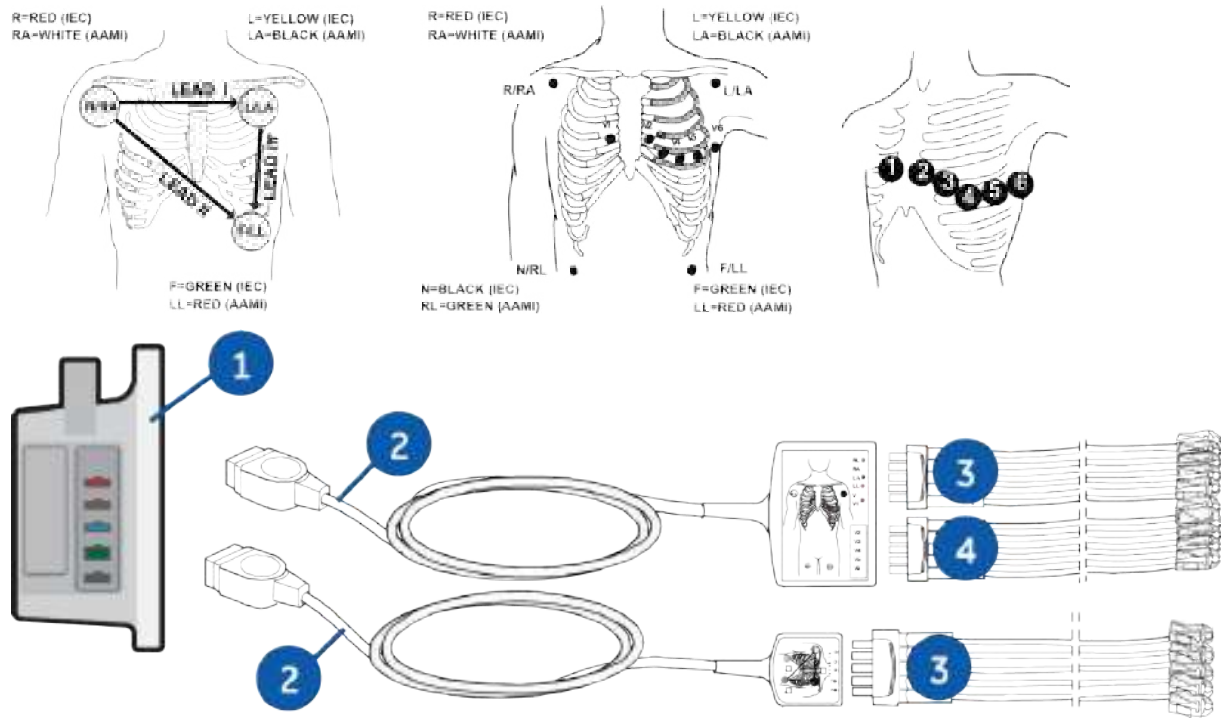
- Electrical devices, such as electrosurgery units and infrared heaters, that emit electromagnetic disturbance, may cause artifacts or disable the respiration measurement completely.
- Motion artifact (such as mobile (walking) patient, shivering, and interference from the beating heart) may interfere with the respiration measurement, reduce the respiration rate accuracy, and/or disable apnea detection. Respiration measurement can only detect central type apnea. Apnea cannot be detected in the presence of any breathing effort or motion of the patient.
- In some rare cases the respiration rate and pulse rate values of the patient may be very close to each other, resulting in too low respiration rate values and false alarms.
- Irregular cardiac rhythm of the patient may cause suboptimal performance of the respiration measurement.
- You can only use one impedance respiration measurement on a patient at a time.

Respiration points to note

- This equipment is suitable for use in the presence of electrosurgery, as tested according to IEC 80601-2-49 clause 202.8.102 Disturbances from HF Surgical Equipment.
- For information on materials used in accessories and their biocompatibility, refer to the instructions for use in the accessory package.
- Defibrillator discharge may affect the respiration measurement. Defibrillation recovery time after discharge is ≤ 15 seconds.
- Always check the patient and the measurement site if the accuracy of the respiration data is questionable.
- Respiration rate may be shown as 0 without an apnea alarm if the patient's respiration frequency and amplitude are very low. Apnea alarm appears if there are no detected breaths during user-configurable apnea alarm time.
- Make sure the electrode gel is moist.
- Make sure electrodes have good skin contact.
- Since respiration monitoring is so closely linked with ECG monitoring, patient preparation and electrode placement are important.
- Intermittent mechanical ventilation: During spontaneous breathing the ventilator may at times support the patient's ventilation with an extra inspiration. If these ventilator inspirations are substantially larger than the spontaneous breaths, the respiration calculation may mistakenly count only the inspirations and expirations produced by the ventilator.

Respiration measurement setup

Respiration equipment to patient connection



1.	The monitor	2.	Multi-Link 3/5-lead, or 10-lead ECG cable
3.	3-leadwire, 5-leadwire set	4.	Precordial leads leadwire set

Preparing the patient's respiration electrode sites

Excessive body hair or skin oil reduces electrode contact with the skin and decreases the quality of electrode signal.

NOTE When preparing the electrode sites, avoid obvious layers of fat and major muscles.

1. Remove any hair from the electrode site.
2. Gently rub the surface of the skin to increase capillary blood flow.
3. Clean the skin with alcohol or a mild soap and water solution to remove skin oil and dead or abraded skin cells.
4. Dry the skin completely before applying the electrodes.

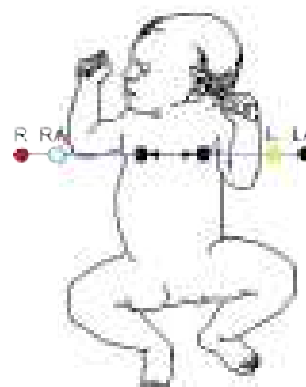
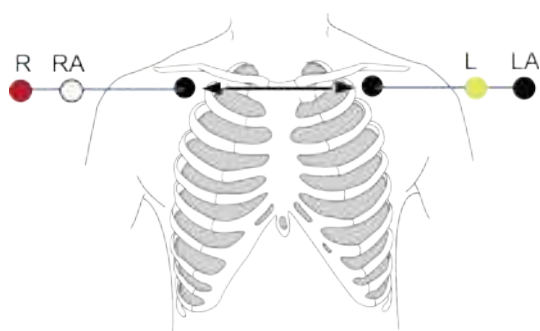
Respiration lead and breath detection

Respiration leads identify the ECG leads used for respiration measurement. Each respiration lead is suited for specific breath detection conditions:

Lead	Description
Lead I	Best for detecting thoracic breathing, but is more susceptible to cardiogenic artifact.
Lead II	Equally good at detecting thoracic or abdominal breathing, but is more susceptible to cardiogenic and motion (head, neck, or arm) artifact.
Lead RL-LL	Best at detecting abdominal breathing and is not as susceptible to cardiogenic or motion artifact. Not available for 3-lead measurement.

Even though the same electrodes are used for ECG and respiration monitoring, it is possible to get a lead fail message for respiration without one for ECG. The impedance may be too high for respiration detection, but the electrode is still good for ECG detection.

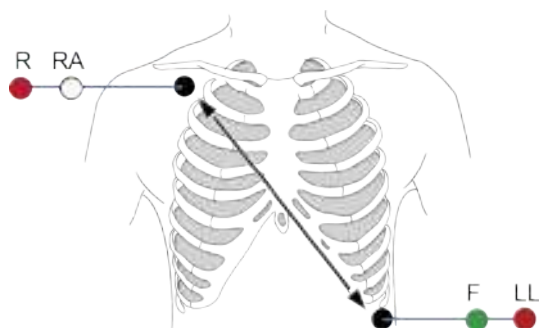
Respiration lead I electrode placement



ECG lead I for upper chest breather

IEC	AAMI/AHA	Electrode placement
R (red)	RA (white)	Just below the right clavicle.
L (yellow)	LA (black)	Just below the left clavicle.

Respiration lead II electrode placement

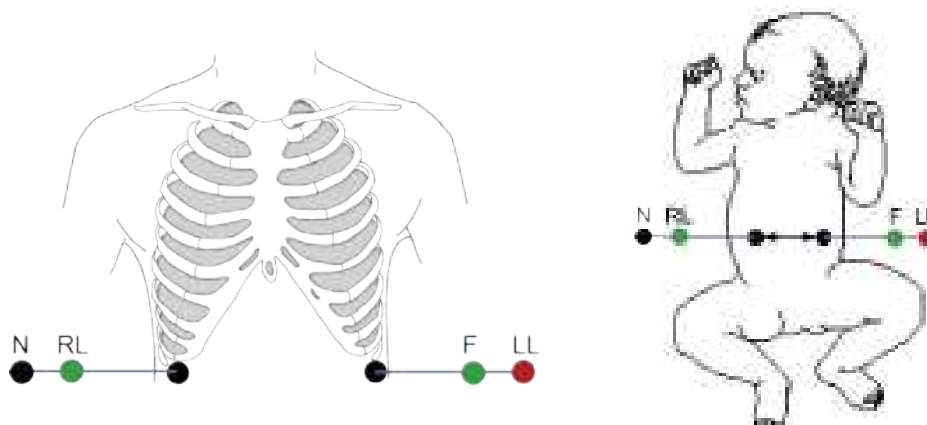


ECG lead II for chest or upper abdominal breather

IEC	AAMI/AHA	Electrode placement
R (red)	RA (white)	Just below the right clavicle.
F (green)	LL (red)	Lower left edge of the rib cage.

Respiration lead RL-LL electrode placement

When monitoring respiration through the RL-LL vector, use a standard 5-, or 10-leadwire electrode placement, except place the RL electrode on the fifth intercostal space on the right side of the chest. Impedance respiration lead between RL and LL provides maximum respiration signal strength, minimum noise/artifact content, and minimum cardiogenic artifact.



RL-LL vector for abdominal breather

IEC	AAMI/AHA	Electrode placement
N (black)	RL (green)	Fifth intercostal space on the right.
F (green)	LL (red)	Lower left edge of the rib cage.

Respiration measurement checks

Check that the waveform and parameter value are displayed when the cable is connected to the patient.



NOTE

There may also be a respiration rate value displayed in the CO₂ digit field. Only the value in the respiration digit field is measured from the impedance respiration source.

Using the respiration measurement

Setup the parameter to normal screen, if need: > **Screen Setup**.

Turning on the respiration measurement

If the respiration measurement does not start automatically, you need to select it on.

1. Select the impedance respiration digit field.
2. Select **ON** from the **Measurement** list.

Selecting the respiration lead

1. Select the impedance respiration digit field.
2. Select a lead from the **Measurement Source** list. Lead selections are presented as graphical icons.

Selecting the respiration waveform size

1. Select the impedance respiration digit field.
2. Select a value from the **Size** list.

The greater the value, the larger the waveform size.

Selecting the waveform speed

1. Select the impedance respiration digit field.
2. Select a value from the **Sweep Speed** list.

The smaller the value, the slower the sweep speed.

Setting the averaging time

1. Select the impedance respiration digit field.
2. Select a value from the **Resp Averaging Time** list.

Parameter filtering (Resp averaging)

When configured, the parameter filter calculates a moving average of the calculated parameter values. The averaging time can be configured with the UI **Resp Averaging Time**. Using the parameter filter makes the values more accurate but may delay the visibility of changes. Also increasing the averaging time reduces fast variations in parameter values.

The averaging is weighted using the estimated reliability and time of each value. Short periods of artifact in original values will have limited effect on the displayed value. Also, recent values will have higher weight than older values.

If the original measurement is reliable and the value clearly violates the alarm limit, the value is updated faster to decrease the delay to alarms. Similarly, if the value is reliable and returns within the alarm limits, the value is updated faster to reduce unnecessary alarms. The fixed alarm delays are still applied.

Setting the apnea alarm delay

You can select the apnea alarm delay by defining seconds in the **Apnea Limit Seconds**.

1. Select the impedance respiration digit field.
2. Select the **Alarms** tab.
3. Select a value from the **Apnea Limit Seconds** list.

Setting the respiration alarm limits

1. Select the impedance respiration digit field.

2. Select the **Alarms** tab.
3. Check that **Alarm** is turned on.
4. Adjust the alarm limits with arrows.

**NOTE**

If you want the alarm off, select from the **Alarm** list.

Turning off the respiration measurement

1. Select the impedance respiration digit field.
2. Select **OFF** from the **Measurement** list.

Pulse oximetry

SpO₂ safety precautions

SpO₂ warnings



WARNING

DEFIBRILLATOR PRECAUTIONS.

Patient signal inputs labeled with the CF and BF symbols with paddles are protected against damage resulting from defibrillation voltages. To ensure proper defibrillator protection, use only the recommended cables and leadwires. Using other cables or leadwires may result in damage to the equipment and compromise patient and user safety.

WARNING

PATIENT SAFETY.

The operator is responsible for checking the compatibility of the pulse oximetry device, sensor, and patient cable prior to use. Incompatible components can result in degraded performance and/or device malfunction and compromised patient safety.

WARNING

PATIENT SAFETY.

If the accuracy of any measurement does not seem reasonable, first check the patient's vital signs, then check for conditions that may cause inaccurate SpO₂ readings. If the problem is still not resolved, check the monitor and the cable, or sensor for proper functioning.

WARNING

PATIENT SAFETY.

A pulse oximeter should not be used as an apnea monitor. A pulse oximeter should be considered an early warning device. As a trend toward patient deoxygenation is indicated, blood samples should be analyzed by a laboratory CO-oximeter to completely understand the patient's condition.

WARNING**PATIENT SAFETY.**

Check that the pulse oximetry waveform is physiological in shape to ensure waveform quality and minimize noise spikes caused by motion conditions. (Not applicable when monitoring SpO₂ with Masimo SET technology.) Otherwise, there is a risk of compromised patient safety.

WARNING**PATIENT SAFETY.**

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

WARNING**PATIENT SAFETY.**

Pulse rate measurement is based on the optical detection of a peripheral flow pulse and therefore may not detect certain arrhythmias. The pulse oximeter should not be used as a replacement or substitute for ECG-based arrhythmia analysis. Otherwise, there is a risk of compromised patient safety.

WARNING**PATIENT SAFETY.**

Cable/sensor after care:

- Do not immerse sensors or patient cables in water, solvents or cleaning solutions.

- Do not reuse sensors intended for single patient use.

- Do not sterilize sensors or patient cables by irradiation, steam, or ethylene oxide.

- Clean the surface of the probe before and after each patient use.

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

- If a probe is damaged in any way, discontinue use immediately.

- Inaccurate SpO₂ data can result if a sensor is past its useful life. Therefore, re-evaluate the measurement periodically by performing additional assessment of the patient and equipment, including consideration of use of alternate monitoring methods such as direct measurement of arterial oxyhemoglobin saturation (SaO₂).

- A damaged sensor may cause burns during electrosurgery.

WARNING**PATIENT SAFETY.**

Oximetry performance may be impaired when patient perfusion is low or signal attenuation is high. Always keep the patient under close observation.

WARNING**INACCURATE RESULTS.**

The display of inaccurate pulse oximetry (SpO₂) values has been linked to the presence of poor signal strength or artifact due to patient motion during signal analysis. This condition is most likely to be encountered when the monitor is used on neonates or infants. These same conditions in adults do not impact the SpO₂ values to the same extent.

We recommend the application of the following criteria when using the pulse oximetry function on neonates and infants:

The peripheral pulse rate (PPR) as determined by the SpO₂ function must be within 10% of the heart rate, and

The SpO₂ signal strength should be adequate. This is indicated by the display of two or three asterisks or the absence of the **Low signal quality** message.

Procedures or devices previously applied in your facility for SpO₂ monitoring should be used in the event the SpO₂ value from the monitor cannot be validated by the above criteria.

WARNING**ERRONEOUS READINGS.**

Interference may occur when the working SpO₂ sensor close to gesture sensor area, leading to low quality of SpO₂ waveform and signal. Do not allow the working SpO₂ sensor close to gesture sensor area.

WARNING**ERRONEOUS READINGS.**

Many factors may cause inaccurate readings and alarms, decreased perfusion, and or low signal strength:

Interfering substances:

Carboxyhemoglobin may erroneously increase SpO₂ reading.

Methemoglobin (MetHb) usually represents less than 1% of the total Hb, but in the case of methemoglobinemia that can be congenital or induced by some IV dyes, antibiotics (such as sulphas), inhaled gases, etc., this level increases sharply and thus can cause inaccuracies in the SpO₂ reading.

Intravascular dyes (such as indocyanine green, methylene blue, etc.)

Physiological characteristics:

Cardiac arrest

Hypotension

Shock

Severe vasoconstriction

Severe anemia

Hypothermia

Venous pulsations

Darkly pigmented skin

Ventricular septal defects (VSDs)

Nail polish or artificial nails at the measurement site

Environmental conditions:

Electromagnetic interference

Excessive ambient light

Electrical interference

Electrosurgery

Defibrillation - may cause inaccurate reading for a short amount of time.

Excessive patient/sensor motion. Artifact can simulate an SpO₂ reading, so that the device fails to sound an alarm. In order to ensure reliable patient monitoring, the proper application of the probe and the signal quality must be checked at regular intervals.

Sensor placement:

Incorrect sensor placement - prolonged monitoring or incorrect sensor application can cause skin irritation or impaired circulation. It is recommended that you check the probe site every four hours (more frequently for poor perfusion or for neonates). Refer to the instructions supplied with the sensor.

Sensor placement on the same extremity as a blood pressure cuff, arterial catheter or intravascular line; or arterial occlusion proximal to the sensor.

- Poor sensor fit or sensor applied too tightly.
- Do not allow tape to block the sensor light emitter and detector.
- Improper connection to the monitor or interconnect cable.
- Contamination of lenses inside the sensor.

WARNING**FAILURE TO DETECT LETHAL ARRHYTHMIA.**

Always monitor ECG for arrhythmia detection purposes. HR calculated from pulsatile SpO₂ waveform may differ significantly from ECG HR measured values. Users should be aware that the **SpO₂ probe off** and **No SpO₂ pulse** alarms escalate no higher than a Medium priority.

WARNING**FAILURE TO DETECT LETHAL ARRHYTHMIA.**

The SpO₂ parameter pulsatile heart rate measurement is based on the optical detection of a peripheral flow pulse and therefore may not detect certain arrhythmias. The pulse oximetry parameter should not be used as a replacement or substitute for ECG based arrhythmia analysis.

WARNING**PATIENT SAFETY.**

Using the **Maximum** sensitivity setting can reduce the **SpO₂ probe off** detection alarm. It is recommended to use the **Maximum** sensitivity setting in care areas where the application site is inspected frequently to ensure patient safety. (Available when monitoring SpO₂ with Masimo SET technology.)

WARNING**PATIENT SAFETY.**

With deactivated **SpO₂ probe off** alarm, keep the patient under close surveillance.

WARNING**MISSED ALARM.**

Check the SpO₂ measurement when switching the SpO₂ measurement sources to avoid missed SpO₂ alarms.

WARNING**SKIN IRRITATION.**

Prolonged monitoring or incorrect sensor application can cause skin irritation or impaired circulation. It is recommended that you check the probe site every four hours (more frequently in case of poor perfusion or neonatal patients). Refer to the instructions supplied with the sensor.

SpO₂ cautions

CAUTION

BURNS.

A damaged sensor or a sensor soaked in liquid may cause burns during electrosurgery. To avoid this risk, always ensure that the sensor is undamaged and dry.

Masimo warnings

WARNING

As with all medical equipment, carefully route patient cabling to reduce the possibility of patient entanglement or strangulation.

WARNING

Do not place the pulse oximetry device or accessories in any position that might cause it to fall on the patient.

WARNING

Do not start or operate the pulse oximetry device unless the setup was verified to be correct.

WARNING

Do not use the pulse oximetry device during magnetic resonance imaging (MRI) or in an MRI environment.

WARNING

Do not use the pulse oximetry device if it appears or is suspected to be damaged.

WARNING

EXPLOSION HAZARD.

Do not use the pulse oximetry device in the presence of flammable anesthetics or other flammable substance in combination with air, oxygen-enriched environments, or nitrous oxide.

WARNING

To ensure safety, avoid stacking multiple devices or placing anything on the instrument during operation.

WARNING

To protect against injury, follow the directions below:

Avoid placing the device on surfaces with visible liquid spills.

Do not soak or immerse the device in liquids.

Do not attempt to sterilize the device.

Use cleaning solutions only as instructed in operator's manual.

Do not attempt to clean the device while monitoring a patient.

WARNING

To protect from electric shock, always remove the sensor and completely disconnect the pulse oximetry device before bathing the patient.

WARNING

If any measurement seems questionable, first check the patient's vital signs by alternate means and then check the pulse oximetry device for proper functioning.

WARNING

Inaccurate SpO₂ readings may be caused by:

Improper sensor application.

Elevated levels of COHb or MetHb: High levels of COHb or MetHb may occur with a seemingly normal SpO₂. When elevated levels of COHb or MetHb are suspected, laboratory analysis (CO-oximetry) of a blood sample should be performed.

Externally applied coloring and texture, such as nail polish, acrylic nails, glitter, etc.

Elevated levels of bilirubin.

Severe anemia.

Low arterial perfusion.

Motion artifact.

WARNING

INTERFERING SUBSTANCES.

Dyes or any substance containing dyes that change usual blood pigmentation may cause erroneous readings.

WARNING

The pulse oximetry device should not be used as the sole basis for medical decisions. It must be used in conjunction with clinical signs and symptoms.

WARNING

The pulse oximetry device is not an apnea monitor.

WARNING

The pulse oximetry device may be used during defibrillation, but this may affect the accuracy or availability of the parameters and measurements.

WARNING

The pulse oximetry device may be used during electrocautery, but this may affect the accuracy or availability of the parameters and measurements.

WARNING

The pulse oximetry device should not be used for arrhythmia analysis.

WARNING

SpO₂ is empirically calibrated in healthy adult volunteers with normal levels of carboxyhemoglobin (COHb) and methemoglobin (MetHb).

WARNING

Do not adjust, repair, open, disassemble, or modify the pulse oximetry device or accessories. Injury to personnel or equipment damage could occur. Return the pulse oximetry device for servicing if necessary.

Masimo cautions

CAUTION

Do not place the pulse oximetry device where the controls can be changed by the patient.

CAUTION

Electrical shock and flammability hazard: Before cleaning, always turn off the instrument and disconnect from any power source.

CAUTION

When patients are undergoing photodynamic therapy, they may be sensitive to light sources. Pulse oximetry may be used only under careful clinical supervision for short time periods to minimize interference with photodynamic therapy.

CAUTION

Do not place the pulse oximetry device on electrical equipment that may affect the instrument, preventing it from working properly.

CAUTION

If the SpO₂ values indicate hypoxemia, a laboratory blood sample should be taken to confirm the patient's condition.

CAUTION

If the Low Perfusion message is frequently displayed, find a better perfused monitoring site. In the interim, assess the patient and, if indicated, verify oxygenation status through other means.

CAUTION

Change the application site or replace the sensor and/or patient cable when a persistent poor signal quality message is displayed on the host monitor. These messages may indicate that patient monitoring time is exhausted on the patient cable or sensor.

CAUTION

If using pulse oximetry during full body irradiation, keep the sensor out of the radiation field. If the sensor is exposed to the radiation, the reading might be inaccurate or the instrument might read zero for the duration of the active irradiation period.

CAUTION

To ensure that alarm limits are appropriate for the patient being monitored, check the limits each time the pulse oximetry device is used.

CAUTION

Variation in hemoglobin measurements may be profound and may be affected by sampling technique as well as the patient's physiological conditions. Any results exhibiting inconsistency with the patient's clinical status should be repeated and/or supplemented with additional test data. Blood samples should be analyzed by laboratory instruments prior to clinical decision making to completely understand the patient's condition.

CAUTION

Do not submerge the pulse oximetry device in any cleaning solution or attempt to sterilize by autoclave, irradiation, steam, gas, ethylene oxide or any other method. This will seriously damage the pulse oximetry device.

CAUTION**ELECTRICAL SHOCK HAZARD.**

Carry out periodic tests to verify that leakage currents of patient-applied circuits and the system are within acceptable limits as specified by the applicable safety standards. The summation of leakage currents must be checked and in compliance with IEC 60601-1 and UL60601-1. The system leakage current must be checked when connecting external equipment to the system. When an event such as a component drop of approximately 1 meter or greater or a spillage of blood or other liquids occurs, retest before further use. Injury to personnel could occur.

CAUTION**DISPOSAL OF PRODUCT.**

Comply with local laws in the disposal of the instrument and/or its accessories.

CAUTION

To minimize radio interference, other electrical equipment that emits radio frequency transmissions should not be in close proximity to the pulse oximetry device.

CAUTION

Replace the cable or sensor when a replace sensor or when Low signal quality is consistently displayed while monitoring consecutive patients after completing troubleshooting steps listed in this manual.

SpO₂ measurement description

Pulse oximetry (SpO₂) is a non-invasive method used for monitoring tissue oxygenation. The measurement method is based on the absorption of red and infrared light in pulsating arterial blood. The ratio of oxygen carrying hemoglobin (HbO₂) to the total amount of hemoglobin capable of transporting oxygen (HbO₂ + Hb) is called functional oxygen saturation of arterial blood (SaO₂). GE pulse oximetry is calibrated to display functional oxygen saturation.

The actual measurement of arterial oxygen saturation is performed by spectrophotometry, a technique that quantifies the amount of transmitted light. A beam of light is passed through a monitored site of pulsating arterial blood. A pulse oximeter emits red and infrared light through its LEDs and measures the relative absorption of red and infrared light. Because HbO₂ and Hb absorb different amounts of light at each of these wavelengths, the oximeter can compare the ratio of each absorbance and convert it into an SpO₂ value.

Plethysmographic pulse waveform is derived from the infrared signal. It reflects the blood pulsation at the measuring site, and the amplitude of the waveform represents perfusion. Peak detection of the plethysmographic pulse wave is used for calculating pulse rate.

There are 3 supported pulse oximetry technologies:

- GE TruSignal
- Masimo SET
- Nellcor OxiMax

SpO₂ measurement displayed on the monitor screen



1.	Pleth (Pleth): waveform label	6.	SpO ₂ alarm limits, alarm status, or other messages
2.	Waveform scale	7.	Masimo SpO ₂ only. SpO ₂ signal strength indicator.
3.	Pleth waveform	8.	SpO ₂ value
4.	SpO ₂ (SpO2): parameter label	9.	PI (PI): Perfusion Index value (not for Nellcor OxiMax technology).
5.	SpO ₂ unit		

SpO₂ measurement limitations

- The pulse oximeter cannot distinguish between oxyhemoglobin and dyshemoglobins.
- Poor perfusion may affect the accuracy of measurement, especially when using an ear sensor.
- To avoid erroneous measurements, do not use a blood pressure cuff on the same limb as the SpO₂ sensor.
- There are several factors that may cause inaccurate readings and alarms. Familiarize yourself with the SpO₂ safety precautions so that you are aware of these factors and can take them into consideration.

SpO₂ points to note

- This equipment is suitable for use in the presence of electrosurgery, as tested according to IEC 80601-2-49 clause 202.8.102 Disturbances from HF Surgical Equipment.
- For information on materials used in accessories and their biocompatibility, refer to the instructions for use in the accessory package.
- For more detailed information regarding sensor accuracies, refer to the supplemental analysis graphs provided.
- Use dry and clean sensors only.
- Do not use damaged sensors.
- Check that you are not re-using a disposable sensor or other disposable accessories.

- Refer to the sensor instructions for use for the recommended maximum application times for different sensor types.
- Always check the patient and the sensor site if the accuracy of the SpO₂ values is questionable.
- Depending on the SpO₂ technology used, not all SpO₂ measurements and settings are available to view or change.
- There are three supported pulse oximetry technologies:
 - Masimo SET
 - Nellcor OxiMax
 - GE TruSignal
- With Nellcor™ sensors with OxiMax™ technology and Masimo SET technology, the pulse oximetry waveform is a normalized waveform. It is not normalized with GE TruSignal technology. GE TruSignal technology provides the actual IrMod% values.

Masimo points to note

- A functional tester cannot be used to assess the accuracy of the pulse oximetry device.
- High-intensity extreme lights (such as pulsating strobe lights) directed on the sensor may not allow the pulse oximetry device to obtain vital sign readings.
- When using the Maximum Sensitivity setting, performance of Sensor Off detection may be compromised. If the instrument is on this setting and the sensor becomes dislodged from the patient, the potential for false readings may occur due to environmental “noise” such as light, vibration, and excessive air movement.
- Do not loop the patient cabling into a tight coil or wrap around the device, as this can damage the patient cabling.
- Additional information specific to the Masimo sensors compatible with the pulse oximeter, including information about parameter/measurement performance during motion and low perfusion, may be found in the sensor's directions for use (DFU).
- Cables and sensors are provided with X-Cal™ technology to minimize the risk of inaccurate readings and unanticipated loss of patient monitoring. Refer to the Cable or Sensor DFU for the specified duration of the patient monitoring time.

SpO₂ measurement guidelines

GE TruSignal technology and sensor measurement guidelines

The following measurement guidelines apply to GE TruSignal SpO₂ technology:

- The time period for acquiring a measurement average is adjustable.
- The SpO₂ waveform corresponds to (but is not proportional to) the arterial pressure waveform.
- Only TruSignal sensors are supported.
- Use the following guidelines when using TruSignal sensors and cables:
 - Read the sensor instructions for use of the SpO₂ sensor before using it.

- Periodically inspect extension cables and sensors for damage.
- Do not use damaged sensors.
- Refer to the cleaning instructions in the instructions for use of reusable TruSignal sensors.
- Do not use NIBP or constricting instruments on the same appendage as the SpO₂ sensor.

Masimo SET technology and sensor measurement guidelines

With motion, the plethysmographic waveform (or SpO₂ waveform) is often distorted and may be obscured by the artifact. With Masimo SET technology, the plethysmographic waveform is not an indication of signal quality or validity. Even with a waveform obscured by artifact, Masimo SET technology is able to read through the noise and locate the arterial pulsation.

Although Masimo SET technology processes SpO₂ measurements differently than other SpO₂ technologies, the function and appearance is essentially the same as other technologies. The following measurement guidelines apply to Masimo SET technology only:

- The time period for acquiring a measurement average is adjustable.
- Only Masimo RD SET and LNCS sensors are supported. Masimo RD SET or LNCS sensors non-invasively measure pulse rate and the amount of oxygenated hemoglobin. Use the following guidelines when using Masimo RD SET or LNCS sensors:
 - Read the sensor directions before use.
 - Only use sensors with Masimo SET technology.
 - Do not use damaged sensors.
 - Do not use a sensor with exposed optical components.
 - Refer to the cleaning instructions in the directions for use for reusable Masimo RD SET or LNCS sensors.

Additional information for Masimo technology

NO IMPLIED LICENSE: Possession or purchase of this device does not convey any express or implied license to use the device with unauthorized replacement parts which would, alone, or in combination with this device, fall within the scope of one or more of the patents relating to this device. Sensors that are designated for single use are licensed for use on a single patient only, and are not sold. There is no license, implied or otherwise, that would allow use of single-use Masimo sensors beyond their intended single use. After use of single-use Masimo sensors, the license is exhausted, there is no further license granted by Masimo, and they must be discarded.

This device is covered under one or more patents as set forth at <https://www.masimo.com/company/masimo/patents/>.

We recommend the use of Masimo SET sensors for use with Masimo technology.

Nellcor OxiMax technology and sensor measurement guidelines

The following measurement guidelines apply to Nellcor OxiMax:

- The SpO₂ waveform corresponds to (but is not proportional to) the arterial pressure waveform.
- Only Nellcor OxiMax sensors are supported. Use the following guidelines when using OxiMax SpO₂ accessories and sensors:

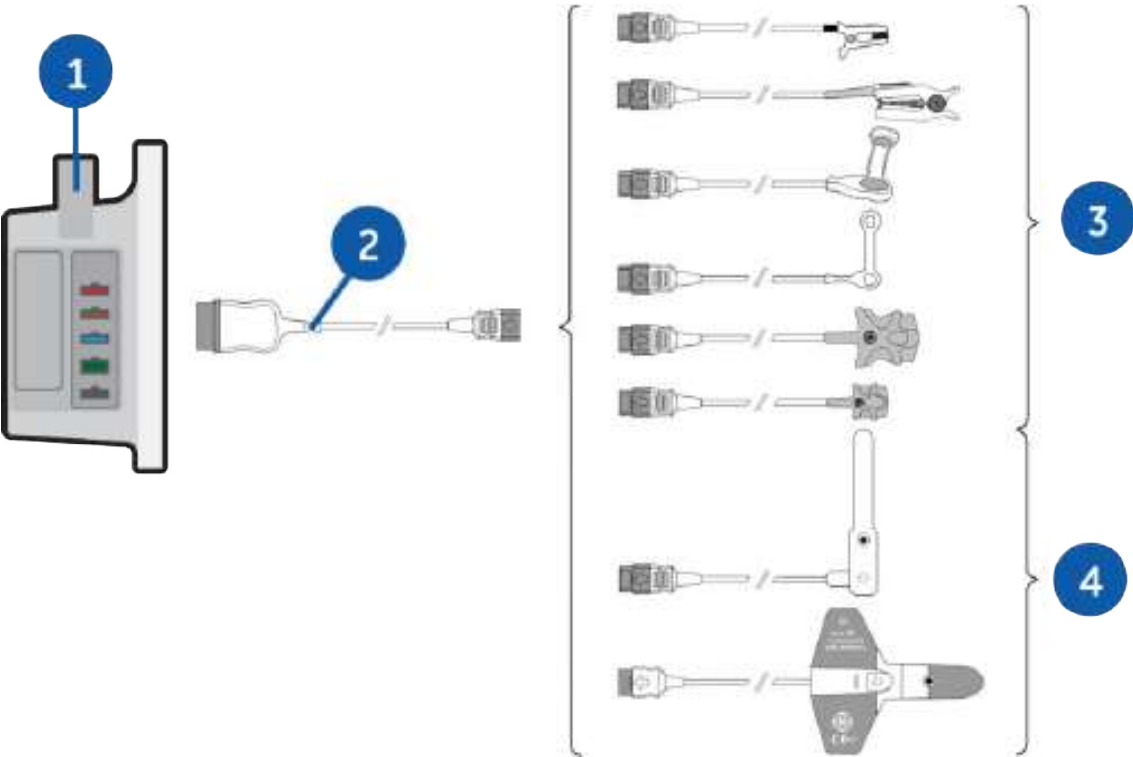
- Periodically inspect extension cables and sensors for damage and discontinue use if damage is found.
- Do not immerse sensors.
- Do not use NIBP or constricting instruments on the same appendage as the SpO₂ sensor.

Additional information for Covidien technology

NOTICE: Purchase of this instrument confers no express or implied license under any Covidien patent to use this instrument with any oximetry, level of consciousness, regional oxygen saturation and respiration rate, as an applicable Sensor that is not manufactured or licensed by Covidien.

SpO₂ measurement setup

SpO₂ equipment to patient connection



1.	The monitor	3.	Reusable sensors
2.	Interconnect cable	4.	Disposable sensors

Preparing the SpO₂ connection

1. Connect the adapter cable to the SpO₂ connector.
2. Clean the surface of reusable sensors.
3. Prepare the application site.

4. Remove nail polish and earrings.
5. Follow the sensor manufacturer's instructions to position the sensor.
6. Attach the sensor to the patient.
7. Stabilize the sensor cable to minimize sensor movement.

Checking the SpO₂ measurement

1. Check that the red light is lit on the sensor.
2. Check that the waveforms and parameter values are displayed when the sensor is connected to the patient.

SpO₂ functional testers

You can verify the functionality of the pulse oximeter sensor and monitor with a SpO₂ functional tester but you cannot evaluate their accuracy with such a device. For more information, refer to the standard ISO 80601-2-61 Annex FF (Simulators, calibrators and functional testers for pulse oximeter equipment).

Using the SpO₂ measurement

Setup the parameter to normal screen, if need:  >  **Screen Setup**.

Changing the SpO₂ waveform scale

1. Select the SpO₂ digit field.
2. Select the scale from the **Pleth Scale** list:
 - For GE TruSignal technology and sensor, the options are:
 - **AUTO**: The scale is automatically selected according to the IrMod % (infrared modulation percentage) received from the measurement source.
 - Other scale options are **2, 5, 10, 20**, or **50**.
 - For Masimo or Nellcor technology and sensor, the options are: **1x, 2x, 4x**, or **8x**.

Selecting the GE TruSignal SpO₂ response averaging time



NOTE

GE TruSignal technology and sensors only.

You can have an average of the SpO₂ measurement on screen instead of the beat to beat values. You can select the average time for response.

1. Select the SpO₂ digit field.
2. Select the average time from **SpO₂ Response** list. Choices are:
 - **Normal**: 12 seconds
 - **Fast**: 3 seconds

Selecting the Masimo SpO₂ averaging time

NOTE

Masimo technology and Masimo sensors only.

You can have an average of the SpO₂ measurement on screen instead of the beat to beat values, and you can select how many seconds are used for this averaging: **2s**, **4s**, **8s**, **10s**, **12s**, **14s**, or **16s**.

1. Select the SpO₂ digit field.
2. Select the number of seconds from the **Averaging** list.

Selecting the Masimo SpO₂ sensor sensitivity level

NOTE

Masimo technology and Masimo sensors only.

1. Select the SpO₂ digit field.
2. Select the appropriate option from the **Sensitivity** list:
 - Use the **Normal** sensitivity setting for normal patient monitoring purposes.
 - Use the **Maximum** sensitivity setting for improved poor perfusion performance and for faster tracking of rapid SpO₂ saturation changes.

Using the **Maximum** sensitivity setting delays the **Probe Off** detection alarm.

- Use the **APOD** (Adaptive Probe Off Detection) sensitivity settings for better probe off detection.

Setting the SpO₂ to show PI



NOTE

For GE TruSignal and Masimo technology and sensors only.

PI (Perfusion Index) is a relative assessment of the pulse strength at the monitoring site.

PI clinical practicalities:

- During sensor placement, use PI to quickly evaluate the appropriateness of an application site, looking for the site with the highest PI number.
- Placing the sensor at the site with the strongest pulse amplitude (highest PI number) improves performance during motion. Monitor the trend of the PI for changes in physiologic conditions.
- Changes in sympathetic nervous tone affect smooth muscle tone, thereby altering levels of perfusion.

1. Select the SpO₂ digit field.
2. Select **ON** or **OFF** from the **Show PI** list.

The larger the PI value, the stronger the strength.

Selecting the SpO₂ as the primary heart rate source

The primary heart rate can be calculated from the ECG leads, SpO₂ measurement, or invasive pressure waveform.

NOTE

This setting adjusts the primary heart rate source for all of the hemodynamic parameters.

1. Select the SpO₂ digit field.
2. Select the heart rate source from the **Primary HR Source** list.

Adjusting the SpO₂ pulse beep tone volume

The beat tone is depends on HR source to calculate. When the source is SpO₂, a variable pitch beep tone rises in pitch with increasing oxygen saturation or falls in pitch with decreasing oxygen saturation.

1. Select the SpO₂ digit field.
2. Adjust the volume with the **Beat Volume** arrows.

Setting the SpO₂ alarm limits

1. Select the SpO₂ digit field.
2. Select the **Alarms** tab.
3. Check that the **Alarm** is turned on.
4. Adjust the alarm limits with the arrows.



NOTE

If you want the alarm turn off, select from the **Alarm** list.

Setting the Masimo SpO₂ alarm delay



NOTE

Masimo technology and Masimo sensors only.

The alarm delay time for **SpO₂ low** alarm can be selected. But if the SpO₂ value drops below the alarm limit by more than 5%, the **SpO₂ low** alarm will be triggered immediately, regardless of the alarm delay setting.

1. Select the SpO₂ digit field.
2. Select the **Alarms** tab.
3. Select the seconds from the **Alarm Delay** list. The choices are: **0s**, **5s**, **10s**, or **15s**.

Stopping the SpO₂ measurement

1. Remove the SpO₂ sensor from the patient.
2. Disconnect the sensor from the sensor cable.
3. Disconnect the sensor cable from the host.

4. Select  to acknowledge the **SpO₂ probe off** alarm.
5. Discard single-use sensors.
 - Always disconnect the sensor from the cable before repositioning the sensor. Reconnect the cable to the sensor after the sensor has been repositioned.
 - Use only sensors and cables listed in the Supplies and accessories.

How to interpret the SpO₂ values

SpO₂ signal strength

- For Masimo technology.

The Signal strength is indicated with asterisks in the digit field. The signal strength indicator refers to Masimo's proprietary measurement, Signal Identification and Quality (Signal IQ) indicator. The Signal IQ provides an indicator of the assessment of the confidence in the displayed SpO₂ value.

- For GE TruSignal technology.

The signal strength indicator is displayed as the PI value in digit field.

SpO₂ waveform quality



NOTE

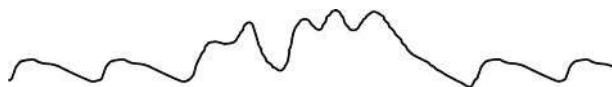
Not for Masimo SET technology.

Under normal conditions, the SpO₂ waveform corresponds to (but is not proportional to) the arterial pressure waveform. The typical SpO₂ waveform can help the user find a sensor location with the fewest noise spikes.



Normal waveform

If noise (artifact) is seen on the waveform because of poor sensor placement, the photodetector may not be flush with the tissue. Check that the sensor is secured and the tissue sample is not too thick. Pulse rate is determined from the SpO₂ waveform, which can be disrupted by hemodynamic pressure disturbances. Motion at the sensor site is indicated by noise spikes in the normal waveform.



Abnormal waveform

SpO₂ waveform stability

The stability of the displayed SpO₂ values can also be used as an indication of signal validity. To aid you in successful SpO₂ monitoring, messages are provided in the SpO₂ digit field.

Surgical pleth index

SPI safety precautions

SPI warnings

There are no SPI specific warnings other than those related to the SpO₂ measurement. Refer to the supplemental information provided for the allowed sensor types and modules for the SPI measurement.

SPI cautions

CAUTION

MISINTERPRETATION.

The SPI measurement is to be used as an adjunct to other physiological parameters to avoid possible misinterpretations.

CAUTION

MISINTERPRETATION.

The SPI reflects autonomic nervous system and cardiovascular activity. Any medication, treatment, stimuli, or action that affects either the autonomic nervous system or cardiovascular system or both, might also affect the SPI.

CAUTION

MISINTERPRETATION.

Any direct or indirect action of medication, treatment, stimuli or care that affects PR, amplitude of the plethysmogram (e.g., by vasoconstriction), or both, may also affect the SPI.

CAUTION

MISINTERPRETATION.

A change of SpO₂ sensor from one finger to another may affect the SPI reading.

SPI instruction

The Surgical Pleth Index (SPI) is a parameter to be used in conjunction with other vital signs and monitoring parameters in assessment of adult (≥ 18 years) patients during general anesthesia.

SPI is a non-invasive parameter derived from the pulse photoplethysmogram. By observing the SPI value and trend together with other monitoring parameters and past anesthetic events, SPI may help

the clinician to monitor the responses of an adult patient to surgical stimuli and analgesic medications during general anesthesia.

SPI measurement displayed on the monitor screen

SPI does not have a menu of its own.

You can configure the SPI data to the screen the same way as any other parameter data. Refer to the screen setup instructions.

- Select **SPI** from the list of parameters.

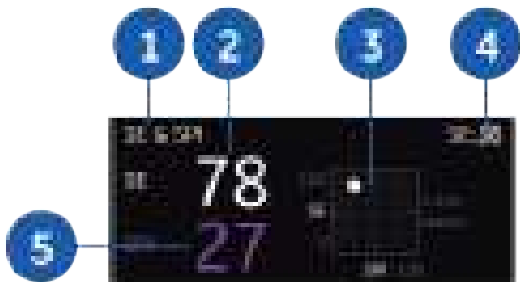


1.	SPI (SPI): parameter label
2.	SPI value
3.	SPI microtrend



NOTE
The trend length is the same as that of Entropy, and it is set through the **Entropy** menu. If the digit field not have enough space, the microtrend will not display.

- Select **SE & SPI** from the list of parameters.

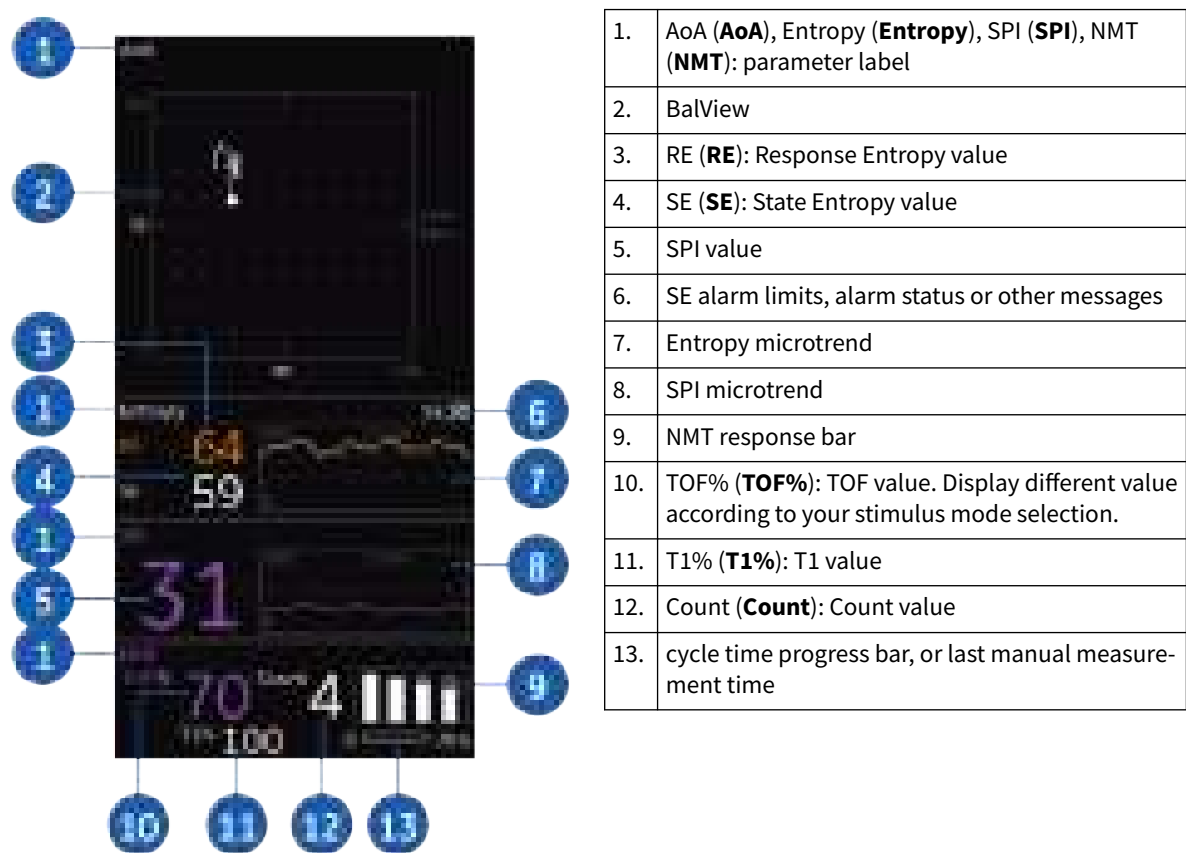


1.	SE&SPI (SE & SPI): parameter label
2.	SE (SE): State Entropy value
3.	BalView, which is a view combining the SPI and SE values in an x-y graph
4.	SE alarm limits, alarm status or other messages
5.	SPI (SPI): SPI value



NOTE
If the digit field not have enough space, the BalView will not display.

- Select **AoA** from split screen menu:



When you select the **SPI** or **SE & SPI** digit field, the **Entropy** setup window open. You can select the Entropy/SPI trend length in the **Entropy** setup window.

SPI measurement limitations

- The SPI measurement is only available on GE TruSignal SpO₂ sensor with SPI function.
- The SPI measurement is applied to unconscious and fully anesthetized adult (≥ 18 years) patients during general anesthesia.
- The SPI measurement is only available in the OR mode.

SPI points to note

- This equipment is suitable for use in the presence of electrosurgery, as tested according to IEC 80601-2-49 clause 202.8.102 Disturbances from HF Surgical Equipment.
- For information on materials used in accessories and their biocompatibility, refer to the instructions for use in the accessory package.
- SPI is based on plethysmographic pulse amplitude and pulse interval. Any medication, treatment, stimuli, or action that may artificially affect a patient's heart rhythm, plethysmographic waveform pulse amplitude, or autonomic nervous system regulation may thus also affect the SPI.
 - Heart rhythm is influenced by factors such as anticholinergic and sympathomimetic drugs, arrhythmias, cardiac arrest, pacemaker rhythm.

- Plethysmographic pulse amplitude is influenced by factors such as vasoactive drugs, hypotension, severe hypovolemia, shock, severe hypothermia, severe cardiac arrhythmias, a change in the SpO₂ measurement site.
- Autonomic nervous regulation of the circulatory system is influenced by factors such as reflexes related to posture change, or autonomic neuropathy.
- Plethysmographic signal quality is influenced by factors such as electrical noise caused by electrosurgery or similar; mechanical movement of the SpO₂ sensor; defibrillation; defective, physically damaged, or poorly attached SpO₂ sensors or cables; NIBP cuff inflation or NMT measurement; excessive ambient light.
- Always relate SPI values to other monitored parameters, such as ECG, Entropy, blood pressure, body temperature, and capnogram.
- Physiological and technical limitations for the SpO₂ measurement may affect the SPI interpretation. For more details, refer to [SpO₂ measurement limitations on page 157](#) and the instructions supplied with SpO₂ sensors.
- Upon placing the SpO₂ sensor on the patient's finger at the beginning of monitoring, or after removing the SpO₂ sensor from the finger for more than 30 seconds, the SPI algorithm performs scaling of the plethysmographic waveform pulse interval and pulse amplitude in order to decrease the interpatient variability in SPI. During the first two-minute initial scaling period, the message **Learning** is displayed and the SPI should not be used for clinical guidance during this time.
- The SPI measurement site must be a finger. Use only SpO₂ finger sensors. SPI has not been validated with ear or foot sensors. Refer to the Supplies and Accessories provided for the allowed sensor types.
- In case the reading seems incorrect, first assess the clinical status of the patient and consult the troubleshooting instruction and the list of messages.

Using the SPI measurement

Patient connections and preparing the patient

Patient connections and preparation are identical to those used in the SpO₂ measurement, but SPI can be measured using GE SpO₂ finger sensors only.

Stopping the SPI and SpO₂ measurement

1. Remove the sensor from the patient.
2. Disconnect the sensor from the patient interface cable.
3. Discard the sensor (if not reusable).

Basics of SPI measurement

SPI clinical implications

SPI is a non-invasive parameter derived from plethysmogram, and it is suitable for use with adult patients. By observing the SPI value and the trend, the clinician can monitor an adult patient's responses to surgical stimuli and analgesic medications during general anesthesia.

SPI measurement description

The SPI incorporates two dimensions of the plethysmogram, the pulse amplitude and pulse interval. Both of these parameters show a patient's hemodynamic responses to surgical stimuli and analgesic medications.

These two parameters are available in the SpO₂ measurement. The SPI algorithm uses these finger pulse wave characteristics to create a single numerical value that correlates with the level of sympathetic activation. This means that the SPI value may be used to monitor the patient's responses to surgical stimuli and analgesic medications during general anesthesia. The degree of responses depends on the levels of surgical stimulation and analgesic medications.

The SPI algorithm uses pulse amplitude and the pulse interval values by normalizing the raw components (thereby considerably reducing the inter-patient variability) and then combining them in an optimal proportion.

Normalization

Clinical indexes are calculated on-line, as the actual patient reactions are taking place. In SPI measurement, the normalization of the individual patient data is based on adaptive histogram transformation. Using this principle, regardless of the original value, a normalized value is produced and distributed between 0 and 100%.

Normalization balances the responsiveness of the SPI, as well as discriminates typical high and low ranges for each patient. Normalization also addresses these factors:

- The normal heart rate range varies between individuals more than within a person.
- The plethysmographic pulse amplitude varies between patients and between sensor sites.
- The plethysmographic amplitude can be too responsive to stimuli.
- Some patients have reactive heart rates, while others have a reactive plethysmogram.

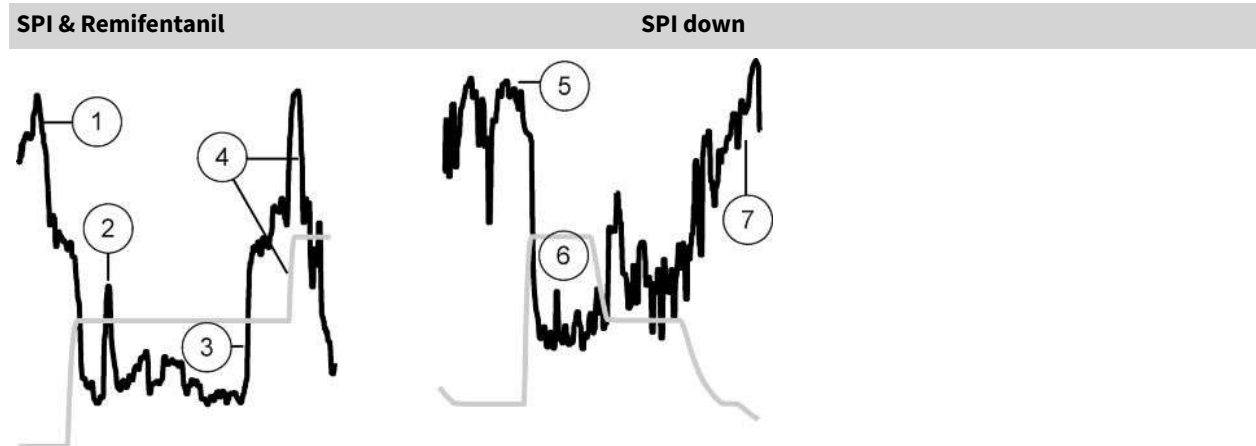
Learning

At the beginning of the measurement, and as needed later on, the algorithm starts to learn the patient's pulse rate and pulse amplitude. During this time of initialization, SPI numbers are shown in gray color and the message **Learning** is displayed. Due to this learning process, the SPI readings may be less accurate during the first two minutes. Learning is marked in the trend as dashed vertical line in SPI color.

How to interpret the SPI values

SPI in typical general anesthesia

In the figure below, black color = SPI, gray = Remifentanyl



1.	Patient awake, SPI not valid	5.	Inadequate analgesia
2.	Intubation	6.	Adequate analgesia
3.	Incision	7.	Patient awake, SPI not valid
4.	Remifentanyl up, SPI down		

When the SPI is high, surgical stimulation may be high or the level of analgesics is low. When the number is low, it may indicate that the level of stimulation has decreased or that the concentration of analgesics is adequate. Individual patients may show different base values and responsiveness to noxious stimuli as the individual sensitivity to both the stimulus and analgesic medication may vary.

Common surgical events

Laryngoscopy and intubation

Sudden reaction to laryngoscopy and intubation is common even in an anesthetized state. It is not necessarily a sign of inadequate anesthesia. The reaction of pulse wave amplitudes and pulse intervals (HR) is reflective in nature, and normally recovers quickly. The SPI, too, will react in relations to the pulse wave amplitude changes. Slow recovery of amplitude may indicate anesthesia that is too light, thus producing higher SPI values.

Skin incision

Skin incision is one of the strongest intraoperative stimuli. Skin incision may cause significant reduction of the pulse wave amplitude/pulse interval.

Maintenance phase

Changes in the intraoperative pulse wave amplitude/pulse interval will affect the SPI. If the intraoperative pulse wave amplitude:

- Remains low or frequently changes, it can be an indication of light anesthesia. This low pulse wave amplitude/pulse interval can produce a higher SPI value.
- Progressively, continuously decreases, it is usually due to discomfort, hypovolemia, hypothermia, or hyperventilation. This lowering pulse wave amplitude/pulse interval can produce a higher SPI value.

Changes in the pulse wave amplitude/pulse interval and their effect on SPI should always be considered together with other parameters in order to diagnose the real cause of any changes.

The end of anesthesia

Vasoconstriction is the expected reaction during this phase. As the patient awakens, the SPI is no longer valid since the parameter is indicated for anesthetized patients.

The waking of the patient can be seen in the SPI values as well as in the Entropy values.

Sensor removal

If the SpO₂ sensor is off of the patient for more than five minutes, the SPI measurement will start the learning process as if the case was just beginning. This is similar to ending a case situation.

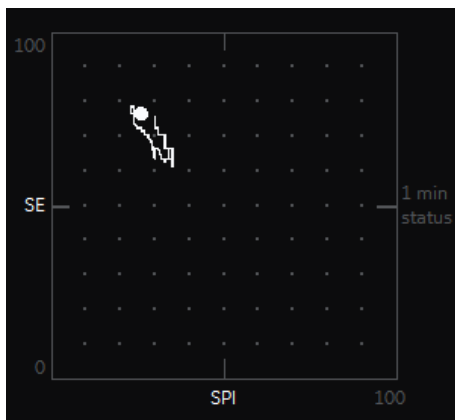
If the sensor's location is changed, the pulse amplitude may abruptly change. This may cause a large and persistent change in the SPI values. To facilitate the learning of new values in this case, the SPI tries to identify these types of changes by seeking periods with unavailable data that are followed by a change in the pulse amplitude.

SPI practicalities

AoA split screen and the BalView

The **AoA** (Adequacy of Anesthesia) split screen includes a view combining the SPI and State Entropy values in an x-y graph. This part of the **AoA** split screen is referred to as BalView. Note that you need an Entropy module for this view. The graph visualizes the combined effects of anesthetic and analgesic medications administered during general anesthesia.

The current SPI and SE values will appear as a dot, and there is a trace to show the trend for the last minute.



The AoA split screen shows:

- The current SPI and SE values as an SPI+SE dot
- The last minute SPI and SE (State Entropy, requires the E-ENTROPY module) values as a trend line
- The Entropy values and minitrend (with Entropy module)
- The SPI numeric value and minitrend
- NMT parameter window (with NMT module)

Observation				May indicate	Consider assessing
SPI	↓	and	SE ↓	SPI: a low level of surgical stimulation or adequate analgesia SE: deep anesthesia, adequate anesthesia	• Other parameters
SPI	↓	and	SE ↑	SPI: a low level of surgical stimulation SE: waking to awake	• Anesthetics • Other parameters
SPI	↑	and	SE ↑	SPI: a high surgical stimulus response SE: waking to awake	• Analgesics • Anesthetics • Other parameters
SPI	↑	and	SE ↓	SPI: a high surgical stimulus response SE: deep anesthesia, adequate anesthesia	• Analgesics • Other parameters

SPI and NIBP measurement

NIBP cuff inflation causes temporary blood flow occlusion distal to the measurement site. If an SpO₂ sensor is located distally to the NIBP cuff, this inflation will also cause a temporary interruption to blood flow at the SpO₂ sensor site. SpO₂, SPI, and plethysmogram measurements will be temporarily interrupted. To avoid this situation, it is suggested that you obtain NIBP measurements from another limb.

When the first NIBP measurement is made during a case, the monitor always performs a safety check. This means that the **NIBP cuff inflated** message will appear on the monitor screen. After the first NIBP measurement, the SPI algorithm checks for any disturbances in the plethysmogram during subsequent NIBP cuff inflations. If there are no variances detected, the **NIBP cuff inflated** message will appear only once. However, if there are any simultaneous disturbances in the plethysmogram

during NIBP inflation, the message will reappear. Situations that produce external artifact or sensor movement may cause the message to appear. The message will occur until there are no changes in the plethysmogram during NIBP cuff inflation. If, for any reason, the plethysmogram signal is disturbed during NIBP inflation (either coincidentally or because of same-limb measurement), the message will appear.

Physiological and technical issues affecting SPI

There are widely known physiological and technical limitations of pulse oximetry, and some of those that may affect the interpretation of the SPI are mentioned below.

Physiological issues

- Vasoconstriction and low pulse wave amplitude states
- Low perfusion states:
 - Cold extremities (hypothermia)
 - Blood loss (hypovolemia) or
 - Low blood pressure (hypotension)
- Venous congestion or pulsation

Technical issues

- Artifact
 - Any type of patient or clinician induced motion. This includes flexion, clenching, shivering, kicking, sensor/cable movement, or patient repositioning, etc.
- Electrosurgery, magnetic resonance imaging (MRI), or pulsatile interference from external devices
- Sensor selection/application
 - Patient's weight, sensor type (durable or adhesive), site location, sensor placement/displacement, finger circulation (sensor not too tight), correct sensor fit

Non-invasive blood pressure

NIBP safety precautions

NIBP warnings

WARNING

PATIENT SAFETY.

The NIBP parameter will not measure blood pressure effectively on patients who are experiencing seizures or tremors.

WARNING

PATIENT SAFETY.

Arrhythmias will increase the time required by the NIBP parameter to determine a blood pressure and may extend the time beyond the capabilities of the parameter.

WARNING

ERRONEOUS READINGS.

Do not apply external pressure against the cuff while monitoring. Doing so may cause inaccurate blood pressure values. Use care when placing the cuff on an extremity used to monitor other patient parameters.

WARNING

ERRONEOUS READINGS.

NIBP cuff inflation/deflation may lead to inaccurate values from other monitored patient parameters that are measured distally from the NIBP measurement site at the same extremity.

WARNING

PATIENT SAFETY.

Ensure that the connection tubing is not kinked. Kinked tubing may cause continuous cuff pressure, which can interfere with the blood flow and cause injury to the patient.

WARNING

PATIENT SAFETY.

Do not place the cuff on the arm on the side of a mastectomy as this may lead to injury or swelling of the arm due to cuff pressurization. To avoid this risk, use another limb if possible.

WARNING**PATIENT SAFETY.**

Do not place the cuff over a wound as this may cause further injury.

WARNING**ERRONEOUS READINGS.**

GE NIBP devices are designed for use with dual-hose cuffs and tubing. The use of single-hose cuffs with dual hose tubing can result in unreliable and inaccurate NIBP data.

WARNING**PATIENT SAFETY.**

To prevent injury to the patient, do not place the cuff on a limb being used for A-V fistulas, intravenous infusion or on any area where circulation is compromised or has the potential to be compromised. To avoid this risk, use another limb if possible.

WARNING**ERRONEOUS READINGS.**

Accuracy of NIBP measurement depends on using a cuff of the proper size. It is essential to measure the circumference of the limb and choose the proper size cuff.

WARNING**NIBP READINGS MAY TIME OUT WHEN USING IABP.**

An IABP creates non-physiological arterial waveforms. These waveforms create an oscillometric signal that may not be interpreted by the NIBP algorithm, causing NIBP to time out. The patient blood pressure can be monitored from the balloon pump device.

WARNING**PATIENT SAFETY.**

The NIBP cuff size must be correctly selected in the NIBP Setup window to obtain reliable NIBP data and to prevent excessive cuff pressure during infant (neonate) or child (pediatric) use.

WARNING**PATIENT SAFETY.**

Always ensure that you are using NIBP neonatal settings when monitoring neonatal patients. Using other settings may lead to risks to the patient due to wrong alarm limits or cuff pressure, for example.

WARNING**ERRONEOUS READINGS.**

If a patient's beat-to-beat pulse amplitude varies significantly (e.g., because of pulsus alternans, atrial fibrillation, or the use of a rapid-cycling artificial ventilator), blood pressure and pulse rate readings can be erratic, and an alternate measuring method should be used for confirmation.

WARNING**INACCURATE READINGS.**

Effectiveness of the NIBP measurement has not been established in pregnant (including pre-eclamptic) patients.

WARNING**BURNS.**

When using an electrosurgery unit, note that the measurement cables do not incorporate means to protect against burns in case of a defective ESU return electrode. To avoid burns at the monitor measurement sites, ensure the following:

- Proper contact of the ESU return electrode to the patient.

- ESU return electrode near the operating area.

- Measurement electrodes, leadwires and probes far from the surgical site and the ESU return electrode.

WARNING**PATIENT SAFETY.**

Devices that exert pressure on tissue have been associated with purpura, skin avulsion, compartmental syndrome, ischemia, and/or neuropathy. To minimize these potential problems, especially when monitoring at frequent intervals or over extended periods of time, make sure the cuff is applied appropriately and examine the cuff site and the limb distal to the cuff regularly for signs of impeded blood flow. Periodically check patient limb circulation distal to the cuff. Check frequently when using auto NIBP in 1 and 2 minute intervals. The 1 and 2 minute intervals are not recommended for extended periods of time.

NIBP cautions

CAUTION**PATIENT SAFETY.**

The device sets the inflation pressure automatically according to the previous measurement. Discharge patient to reset the inflation limits before measuring NIBP on a new patient.

NIBP instruction

Non-invasive blood pressure (NIBP) monitoring is an indirect measurement that reflects the force exerted by circulating blood on the walls of blood vessels. NIBP is one of the principal vital signs.

NIBP measurement displayed on the monitor screen



1.	The history items display in the waveform field, or in large number field. Date , Time (Time), NIBP (NIBP) value and PR (PR) value will be displayed.	6.	MAP (MAP): mean pressure
2.	NIBP (NIBP): parameter label	7.	SYS (SYS): Systolic pressure
3.	mmHg (mmHg), /min (/min): unit	8.	PR (PR): Pulse Rate
4.	Adult/Child (Adult/Child): cuff type according to your selection	9.	DIA (DIA): Diastolic pressure
5.	SYS alarm limits, alarm status, or other messages	10.	x min ago (x min ago): indicate how long time for the displayed value are. There have other display in different situation, more details see below instruction.

- **NIBP Manual:**
 - During measurement, the text **Manual** displays in the NIBP digit field.
 - 1 minute after measurement, the text **x min ago** displays in the NIBP digit field, indicate how long time for the displayed value are.
- **NIBP Auto:**

During measurement, a time progress bar displays in the NIBP digit field:

5 min
- **STAT:**

During 5 minutes continuous measurement, the text **STAT** displays in the NIBP digit field.
- **Stasis:**

During venous stasis mode, the text **Stasis** displays in the NIBP digit field. In the last 10 seconds, the **Stasis** text starts to flash indicating the monitor will return to the previously selected cycling interval or manual mode.

During cuff inflation and deflation phases, the cuff inflation pressure will be labeled as **Cuff** to display on digit field. Within a wide or large digit field, the value shows after MAP.

More than 60 minutes after previous measurement, the NIBP value will become gray.

More than 4 hours if no new NIBP data is received, the NIBP value will be replaced by “– – –”.

NIBP measurement limitations

- A patient's vital signs may vary dramatically during the use of cardiovascular agents such as those that raise or lower blood pressure or those that increase or decrease heart rate.
- Although automated NIBP is generally safe and accurate, it has some limitations. It may be difficult to obtain reliable readings under the following circumstances:
 - Shock accompanied by low blood pressure and pulse.
 - Variations in blood pressure and pulse rate.
 - In patients with anatomic abnormalities, such as calcified (hardened) arteries or subclavian compression.
 - Compression of the cuff caused by shivering, seizures, arm movement, or bumping against the cuff.
- Proper sizing and position of the cuff are essential for obtaining reliable readings:
 - Too large a cuff is better than too small a cuff, which may yield falsely high readings.
 - The cuff should also fit properly over the brachial artery (or whatever artery is being used) so that the cuff is sufficiently sensitive to vibrations in the artery.

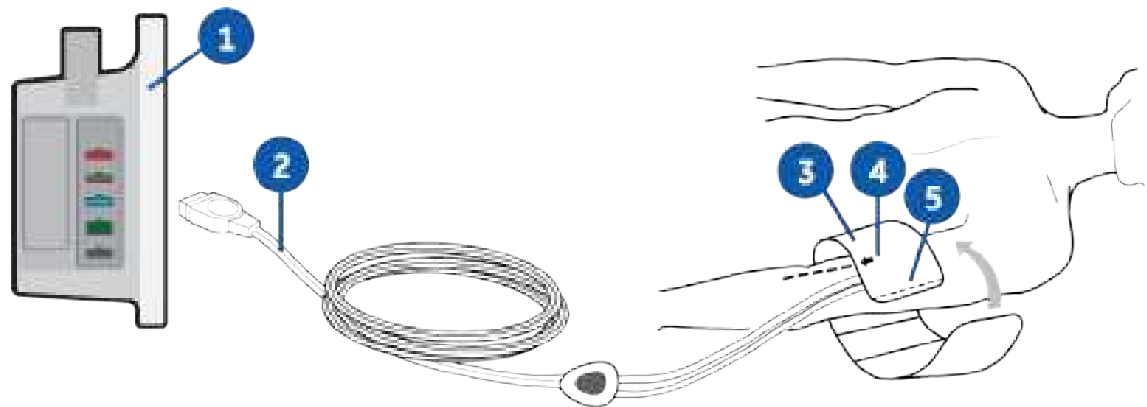
NIBP points to note

- This equipment is suitable for use in the presence of electrosurgery, as tested according to IEC 80601-2-49 clause 202.8.102 Disturbances from HF Surgical Equipment.
- For information on materials used in accessories and their biocompatibility, refer to the instructions for use in the accessory package.
- Blood pressure measurements determined with this device are equivalent to those obtained by an intra-arterial blood pressure measurement device, within the limits prescribed by the standard.
- Use the appropriate size NIBP cuff for the patient (adult, child, or infant).
- Operator position: Make sure you do not lean on the cuff or hoses, and do not disturb the patient in any way during measurement. Position yourself accordingly.
- The measurement site, patient's position (standing, sitting, lying down), exercise, or physiological condition can affect the NIBP readings.
- With mobile patients and when taking routine resting blood pressure, ensure that:
 - The patient is comfortably seated, with their legs uncrossed and feet flat on the floor.
 - The patient's arms and back are supported.
 - The middle of the cuff is at the level of the right atrium of the patient's heart.
- Also consider the following recommendations:
 - Allow 5 minutes to pass before taking the first measurement.

- Ensure that the patient is relaxed and does not talk during the measurement.

NIBP measurement setup

NIBP equipment to patient connection



1.	The monitor	4.	Brachial artery arrow (printed on cuff)
2.	Cuff hose	5.	Cuff index line (printed on cuff)
3.	Cuff of correct size		

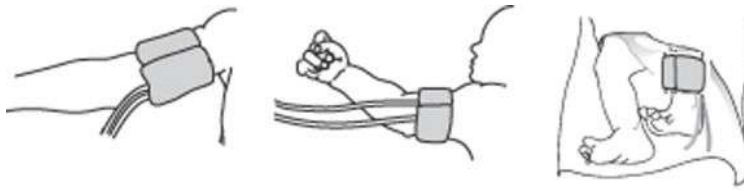
Preparing the NIBP patient connection

1. Select an appropriate NIBP cuff size for the patient.
2. Connect the NIBP cuff hose to the NIBP connector.
3. Position the NIBP cuff on the patient:
 - Place the cuff arrow over the brachial artery (or whatever artery is being used).
 - Make sure that the cuff index line falls within the range markings on the cuff.
 - Wrap the cuff around the limb.
4. Make sure that the NIBP cuff tubes are not kinked, compressed, or stretched.
5. Verify or select the correct **Cuff Size** from the NIBP menu.

NIBP cuffs

NIBP cuff selection and placement

Always choose the appropriate blood pressure measurement site. In adult and pediatric patients, the upper arm is preferred for convenience and because normative values are generally based on this site. When factors prohibit use of the upper arm, the clinician must plan patient care accordingly, taking into account the patient’s cardiovascular status and the effect of an alternative site on blood pressure values, proper cuff size, and comfort.



Always measure the patient's limb and select appropriately sized cuff according to size marked on cuff or cuff packaging. When cuff sizes overlap for a specified circumference, choose the larger size cuff.

If patient is standing, sitting, or inclined, ensure that cuffed limb is supported to maintain the cuff at level of patient's heart. If the cuff is not at heart level, the difference in the measured pressure values due to hydrostatic effect must be considered.

Selecting NIBP cuff size

You must first select the NIBP cuff size before starting a NIBP measurement.

1. Select the NIBP digit field.
2. Select **Adult/Child**, or **Neonatal** from the **Cuff Size** list.



NOTE

If the **Cuff Size** is set to **(Not Selected)**, when starting a NIBP measurement, this menu will pop up and require you to setup manually.

Initial NIBP cuff inflation pressure

The default value for initial NIBP cuff inflation pressure corresponds to **Cuff Size** selected. You can adjust the inflation pressure, if not wish to use the default value.

Table 7 Default inflation pressure

Cuff Size	Infl. Press.
Adult/Child	135 mmHg (18 kPa)
Neonatal	100 mmHg (13.3 kPa)

Selecting the auto initial NIBP cuff inflation pressure

You can determine the cuff inflation pressure automatically based on the **Cuff Size**.

1. Select the NIBP digit field.
2. Select **Use Default Inflation Pressure**.

Setting the target NIBP inflation pressure

You can manually change the target inflation pressure for the first NIBP measurement.

1. Select the NIBP digit field.
2. Check that **Use Default Inflation Pressure** is not selected.
3. Select a value from the **Infl. Press.** list.

Manual NIBP measurements

Starting or stopping a single NIBP measurement from the NIBP menu

1. Select the NIBP digit field.
2. Start the measurement by selecting **Start Manual** for **NIBP Manual**.
3. Stop the measurement by selecting **Stop** for **NIBP Manual**.

Starting or stopping a single NIBP measurement from the key

1. Start the measurement by pressing  from soft key on screen.
2. Stop the measurement by pressing  from soft key on screen.

Automatic NIBP measurements

NIBP Auto mode

The NIBP Auto mode initiates repeated measurements for the selected **Cycle Time**. There will be at least a 30 seconds' delay between two consecutive NIBP measurements during auto cycling.

Setting the cycle time between NIBP measurements

To automatically measure NIBP at set time intervals, you must first set the cycle time.

1. Select the NIBP digit field.
2. Select the cycle time from the **Cycle Time** list.

Setting the custom series for NIBP measurement

You can set a custom series for NIBP automatic measurement. NIBP has user-defined 1 to 4 series measurement modes. The measurement interval of each series is adjustable from 1 to 120 minutes. The repeat number of measurements is adjustable from continuous, and 1 to 25 times.

1. Select the NIBP digit field.
2. Select the **Custom Series** tab.
3. Set up time interval from **X BP Series** list. Set up repeat times from the **repeat** arrows.

To use the custom mode for NIBP automatic measurement, you should set **Cycle Time** to **Custom** in NIBP setup menu.

Starting or stopping an Auto NIBP measurement from the NIBP menu

1. Select the NIBP digit field.
2. Select **Start Cycling** for **NIBP Auto**.

3. Stop the measurement by selecting **Stop Cycling**.

NIBP STAT mode

The **STAT** mode initiates a continuous cycle of measurements for five minutes. A new NIBP measurement starts after the previous measurement completes. After five minutes, the monitor automatically returns to the previously selected cycling interval or manual mode.

STAT NIBP measurement is deactivated when **Cuff Size** is set to **Neonatal**.

Starting or stopping a Stat NIBP measurement

You can set the NIBP measurement to continue for five consecutive minutes.

1. Select the NIBP digit field.
2. Select **Start STAT**.
3. Stop the measurement by selecting **Stop STAT**.

Venous Stasis

The venous stasis mode can initiate inflation and keep constant pressure in the cuff for venous catheterization. The stasis measurement pressure can be selected by user.

The venous stasis is used to produce continuous NIBP cuff pressure in a short time. The duration of cuff inflation pressure is 2 minutes.



NOTE

The venous stasis is disabled when selecting **Neonatal** as **Cuff Size**.

Selecting the venous stasis pressure

1. Select the NIBP digit field.
2. Select **Venous Stasis** tab.
3. Select a value from the **Stasis Press.** list.

Selecting the cuff size for venous stasis

1. Select the NIBP digit field.
2. Select **Venous Stasis** tab.
3. Select a type from the **Cuff Size** list.



NOTE

This setting adjusts the cuff size for all of the NIBP measurement. It's the same setting as in NIBP **Setup** tab.

Starting or stopping a Venous Stasis measurement

1. Select the NIBP digit field.
2. Select **Start Stasis**.
3. Stop the measurement by selecting **Stop Stasis**.

NIBP volume and display settings

Adjusting the NIBP measurement completion tone volume

1. Select the NIBP digit field.
2. Set the **Completed NIBP Volume**.

Selecting the blood pressure unit of measurement

The units of measurement settings required a password. For more information, see the supplemental information manual.

1. Select the  **Service** > **Parameter Settings** > **Units**.
2. Select the units for **Blood Pressure**.

NOTE

This setting adjusts the blood pressure unit for NIBP and IBP parameters.

Selecting the NIBP color

The color settings required a password. For more information, see the supplemental information manual.

1. Select the  >  **Service** > enter **Username** and **Password**.
2. Select the **Parameter Settings** > **Colors** > **Common** horizontal tab.
3. Select the color for **NIBP**.

NIBP alarms

Setting the NIBP alarm limits

1. Select the NIBP digit field.
2. Select the **Alarms** tab.
3. Check that the **Alarm** is turned on.
4. Set the related alarm limits with arrows.

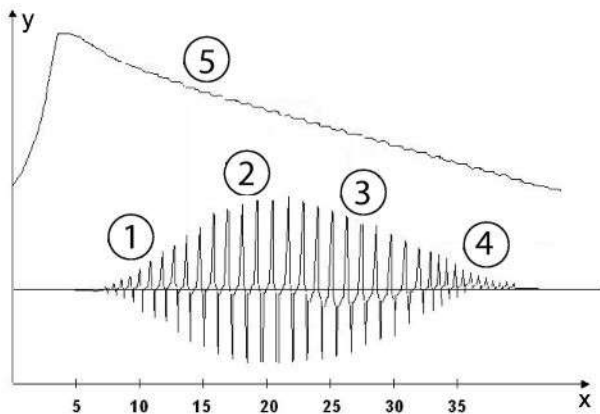
NIBP alarms' deactivation with pause audio key

Unlike the continuously monitored parameters, NIBP is measured periodically, and its physiological alarms can be deactivated with the pause audio key. Deactivating a physiological NIBP alarm will clear that active alarm until the next NIBP measurement is taken. If the new measurement is outside the alarm limits, the alarm is activated again.

NIBP measurement description

NIBP is acquired using oscillometric technology. Oscillometry is the most commonly used means of indirect blood pressure measurement in automated devices. It is based on the principle that pulsatile blood flow through an artery creates oscillations of the arterial wall.

Oscillometric devices use a blood pressure cuff to sense these oscillations, which appear as tiny pulsations in cuff pressure. By measuring and analyzing at various cuff pressures, the amplitude (which changes based on the pressure within the cuff) and the frequency of these pulsations (which is dependent on the patient’s heart rate), oscillometric devices can non-invasively determine blood pressure.



x = Time(s)

y = Pressures

1.	Systolic	4.	Extracted pulse wave
2.	Mean	5.	Cuff pressure
3.	Diastolic		

DINAMAP SuperSTAT NIBP technology

DINAMAP SuperSTAT technology estimates the systolic, mean arterial, and diastolic values by evaluating all cuff pressure data gathered during an NIBP determination.

The first determination initially pumps up to a default target cuff pressure of about 135 mmHg for adults/children, or 100 mmHg for neonatal patients. To allow for rapid setting of cuff pressure, the monitor will momentarily inflate to a higher pressure, then immediately deflate to the target pressure.

As a determination is taken, the pattern of the patient's oscillation size is stored as a function of pressure. In any subsequent determination, as few as four pressure steps may be necessary to complete the process. When employing fewer pressure steps, the system uses the stored information from the previous blood pressure determination to decide the best pressure steps to take. The consistency of pulse sizes is measured to ascertain if the oscillations taken at a step are correct and if more steps are needed.

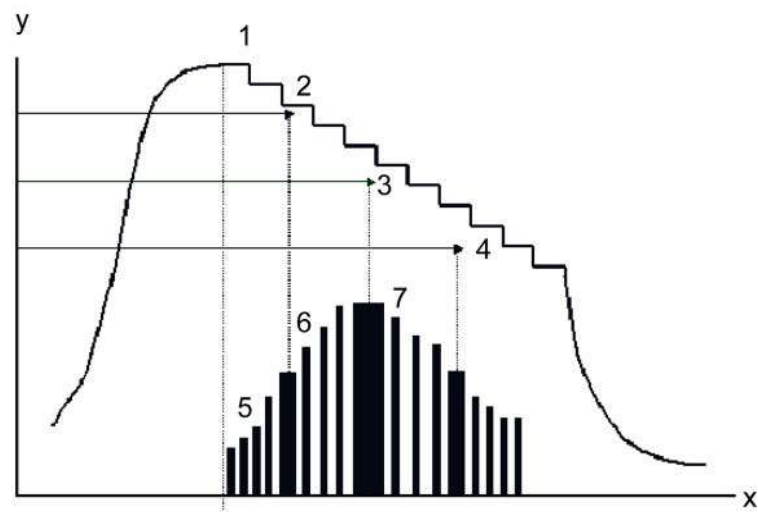
If the current blood pressure reading is similar to the previous reading, some information from the previous blood pressure may be used in the current determination. The data is constantly evaluated during a measurement to try to perform a blood pressure determination in the shortest possible time, providing greater comfort to the patient.

If it has been 16 minutes or less since the last determination and the current blood pressure is similar to the previous reading, the monitor will try to make an accelerated determination of blood pressure.

DINAMAP Step Deflation technology

DINAMAP SuperSTAT technology includes DINAMAP Step Deflation technology. During the deflation process, the monitor measures two consecutive pulsations in cuff pressure. If their amplitude differs by an acceptably small amount and the time interval between the pulsations matches the previous time intervals, the pulsations are averaged and stored along with the corresponding cuff pressure. The cuff is then deflated to the next step (in steps of 5-10 mmHg). As the deflation occurs, oscillation waves are assessed for strength and amplitude until the maximum oscillation amplitude or MAP is obtained.

If either of the above criteria is not met, the cuff pressure is maintained until two consecutive pulsations are detected that meet the criteria. Eventually, if the cuff is maintained at one pressure step for longer than one minute or the determination time exceeds 85 seconds (neonatal cuffs) or two minutes (adult and child cuffs), the monitor will time out and display an error.



x = Cuff pulsation waveform
y = Cuff pressure

1.	Cuff deflation	5.	Cuff pulsations (each pulsation represents one heart beat)
2.	Systolic pressure (ratio of maximum amplitude)	6.	Amplitude (changes based on cuff pressure)
3.	Mean arterial pressure (maximum pulsation amplitude)	7.	Resulting waveform
4.	Diastolic pressure (ratio of maximum amplitude)		

Systolic and diastolic determinations are based on a mathematical calculation within the algorithm. The deflation mode is heart-rate dependent: it is typically longer with heart rates that are slow and/or irregular.

This patented process of finding two matched pulsations of relatively equal amplitude and frequency at each step rejects artifact due to patient movement or other deviations from ideal conditions (e.g., cuff disturbances) and greatly enhances the overall accuracy of the measurement.

NOTE

NIBP values are based on the oscillometric method of non-invasive blood pressure measurement taken with a cuff on the arm of adult and child patients, and a cuff on the calf of infants. The values correspond to comparisons with intra-arterial values within IEC-specific standards for accuracy (a mean difference of ± 5 mmHg, and a standard deviation of < 8 mmHg).

Invasive blood pressure

Invasive blood pressure safety precautions

Invasive pressure warnings



WARNING

DEFIBRILLATOR PRECAUTIONS.

Patient signal inputs labeled with the CF and BF symbols with paddles are protected against damage resulting from defibrillation voltages. To ensure proper defibrillator protection, use only the recommended cables and leadwires. Using other cables or leadwires may result in damage to the equipment and compromise patient and user safety.

WARNING

PATIENT SAFETY.

All invasive procedures involve risks to the patient. Use aseptic technique. Incorrect use of the catheter can lead to vessel perforation. Follow catheter manufacturer's instructions.

WARNING

PATIENT SAFETY.

Make sure that no part of the patient connections touches any electrically conductive material including earth to avoid the risk of electric shock.

WARNING

ERRONEOUS READINGS.

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

WARNING

ERRONEOUS READINGS.

Repositioning the patient after a completed zeroing procedure may cause incorrect measurement values.

WARNING**BURNS.**

When using an electrosurgery unit, note that the measurement cables do not incorporate means to protect against burns in case of a defective ESU return electrode. To avoid burns at the monitor measurement sites, ensure the following:

Proper contact of the ESU return electrode to the patient.

ESU return electrode near the operating area.

Measurement electrodes, leadwires and probes far from the surgical site and the ESU return electrode.

Invasive pressure parameters

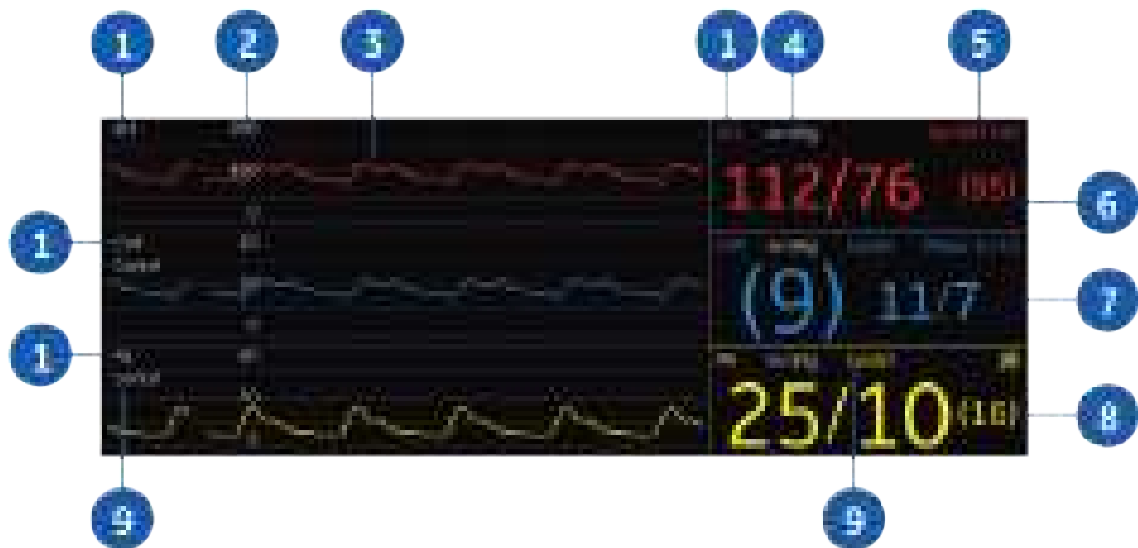
The measured invasive pressure parameters are systolic, diastolic, and mean. Pulse rate can be monitored with any arterial site. CPP is a calculated value that requires a valid ICP value and a valid arterial site value.

PCWP can also be measured for a PA site.

SPV and PPV can also be measured.

You can monitor up to three channel pressures, two channels from monitor frame, one channel from E-COP module.

Invasive pressure measurement on the monitor screen



Normal view



Combined pressures view

1.	Art (Art), CVP (CVP), PA (PA), ICP (ICP): parameter label	7.	IBP value when Digit Format set to Mean
2.	waveform scale	8.	IBP value when Digit Format set to S/D/M
3.	IBP waveforms	9.	Contrl (Contrl): ventilation mode
4.	mmHg (mmHg): IBP unit	10.	IBP combined waveforms
5.	alarm limits, alarm status, or other messages	11.	CPP display when channel label is ICP
6.	IBP value when Digit Format set to S/D		

The invasive pressure channel labels are as follows:

Label	Description
Art	Arterial pressure
ABP	Arterial blood pressure
PA	Pulmonary arterial pressure
CVP	Central venous pressure
LAP	Left atrial pressure
RAP	Right atrial pressure
ICP	Intracranial pressure
RVP	Right ventricular pressure
UAC	Umbilical arterial pressure
UVC	Umbilical venous pressure
IBP1, IBP2, IBP8	Non-specific pressure channel labels

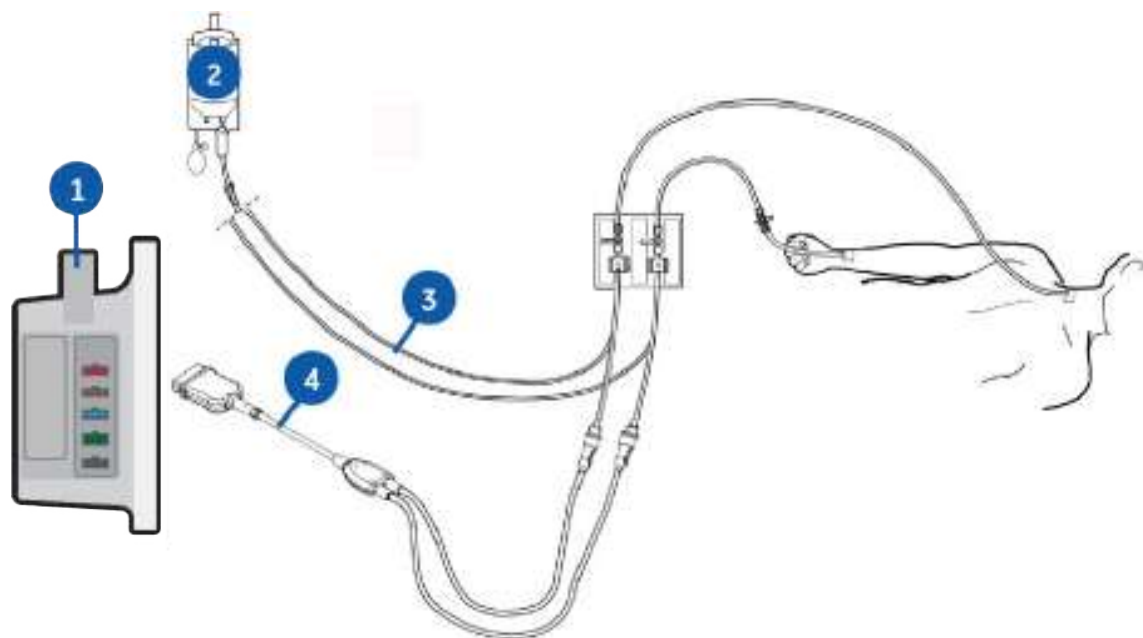
Label	Description
 NOTE	UAC and UVC are only available in the NEONATAL mode.
NOTE	IBP8 invasive pressure channel is not available in the NEONATAL mode.

Invasive pressure points to note

- This equipment is suitable for use in the presence of electrosurgery, as tested according to IEC 80601-2-49 clause 202.8.102 Disturbances from HF Surgical Equipment.
- For information on materials used in accessories and their biocompatibility, refer to the instructions for use in the accessory package.
- Defibrillator discharge may affect the invasive pressure measurement. Defibrillation recovery time after discharge is < 10 seconds.
- A pressure channel is activated when a pressure transducer interface cable is connected to the monitor, or when a pressure transducer is connected to the E-COP module.
- A pressure channel is deactivated when the pressure transducer interface cable is disconnected from the monitor, or when a pressure transducer is disconnected to the E-COP module.
- PCWP: Follow your care unit's policy and procedures for obtaining PCWP measurements, including balloon inflation duration.
- SPV and PPV: Measurement is reliable only when the patient is mechanically ventilated.

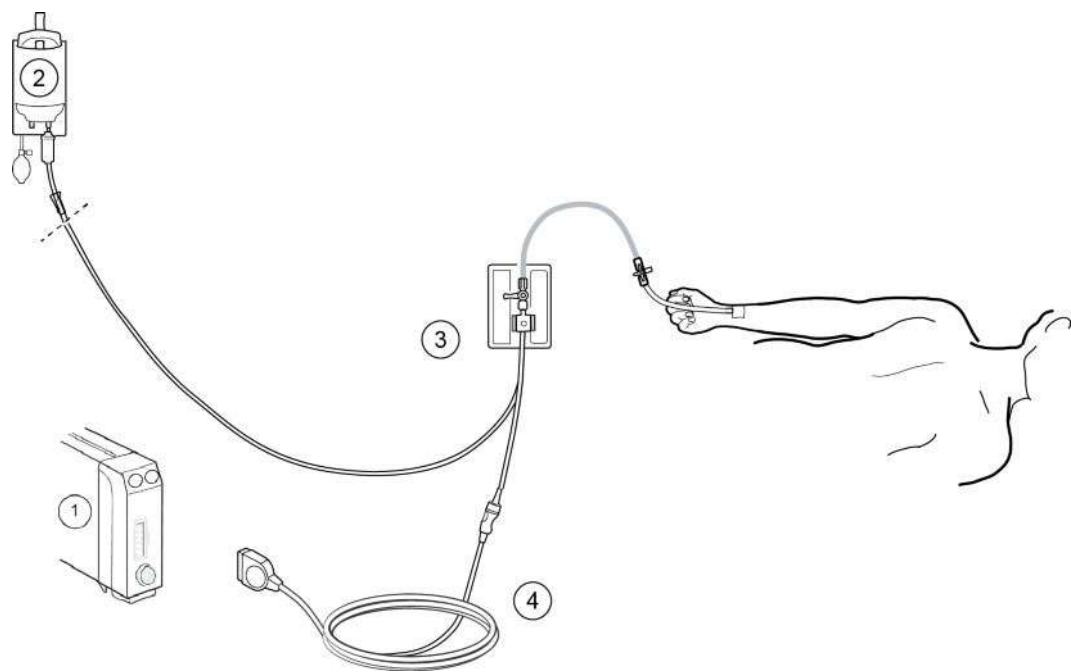
Invasive blood pressure measurement setup

Invasive pressure equipment to patient connection with monitor



1.	The monitor	3.	Transducer setup
2.	Fluid bag with pressure infusor	4.	Invasive blood pressure adapter cable; single or dual cable (optional)

Invasive pressure equipment to patient connection with E-COP module



1.	The E-COP module	3.	Transducer setup
2.	Fluid bag with pressure infusor	4.	Invasive blood pressure adapter cable; single or dual cable (optional)

Connecting the invasive pressure transducer and cable

1. Prepare the transducer kit according to the manufacturer’s instructions.
2. Connect the pressure transducer to the transducer cable.
3. Remove entrapped air from within the transducer setup by tapping the setup and by turning it into different positions.
4. Connect the transducer cable to the invasive pressure connector.
5. Connect the transducer to the patient line.

Checking the invasive pressure measurement

1. Check that the monitor recognizes cable connections (activates the display) for all the pressure channels used and the pressure values and appropriate waveforms are displayed.
2. Make sure that all the transducers are zeroed correctly.

Selecting the display mode for IBP waveforms

You can select the invasive pressure waveforms to be shown as individual waveforms, or in a combined view.

1. Select the  **Screen Setup**.
2. Select the **Layout 1** or **Layout 2** tab.
3. Select the **Combine Pressures** checkbox to combine up to three adjacent IBP waveforms in one field.

The new waveform field will use the combined height of the original fields.

Using the invasive blood pressure measurement

Setup the parameter to normal screen, if need:  **Screen Setup**.

Invasive pressure measurement mapping

Invasive pressure measurements are mapped to one of the invasive pressure channels as follows:

Pressure channel	Pressure measurement source
IBP1	Monitor frame
IBP2	Monitor frame
IBP8	E-COP module

About zeroing the invasive pressure transducers

- Prior to monitoring, zero transducers at the patient's phlebostatic axis. Zeroing the pressure transducers is very important for accurate pressure measurements. To avoid inaccurate measurements, you must zero the pressure transducers:
 - Before measuring invasive pressures.
 - Before initiating treatment changes reliant upon pressures data.
 - When using a new transducer or tubing.
 - After reconnecting the transducer cable to the acquisition device.
 - Whenever the patient's position is changed.
 - Whenever the pressure reading is questionable.
- Pressures can be zeroed individually by selecting **Zero** on the invasive pressure menu.
- You can zero all active transducers except ICP by selecting .

NOTE

The monitor record a time stamp of the last successful zeroing for each invasive blood pressure channel.

Zeroing the invasive pressure transducers

1. Level the transducer following your care unit's policy (usually level of the phlebostatic axis).
2. Close the transducer stopcock to the patient and open the venting stopcock to air.

3. You can zero all connected pressure transducers simultaneously by selecting . Or, you can zero a single active pressure transducer by selecting the invasive pressure digit field > **Zero**.
4. Check that a zero reference has been established. Watch the pressure digit field for messages.
5. Close the venting stopcock to air and open the transducer stopcock to the patient.
6. Check that pressure numerics display on screen.

NOTE

The  does not zero a connected ICP channel. The ICP channel must be zeroed separately. When the **Zero ICP separately** message displays, you can zero the ICP channel separately.

Selecting an invasive pressure channel label

One channel label can only be mapped to one channel at a time. If you select a channel label that is already mapped to another channel, the other channel's label will change to the default value.

1. Select the invasive pressure digit field.
2. Select a channel label from the **Label** list.

Selecting the size of the invasive pressure waveform

1. Select the invasive pressure digit field.
2. Set the waveform scale with the **Scale** arrows.

The larger the scale value, the smaller the waveform size.

Optimizing the invasive pressure waveform scale

You can select an automatic calculation for an optimized waveform size. This size will then be used for the local waveform, snapshot waveform, full disclosure waveform, and waveform printouts. Other instances (e.g., information sent to the network) will use the scale selection that is as close as possible to the upper limit of the optimized scale.

The algorithm uses the last four seconds of the waveform data to calculate the scale. If you notice a considerable change in the waveform during that time, wait for the waveform to stabilize and perform the operation again.

1. Select the invasive pressure digit field.
2. Select **Optimize Scale**.

The **Scale** selection will now show the automatic limit range.

NOTE

The **Optimize Scale** selection will not automatically change to match the waveform, you will always have to select it manually every time.

Selecting the hemodynamic waveform sweep speed

NOTE

This setting adjusts the waveform speed for all of the hemodynamic parameters.

1. Select the invasive pressure digit field.
2. Select a numeric value from the **Hemodynamics Sweep Speed** list.

The smaller the value, the slower the sweep speed.

Selecting the displayed invasive pressure format

You can choose to display systolic, diastolic or mean pressure values in different formats.

1. Select the invasive pressure digit field.
2. Select the format from the **Digit Format** list:
 - **Mean**: All values are shown, but the mean value is shown in a bigger font.
 - **S/D**: All values are shown, but the sys/dia values are shown in a bigger font.
 - **S/D/M**: All values are shown in an equally big font.
 - **CPP**: All values are shown, with additional CPP value.



NOTE

This option is available only when the label is **ICP**.

Selecting invasive pressure as the primary heart rate source

The primary heart rate can be calculated from the ECG leads, SpO₂ measurement, or invasive pressure waveform.

NOTE

This setting adjusts the primary heart rate source for all of the hemodynamic parameters.

NOTE

This setting is available for **Art**, **ABP**, or **UAC** invasive pressure channels only.

1. Select the invasive pressure digit field.
2. Select the heart rate source from the **HR Source** list.

Selecting the ventilation mode

This setting affects the respiration filter.

1. Select the invasive pressure digit field.
2. Select the **Advanced** tab.
3. Select the mode from **Ventilation Mode** list. Choices are:
 - **Spont**: Spontaneous respiration.
 - **Contrl**: Controlled ventilation.



NOTE

The ventilation mode is shown on the digit field for labels **IBP2**, **IBP8**, **CVP**, **PA**, **RAP**, **RVP**, and **LAP**.

Selecting the invasive pressure response time

1. Select the invasive pressure digit field.
2. Select **Advanced** tab.
3. Select the invasive blood pressure response time from the **Response** list. Choices are:
 - **Normal**: Normal averaging time is used.
 - **B-TO-B** (beat-to-beat): The last detected pulse is displayed, values can change up to three times per second. This feature is useful when it is necessary to detect fast pressure changes.

Selecting the invasive pressure noise reduction filter

Measured signal is filtered to remove noise and artifacts.

1. Select the invasive pressure digit field.
2. Select the **Advanced** tab.
3. Select a numeric value from the **Filter Frequency** list.

The smaller the filter value, the greater the degree of filtering that occurs.

Setting invasive pressure alarm limits

1. Select the invasive pressure digit field.
2. Select the **Alarms** tab.
3. Check that the **Alarm** is turned on.
4. Set the related alarm limits with arrows.

Systolic pressure variation and pulse pressure variation

Systolic pressure variation (SPV) and pulse pressure variation (PPV) can provide useful information, for example when assessing the effects of fluid therapy on the cardiac output of a patient.

The SPV and PPV measurements are automatic.

NOTE

The SPV and PPV measurements are reliable for mechanically ventilated patients with no arrhythmias, and when the arterial site selected as the SPV source is providing reliable readings.



NOTE

The SPV and PPV measurements are not available in NEONATAL mode.

Changing the SPV source

1. Select the invasive pressure digit field.
2. Select the **Advanced** tab.
3. Select an option from the **SPV Source** list. The options available depend on the arterial pressure channels that are configured. You can also turn off the measurement by selecting **Off** (default).

Pulmonary capillary wedge pressure (PCWP) measurement

You can obtain a PA wedge measurement (PCWP) with the automated wedge program. The automated wedge program displays on-screen messages to inflate or deflate the catheter balloon. The wedge algorithm then determines the PCWP value. You can confirm this value or adjust the measurement with the provided cursor.

Showing the PCWP digit field

1. Select  > **Screen Setup** > **Lower Area** vertical tab.
2. Select **PCWP** to one of the Lower Field.
3. Make sure one of the IBP channels set to **PA**.

Taking an automated PA wedge measurement

1. Zero the PA channel, if necessary.
2. Select **PCWP** digit field.
3. Inflate the catheter balloon when the **Inflate the Balloon** message displays.
After 10 seconds, the automated wedge program displays the **Deflate the balloon**, after another 10 seconds, displays the **Wedge Complete** message.
4. To adjust the PA wedge value, move the cursor up or down with the **PCWP / Cursor** arrows.
5. To save the PCWP value, select **Confirm Wedge**.

The saved PA wedge value displays in the digit field and is stored in trends.

Starting a new PA wedge measurement

You can clear the current wedge measurement and start a new one:

1. Select **PCWP** digit field.
2. Select **Restart Wedge**.

Other selection in the Wedge menu

There is also other selection in the **Wedge** menu:

- **C.O.:** This selection will open the C.O. **Setup** menu.

Temperature

Temperature safety precautions

Temperature warnings



WARNING

DEFIBRILLATOR PRECAUTIONS.

Patient signal inputs labeled with the CF and BF symbols with paddles are protected against damage resulting from defibrillation voltages. To ensure proper defibrillator protection, use only the recommended cables and leadwires. Using other cables or leadwires may result in damage to the equipment and compromise patient and user safety.

WARNING

BURNS.

When using an electrosurgery unit, note that the measurement cables do not incorporate means to protect against burns in case of a defective ESU return electrode. To avoid burns at the monitor measurement sites, ensure the following:

- Proper contact of the ESU return electrode to the patient.

- ESU return electrode near the operating area.

- Measurement electrodes, leadwires and probes far from the surgical site and the ESU return electrode.

Temperature measurement description

Up to 2 temperature sites can be simultaneously measured and monitored (3 sites when monitoring TBlood). Temperature monitoring provides numerics only. No waveform is generated or displayed.

Tblood is obtained from a pulmonary artery catheter.

Temperature measurement displayed on the monitor screen



1.	Temp (Temp): parameter label
2.	Temperature unit
3.	Temperature alarm limits, alarm status or other messages
4.	T1 (T1): Channel 1 temperature value
5.	T2 (T2): Channel 2 temperature value

The temperature measuring site labels are as follows:

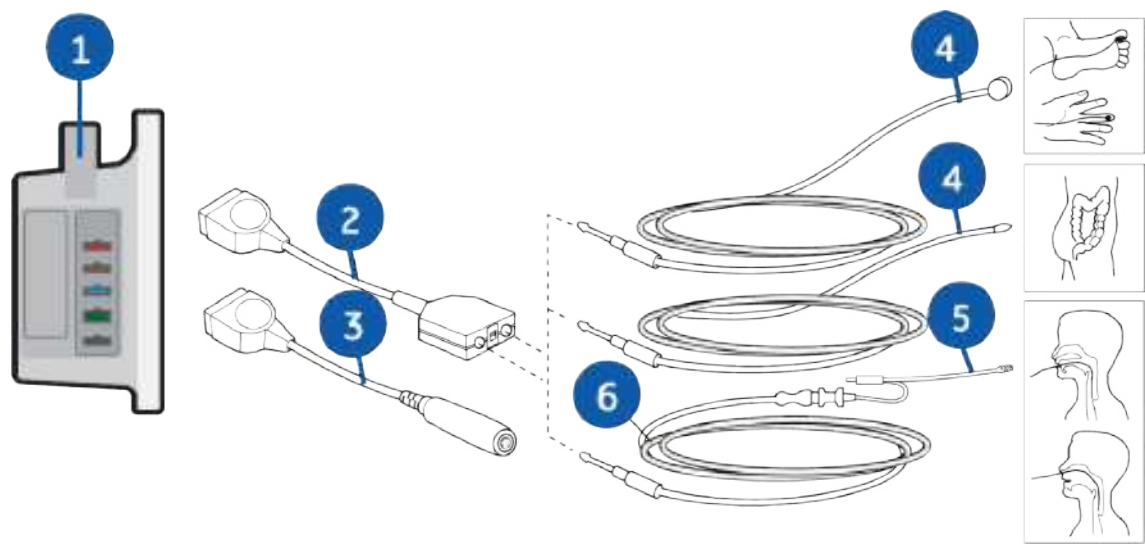
T1, T2 = general label	AirW = airway
Eso = esophageal	Room = room
Naso = nasal	Myo = myocardial
Tymp = tympanic	Core = core
Rect = rectal	Surf = surface
Axil = axillary	Blad = bladder
Skin = skin	

Temperature points to note

- This equipment is suitable for use in the presence of electrosurgery, as tested according to IEC 80601-2-49 clause 202.8.102 Disturbances from HF Surgical Equipment.
- For information on materials used in accessories and their biocompatibility, refer to the instructions for use in the accessory package.
- Use only GE-approved temperature accessories.
- For more detailed information regarding the temperature probes, refer to their own instructions for use.
- Temperature measurement uses direct mode. Displayed temperature values represent the probe temperature of the measurement site on the patient.
- A temperature channel is activated when the monitor detects a temperature probe.
- A temperature channel is deactivated when a temperature probe is detached.

Temperature measurement setup

Temperature equipment to patient connection



NOTE
The temperature measurement site in above graphic is only for reference, please refer to the accessories' instruction for details.

1.	The monitor	4.	Reusable temperature probe
2.	Dual temperature cable	5.	Disposable temperature probe
3.	Single temperature cable	6.	Temperature interconnect cable for disposable temperature probes

Preparing the patient for temperature measurement

1. Follow the manufacturer's instructions for probe application.
2. Connect the temperature cable to the connector.

Checking the temperature measurement

1. Check that the temperature value is displayed when the probe is connected to a temperature cable.

Using the temperature measurement

Setup the parameter to normal screen, if need:  >  **Screen Setup.**

Temperature mappings

Temperature measurements are mapped to one of the temperature channels as follows:

Temperature channel	Measurement source
T1	Monitor frame
T2	Monitor frame
Tblood	E-COP module

Changing the temperature site label

1. Select the temperature digit field.
2. Choose a site label from the **T1 Label** and **T2 Label** list.

Selecting the temperature unit

1. Select the temperature digit field.
2. Select the °C or °F from the **Unit** list.

Setting temperature alarms

1. Select the temperature digit field.
2. Select the **Alarms** tab.
3. Check that the **Alarm** is turned on.
4. Set the related alarm limits with arrows.

Temperature practicalities

- Each temperature label can be changed to reflect the temperature measurement site.
- The dual temperature cable allows a two-channel measurement.
- The signal input is a high-insulation port to ensure patient safety and to protect the device during defibrillation and electrosurgery.
- The monitor automatically calibrates the temperature measurements at startup: every 10 minutes.
- Tblood is obtained from a pulmonary artery catheter.

Cardiac output

C.O. safety precautions

C.O. warnings



WARNING

DEFIBRILLATOR PRECAUTIONS.

Patient signal inputs labeled with the CF and BF symbols with paddles are protected against damage resulting from defibrillation voltages. To ensure proper defibrillator protection, use only the recommended cables and leadwires. Using other cables or leadwires may result in damage to the equipment and compromise patient and user safety.

WARNING

BURNS.

When using an electrosurgery unit, note that the measurement cables do not incorporate means to protect against burns in case of a defective ESU return electrode. To avoid burns at the monitor measurement sites, ensure the following:

- Proper contact of the ESU return electrode to the patient.

- ESU return electrode near the operating area.

- Measurement electrodes, leadwires and probes far from the surgical site and the ESU return electrode.

WARNING

PATIENT SAFETY.

All invasive procedures involve risks to the patient. Use aseptic technique. Incorrect use of the catheter can lead to vessel perforation. Follow catheter manufacturer's instructions.

WARNING

ERRONEOUS READINGS.

The cardiac output measurement results may be erroneous during electrosurgery.

WARNING

ERRONEOUS READINGS.

During atrial fibrillation the C.O. readings may be erroneous.

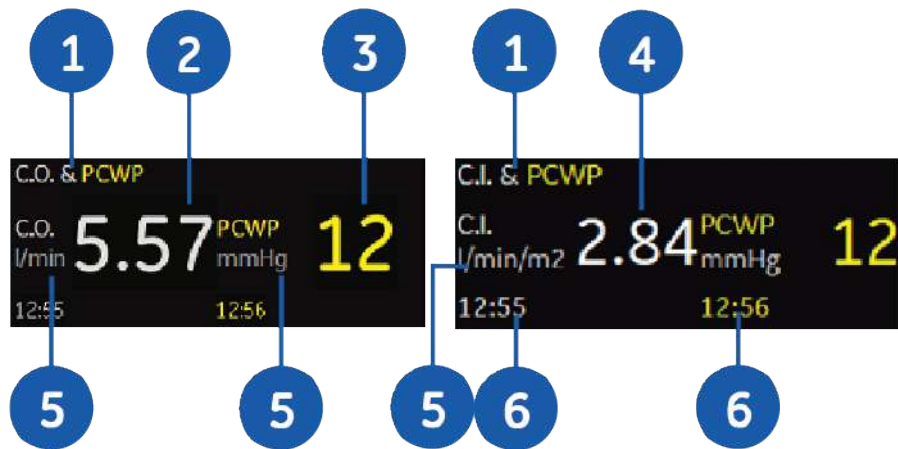
C.O. instruction

The cardiac output (C.O.) measurement invasively measures cardiac output and other hemodynamic parameters by use of a thermodilution catheter. Numeric values display in digit field and a real-time cardiac output washout curve display in measurement menu. Performing a cardiac trail allows to perform up to six time measurements and you can select the effective measurements to achieve a reliable C.O. average value. The confirmed average C.O. value will be displayed in the digit field.

C.O. parameters, E-COP

Parameter	E-COP
Cardiac output (C.O.)	Support
Cardiac Index (C.I.)	Support
Continuous cardiac output (CCO)	n/a
Right ventricular ejection fraction (REF)	Support
SvO ₂	n/a
ScvO ₂	n/a
Invasive pressure	Support 1 channel
blood temperature (T _{blood})	Support
Injectate temperature (T _{inj})	Support
Pulmonary capillary wedge pressure (PCWP)	Support

C.O. measurement displayed on the monitor screen



1.	C.O. & PCWP (C.O. & PCWP), C.I. & PCWP (C.I. & PCWP): parameter label	4.	C.I. value
2.	C.O. value	5.	l/min (l/min), mmHg (mmHg), l/min/m2 (l/min/m2): unit
3.	PCWP value. This parameter can be setup by Show With C.O./C.I..	6.	parameter measurement time

C.O. module key

There is two C.O. module key on the E-COP module:

Start C.O.	Starts and stops the cardiac output measurement.
Zero P4/P8	Zero channel IBP8

C.O. measurement limitations

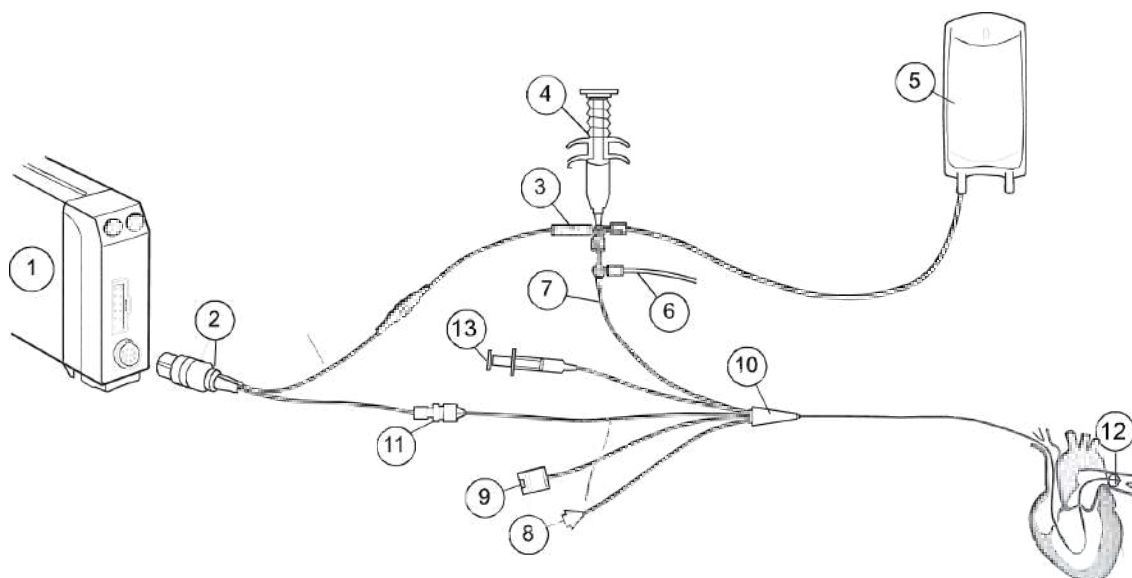
- E-module used for this measurement is not suitable for use with neonatal patients.

C.O. points to note

- This equipment is suitable for use in the presence of electrosurgery, as tested according to IEC 80601-2-49 clause 202.8.102 Disturbances from HF Surgical Equipment.
- For information on materials used in accessories and their biocompatibility, refer to the instructions for use in the accessory package.
- The C.O. connector cables are module-specific and can only be used with the appropriate C.O. module. For detailed information, see the Supplies and accessories.
- The patient's height and weight values are required for determining Cardiac Index (C.I.).
- The right ventricular ejection fraction (REF) measurement is only available with Baxter REF catheters, the **Catheter Type** should setup to **User Defined**.

C.O. measurement setup

C.O. equipment to patient connection with an in-line probe



1.	E-COP module	8.	PA distal port
2.	Cardiac output cable	9.	Optical module connector (used for SvO2 measurement, not available)
3.	In-line injectate probe	10.	Swan-Ganz thermodilution catheter
4.	Injectate syringe	11.	Thermistor connector
5.	Injectate solution	12.	Balloon
6.	CVP line to IP transducer or fluid infuser	13.	Balloon inflation valve
7.	Proximal injectate port		

Preparing the C.O. measurement

1. Connect the C.O. cable to the module, thermistor, and injectate temperature port.
2. Follow your care unit's policy and procedures for positioning the patient for the C.O. measurement.
3. Follow the catheter manufacturer's instructions to set up the in-line or bath probe patient cables.
4. For an in-line setup, make sure the in-line sensor is securely connected to the tubing.
5. For the bath probe setup, make sure the bath probe is correctly sensing the injectate temperature.

Checking the C.O. measurement

1. Check that the monitor recognizes cable connections (activates the display) and all C.O. menu selections are available.

2. Remember that in order to get Cardiac Index (C.I.) you must first enter the patient height and weight.
3. Check that the message **Press Start C.O.** appears on the screen.

Using the C.O. measurement

Entering patient data for the C.I. value

The patient's height and weight values are required for determining cardiac index (C.I.).

1. Select the C.O. digit field.
2. Select **Measurement** tab > **Demographics**.
3. Set the patient's height and weight.

The BSA value is calculated automatically once the height and weight have been selected.

C.O. catheter selections

You can select a cardiac output catheter types.

777F8	Swan-Ganz CCombo V CCO/SvO2/CEDV/VIP Thermodilution Catheter
782F75M	Swan-Ganz VIP/Oximetry Catheter
131F7	Swan-Ganz Thermodilution Catheter
931F75	Swan-Ganz Paceport Catheter
132F5	Swan-Ganz Thermodilution Catheter
131F7P	Swan-Ganz Thermodilution Catheter
User Defined	User defined catheter for temporary use.

Selecting a C.O. catheter type

1. Select the cardiac output digit field.
2. Select the **Setup** tab.
3. Select a catheter from the **Catheter Type** list.

Entering a user-defined C.O. catheter

All user-defined catheter settings are erased when the monitor is discharged.

1. Select the cardiac output digit field.
2. Select the **Setup** tab.
3. Select **User Defined** from the **Catheter Type** list.
4. Set the **Injectate Volume** to match the value listed on the catheter packaging.
5. Set the **Computation Constant** to match the value listed on the catheter packaging.

C.O. measurement modes

C.O. measurements can be taken using the automatic or manual measurement modes. Both measurement modes allow you to use up to six C.O. measurements for calculating a C.O. average.

You can confirm the C.O. measurements within 30 minutes from the start of the first thermodilution measurement, so even if you leave the menu the measurements will not disappear during this time.

Taking an automatic C.O. measurement

When measuring C.O. using the automatic mode, new measurements can be taken when the **Press Start C.O.** message displays.

Holding the injectate syringe by the plunger, not the barrel, improves measurement accuracy.

1. Select the cardiac output digit field.
2. Select the **Setup** tab.
3. Select **Auto** for **Measurement Type**.
4. Verify that the catheter settings are correct.
5. Select the **Measurement** tab.
6. When the message **Press Start C.O.** appears, select **Start C.O. Serial**.
7. Inject the injectate solution smoothly within 4 to 5 seconds.
8. The message **Measuring** displays, followed by the message **Please wait** until the calculation is completed.
9. Observe the washout curve displayed on the screen.

The curve disappears from the screen when the next measurement cycle can start.

10. To take another C.O. measurement, wait for the message **Inject now!** displays before injecting the injectate.

Taking a manual C.O. measurement

Measuring C.O. using the manual mode allows you to determine when to begin the injection procedure. This mode may be preferred for patients with extreme blood temperature fluctuations, or when the automatic mode is unable to establish a stable baseline.

Holding the injectate syringe by the plunger, not the barrel, improves measurement accuracy.

1. Select the cardiac output digit field.
2. Select the **Setup** tab.
3. Select **Manual** for **Measurement Type**.
4. Verify that the catheter settings are correct.
5. Select the **Measurement** tab.
6. Select **Start C.O.**, Or, you can also use the **Start C.O.** module key.
7. When the **Inject now!** message appears, inject the injectate solution smoothly within 4 to 5 seconds.

8. The message **Measuring** displays, followed by the message **Please wait** until the calculation is completed.
9. Observe the washout curve displayed on the screen.
10. Allow 1 to 1.5 minutes between injections to stabilize the catheter baseline temperature. The colder the injectate, the longer the time needed.
11. To perform another C.O. measurement, wait for the **Press Start C.O.** message to display, then select **Start C.O.**.

C.O. trial measurements

A real-time thermodilution curve and numeric value are displayed with each cardiac output trial. Up to six measurements can be retained. After each measured C.O. the program automatically averages the C.O. value. It is recommended to use three to five measurements with less than 10% variation between them for average C.O. The saved average C.O. value is displayed in the parameter window with a timestamp.

Editing the C.O. average

After C.O. trial measurements, you need to edit and confirm the C.O. average to save and display the C.O. average value.

1. Select the cardiac output digit field.
2. Select the **Measurement** tab.
3. Select **Edit Average**.
4. Check the selection boxes for those trials you wish to include in the C.O. average. If you do not wish to include a trial, ensure its selection box is not checked.
5. Select **Confirm C.O.** to store the calculated C.O. average and display it in the cardiac output digit field and measurement menu.

Canceling a C.O. measurement

When a C.O. measurement has just completed, you can remove this C.O. measurement trial without entering the **Edit Average** window.

1. Select the cardiac output digit field.
2. Select the **Measurement** tab.
3. Select the **Cancel/Reject Injection**.

In addition to removing the previous measurement, you can also cancel an in-process measurement.

Setting a C.O. right ventricular ejection fraction (REF) measurement

A valid heart rate is required to take a REF measurement.

1. Select the cardiac output digit field.
2. Select the **Setup** tab.
3. Select the check box for **REF Measurement**.

Selecting the C.O. scale

This selection sets the upper limit of the waveform scale for the thermodilution waveform fields.

1. Select the cardiac output digit field.
2. Select the **Setup** tab.
3. Select a value from the **Scale** list.

Selecting what to show with C.O./C.I.

This setting affects the contents of the cardiac output digit field.

1. Select the cardiac output digit field.
2. Select the **Setup** tab.
3. Select a value from the **Show With C.O./C.I.** list: **NONE**, **PCWP**, **Tblood** and **REF**.

Setting the Tblood alarm

1. Select the cardiac output digit field.
2. Select the **Alarms** tab.
3. Check that the **Alarm** is turned on.
4. Set the related alarm limits with arrows.

Adjusting the wedge from the cardiac output menu

The **Wedge** selection is available only when there is a confirmed C.O. measurement and an invasive pressure channel has been labeled as **PA**.

1. Select the cardiac output digit field.
2. Select the **Measurement** tab.
3. Select **Wedge**.
4. Adjust the wedge settings as required.

Stopping the cardiac output measurement

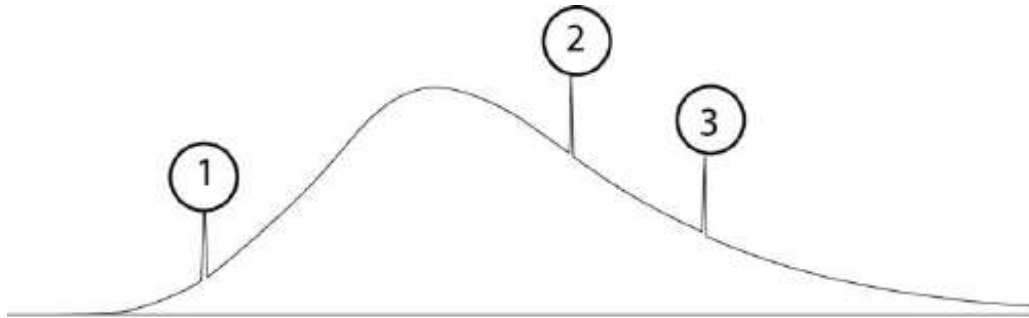
1. Remove the catheter from the patient.
2. Disconnect the probe patient cables.

C.O. practicalities

Cardiac output thermodilution curve

The thermodilution curve, which displays after a C.O. injection, shows the drop in blood temperature as the injectate mixes with the blood. The peak of the curve indicates the maximum difference in the patient's baseline blood temperature and the temperature of the injectate solution. As the mixture

passes through the catheter and then out the pulmonary artery, the temperature difference decreases as indicated by the curve returning to the baseline. A spike is displayed at the onset of the curve, again at 70% of the maximum temperature difference, and again at 35% of the maximum temperature difference. Spikes are also visible during an ongoing C.O. measurement.



1. Onset spike
2. 70% spike
3. 35% spike

Cardiac output is inversely proportional to the area under the thermodilution curve. Cardiac output varies with body size. To more accurately assess cardiac performance for individual patients, the cardiac index is often used.

How to improve the C.O. accuracy

The following influencing factors can influence the cardiac output accuracy:

- The technique used in performing a cardiac output.
- Temperature of the injectate solution.
- Volume of the injectate solution.
- Patient's baseline blood temperature.
- Patient's inspiratory/expiratory cycle.
- Placement of catheter with relation to proximity of lung field.
- The pulmonary artery catheter itself.
- The patient's rhythm and hemodynamic status.
- Any other rapid IV solutions which are infused while the cardiac output is being performed.

The following are suggestions about technique that can help obtain accurate cardiac output:

- Always hold the syringe by the plunger, not the barrel.
- Inject solution rapidly and smoothly.
- Inject within four to five seconds.
- Inject at end expiration.
- When not using an automatic program, wait one minute between injections to allow baseline to stabilize.
- The temperature of the injectate should always be colder than blood temperature. Keep the handling and waiting time with a filled syringe before injection as short as possible. Warm injectate may lead to erroneous C.O. values.

- The probe can be a bath probe continuously measuring the cooling bath temperature or the infusion bag temperature. Alternatively, a flow-through probe is used for a closed injectate delivery. With an in-line system, the displayed injectate temperature is the lowest temperature measured during injection.

Airway gases

Airway gases safety precautions

Airway gases warnings

WARNING

PATIENT SAFETY.

Always inspect the airway adapter for a tight connection and proper operation before attaching it to the patient.

WARNING

ERRONEOUS READINGS.

Leaks in the gas sampling circuit (water trap and sampling line) may cause inaccurate readings.

WARNING

WATER TRAP BLOCKAGE.

Remove the airway sampling line from the patient's airway while nebulized medications are being delivered.

WARNING

INFECTION HAZARD.

Handle the water trap and its contents as you would any body fluid. Infectious hazard may be present.

WARNING

EXPOSURE TO ANESTHETIC AGENTS.

Since sample gas may contain anesthetic agents, make sure that it is not released in the room. Connect exhaust to a scavenging system to prevent exposure to anesthetic agents.

WARNING

ERRONEOUS READINGS.

Strong scavenging suction may cause excessive sample gas flow and inaccurate gas readings.

WARNING**STRANGULATION.**

Route all tubing away from the patient's throat to avoid strangulation.

WARNING**INFECTION HAZARD.**

To avoid the spread of infectious disease, do not allow the exhaust to discharge in the direction of the patient or user.

WARNING**MISINTERPRETATION.**

EtCO₂ values may differ from blood gas readings.

WARNING**ERRONEOUS READINGS.**

A failure in zeroing or calibrating airway gases may cause inaccurate readings.

WARNING**INACCURATE READINGS.**

To ensure the accuracy of gas measurement, perform regular calibration according to the instructions provided. Failing to do so may result in inaccurate readings and compromised patient safety. To avoid this risk, always adhere to the specified calibration intervals.

WARNING**EXPOSURE TO ANESTHETIC AGENTS.**

Since calibration gas contains anesthetic agents, always ensure sufficient ventilation of the room during calibration.

WARNING**EQUIPMENT DAMAGE.**

Do not wash, disinfect or open the water trap cartridge. Do not touch the water trap membrane. The hydrophobic membrane is damaged if any cleaning is attempted, and this may result in the contamination of the gas sensors.

WARNING**CROSS-INFECTION.**

E-miniC: To avoid the risk of patient cross-infection, do not return the sampled gas to the breathing system.

WARNING**PATIENT SAFETY.**

Always ensure the correct size and fit of accessories according to patient type and application, especially when monitoring pediatric and neonatal patients. The size and fit of accessories may impact the measured gas concentration values at low tidal volumes. It is recommended to have the gas sampling port close to the proximal end of the endotracheal tube. Excessive dead space in the circuit, including the accessories, may cause re-breathing of gases. Very low accessory dead space between the breathing circuit Y-piece and the gas sampling site may impact the measured gas concentration due to dilution of the sampled exhaled gas with fresh gas from the ventilator. To confirm accurate correlation with measured gases and blood, check arterial blood gas values to confirm a suitable setup is used.

WARNING**PATIENT SAFETY.**

E-miniC module: Do not use this module on patients that cannot tolerate the removal of 150 ml/min from their total minute ventilation.

WARNING**ERRONEOUS READINGS.**

E-miniC module: O₂, N₂O and anesthetic agent gases may interfere with EtCO₂ readings.

WARNING**PATIENT SAFETY.**

Connect only one CO₂ module (E-sCAiO, E-sCO, N-CAiO, or E-miniC module) to the monitor at a time.

The following apply to the E-sCAiO, E-sCO, or N-CAiO module only:

WARNING**PATIENT SAFETY.**

When using the E-sCAiO, E-sCO, or N-CAiO module with volume controlled ventilation at low tidal volumes, the specified gas withdrawal rate may significantly reduce the amount of gas delivered to the patient.

WARNING**PATIENT SAFETY.**

Make sure to compensate for the possible reduction of tidal volume caused by the 120 ml/min gas sample flow.

WARNING**ERRONEOUS READINGS.**

Ensure that the E-sCAiO, E-sCO, or N-CAiO modules are in vertical position when used. Tilting them may result in erroneous readings.

WARNING**PATIENT CROSS-INFECTION.**

Returning the sampled gas to the patient circuit causes a risk of patient cross-infection.

WARNING**PATIENT CROSS-INFECTION.**

Sampled gas may be returned to the patient circuit only when using a bacterial filter system proximal to the patient. In addition, the anesthesia machine must have a bacterial filter between the module gas output and patient circuit. Otherwise, there is a risk of patient cross-infection.

Airway gases cautions

CAUTION**EQUIPMENT DAMAGE.**

Do not apply pressurized air or gas to any outlet or tubing connected to the monitor. Pressure may destroy sensitive elements.

CAUTION**MISINTERPRETATION.**

Patient-specific MAC is affected by several factors such as patient age and body temperature.

Airway gases instruction

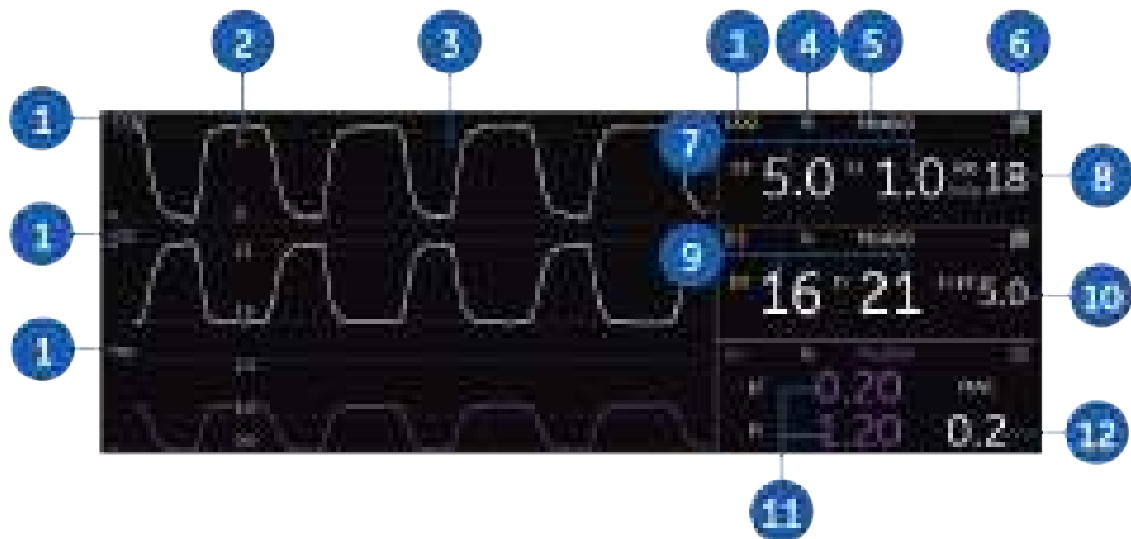
Airway gas measurement is a continuous, non-invasive technology, which provides inspired (Fi) and expired (Et) values of CO₂, O₂, N₂O and anesthetic agents (AA).

According to the module in use, monitoring airway gases, and CO₂ in particular, may help clinician to reduce the risk of hypercapnia and hypocapnia and their consequences. With CO₂ monitoring it is possible to detect unsuccessful (esophageal) intubation and supervise normoventilation.

In intensive care it is to be noted that in critically ill patients there may be arterialalveolar CO₂ difference due to ventilation/perfusion mismatch. However, continuous and non-invasive CO₂ measurement provides useful trend information.

Monitoring of inspiratory and expiratory gas concentrations of oxygen, nitrous oxide, and anesthetic agents guides fresh gas delivery during anesthesia. The lower the amount of fresh gases used, the more important the gas monitoring is, since the rebreathed gases dilute the fresh gas concentrations from the anesthesia machine.

Airway gases measurement displayed on the monitor screen



1.	CO ₂ , O ₂ , Iso (CO₂ , O₂ , Iso): parameter or waveform label	7.	ET, FI (ET , FI): value of EtCO ₂ , FiCO ₂
2.	waveform scale	8.	RR (RR): value of respiration rate
3.	waveforms	9.	value of EtO ₂ , FiO ₂
4.	unit	10.	FI-ET (FI-ET): value of O ₂ diff
5.	Mod(A) (Mod(A)): measurement source, which depends on your selection in CO₂ Setup menu.	11.	value of EtAA, FiAA ^{*1}
6.	alarm status, alarm limits, or other messages	12.	MAC (MAC): value of MAC ^{*2}

^{*1} If mixture agent identified, will be display 2 agents value.

^{*2} If MACage is configured, it is displayed **MAC xxys**.

The in lower digit field also can configure to display Gases, MAC, and Balance field.



1.	Gases, MAC, Balance (Gases , MAC , Balance): parameter label	6.	N ₂ O (N₂O): value of EtN ₂ O, FiN ₂ O
2.	unit	7.	Iso (Iso): value of EtAA, FiAA ^{*1}

3.	Mod(A) (Mod(A)): measurement source, which depends on your selection in CO2 Setup menu.	8.	MAC (MAC): value of MAC ^{*2}
4.	alarm status, alarm limits, or other messages	9.	ET (ET): value of EtBalance
5.	O2 (O2): value of EtO ₂ , FiO ₂		

*1 If mixture agent identified, will be display 2 agents value.

*2 If MACage is configured, it is displayed **MAC xx yrs**.

Airway gases parameters

Airway gases parameters, gas modules

The CARESCAPE respiratory module (E-sCAiO, E-sCO modules) and Airway Gas Option (N-CAiO module) measure the following airway gas parameters:

Parameter	E-sCAiO	E-sCO	N-CAiO
CO ₂	Support	Support	Support
O ₂	Support	Support	Support
N ₂ O	Support	Support	Support
AA	Support	n/a	Support ^{*1}
Agent ID	Support	n/a	Support ^{*2}
Additional measurements			
MAC	Support	n/a	Support
MACage	Support	n/a	n/a
Balance gas	Support	n/a	n/a
Gas exchange	n/a	n/a	n/a
Patient Spirometry	n/a	n/a	n/a
Respiration rate	Support	Support	Support
Sampling method			
Sidestream	Support	Support	Support
Mainstream	n/a	n/a	n/a
*1 The N-CAiO module only supports single agent display and identify.			
*2 The N-CAiO module only supports single agent display and identify.			

Airway gases parameters, E-miniC

Parameter	E-miniC
CO ₂	support
O ₂	n/a ^{*1}
N ₂ O	n/a ^{*1}
AA	n/a
Agent ID	n/a

Parameter	E-miniC
Additional measurements	
MAC	n/a
MACage	n/a
Balance gas	n/a
Gas exchange	n/a
Patient Spirometry	n/a
Respiration rate	support
Sampling method	
Sidestream	support
Mainstream	n/a
*1 The measured N ₂ O and O ₂ value are not displayed. E-miniC requires manual selection from the monitor menu to compensate for N ₂ O and O ₂ .	

Airway gases parameters, anesthesia machine

Connect the device to any compatible anesthesia machine, so that patient data can be intensively displayed on one device. If the parameter source is the anesthesia machine, the device can only display the messages delivered from the anesthesia machine, but not send control commands to the anesthesia machine, e.g. silencing alarms on the anesthesia machine.

The compatible anesthesia machine is DOCom device as required. For more information, see the supplemental information provided.

The anesthesia machine can transmit the following data:

- Waveform
- Parameter digits
- Alarm

The message **Ext** appears in the certain area of screen when the data is from the external source.

The monitor displays the data and based on the measured values generates:

- MAC, MACage, O₂Diff, Et Balance
- Trend
- Print output
- Real-time data transmission to the central station and network compatible with the device

The anesthesia machine can transmit the following parameters:

- CO₂
- O₂
- N₂O
- AA
- AA ID
- RR

Airway gases measurement limitations

- E-miniC is not suitable for use with patients weighing less than 5 kg (11 lbs). In the NEONATAL mode, the CO₂ parameter is not displayed.

Airway gases points to note

- This equipment is suitable for use in the presence of electrosurgery, as tested according to IEC 80601-2-49 clause 202.8.102 Disturbances from HF Surgical Equipment.
- For information on materials used in accessories and their biocompatibility, refer to the instructions for use in the accessory package.
- If anesthetic agents are present, use GE anesthesia sampling lines (PE/PVC). Otherwise, you can use GE CO₂ sampling line (PVC).
- Make sure that you are using a water trap that is compatible with the module:
 - E-sCAiO, E-sCO and N-CAiO modules: D-fend Pro or D-fend Pro+
 - E-miniC: Mini D-fend

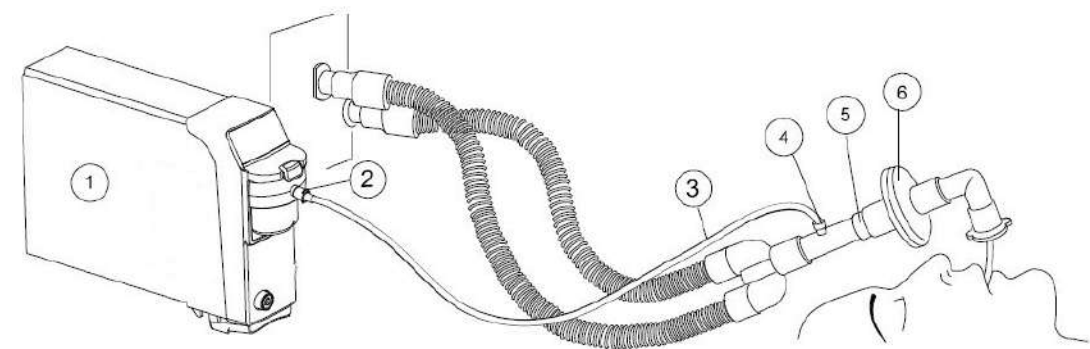
- Empty the water trap container as soon as it is more than half full.

D-fend Pro or D-fend Pro+: With a sample gas temperature of 37°C, a room temperature of 23°C, and sample gas relative humidity of 100 %RH, the water trap should be emptied every 24 hours (applies when the sample gas flow is within 120 ± 20 ml/min for E-sCAiO, E-sCO and N-CAiO modules, 150 ± 25 ml/min for E-miniC module).

- Place the airway adapter between the HME and Y-piece.
- Place the airway adapter with all sampling ports upwards.
- Always check the tightness of all connections.
- Make sure that the gas sampling line is properly connected to the water trap and the water trap is properly connected to the airway gas module. Gas leaks in these connections may dilute the gas sample from the patient circuit, thus resulting in erroneous gas readings. During normal operation, all sampled gas flows out of the sample gas outlet. Room air is used as reference gas for the oxygen measurement and it is mixed with the sampled gas. The sampled gas is diluted by room air so that the fraction of room air in the exhaust gas is about 20%.
- E-miniC: The system automatically compensates for changes in barometric pressure over the atmospheric pressure range of 500 to 800 mmHg (66.7 to 106.7 kPa) over the specified atmospheric pressure ranges.
- Data from external source: The monitor's data display may have delay compare with the anesthesia machine, please observe the patient frequently.

Airway gases measurement setup

Airway gases equipment to patient connections with gas module



1.	E-sCO, E-sCAiO, or N-CAiO module	4.	Gas sampling line connector on the airway adapter; place the connector upwards
2.	Gas sample, gas sampling line connector on the water trap	5.	Airway adapter with sampling line connector
3.	Gas sampling line	6.	Heat and moisture exchanger with filter (HMEF) (optional when sampled gas is directed to the scavenging system)

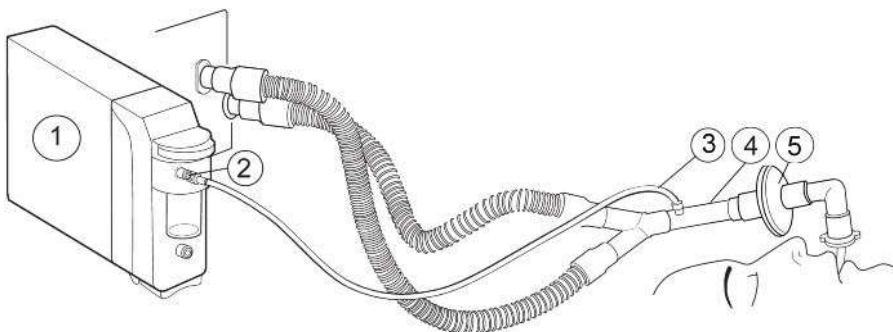


NOTE

Place all D-lite ports upwards with a 20° to 45° tilt to prevent condensed water from entering the sensor interior and the tubings.

Always ensure the correct size and fit of accessories according to patient type and application, especially when monitoring pediatric and neonatal patients. The size and fit of accessories may impact the measured gas concentration values at low tidal volumes. It is recommended to have the gas sampling port close to the proximal end of the endotracheal tube. Excessive dead space in the circuit, including the accessories, may cause re-breathing of gases. Very low accessory dead space between the breathing circuit Y-piece and the gas sampling site may impact the measured gas concentration due to dilution of the sampled exhaled gas with fresh gas from the ventilator. To confirm accurate correlation with measured gases and blood, check arterial blood gas values to confirm a suitable setup is used.

Airway gases equipment to patient connections with E-miniC, critical care setup



1.	E-miniC module	4.	Adapter with sampling line connector
2.	Sampling line connector on the water trap	5.	Heat and moisture exchanger with filter (HMEF)
3.	Gas sampling line		

Connecting to anesthesia machine

For the anesthesia machine to monitor connection, refer to [Connecting the anesthesia machine on page 67](#).

For the anesthesia machine to patient connection, refer to the instructions for use supplied with related device.

Setting up the airway gases measurement

1. Make sure that the water trap container is empty and properly attached.
2. Connect the gas sampling line to the sampling line connector on the water trap.
3. Connect the sample gas outlet to gas scavenging if N₂O or volatile agents are used.
4. Turn on the monitor or connect the module to the monitor. The monitor performs a self-check for the module when the module is connected.

Automatic agent identification is activated in those modules that have this feature.

5. Wait until the message **Calibrating** disappears.
6. Connect the sampling line to the airway adapter or connect the airway adapter to the ventilator circuit. Position the adapter with the sampling port upwards to minimize the amount of condensed water possibly entering the sampling line.
7. Check that the airway adapter connections are tight and that the adapter is operating properly.

NOTE

Check that the sample line is connected to the water trap before connecting the module to the monitor or turning on the monitor.

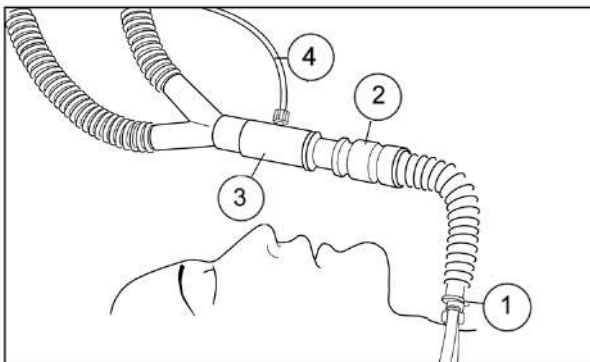
NOTE

To minimize the amount of dust drawn into the gas sampling system, always keep the water trap connected to the module. When gas measurement is not in use, you can disconnect the module from the monitor to eliminate the operating sound of the gas pump.

Airway gases alternative patient connections

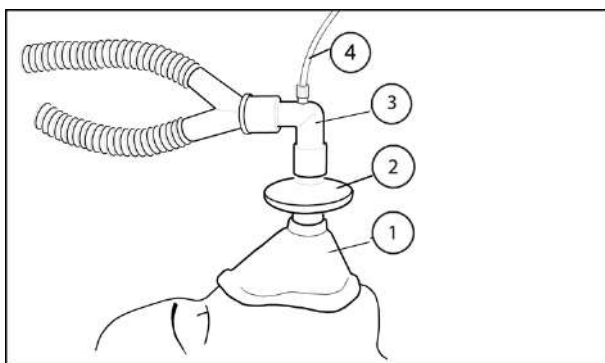
- Use an airway adapter and a sampling line.

Tracheostomy



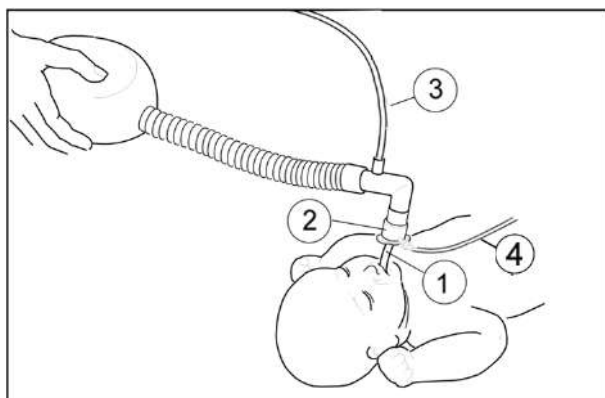
1.	Tracheostomy tube with 15 mm connector
2.	Heat and Moisture Exchanger (HME)
3.	Airway adapter
4.	Sample line

Mask ventilation



1.	Mask
2.	Bacterial filter
3.	Airway adapter
4.	Sample line

Infant ventilation



1.	Endotracheal tube
2.	Pediatric airway adapter
3.	Fresh gas inlet
4.	Sample line

Checking the airway gases measurement

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

Using CO₂ measurement

Setup the parameter to normal screen, if need:  >  **Screen Setup**.

Turning on the CO₂ measurement

If **Measurement off** is shown on CO₂ waveform field or **OFF** is shown on CO₂ digit field, you need to select CO₂ measurement on.

1. Select the CO₂ digit field.
2. Select **ON** from the **Measurement** list.

Starting and stopping pump



NOTE

E-sCO₂, E-sCAiO, N-CAiO module only.

1. Select the CO₂ digit field.
2. Start the pump by selecting **Start Gas Module pump**.
The pump starts and the selection changes to **Stop Gas Module pump**.
3. You can stop the pump by selecting **Stop Gas Module pump**.
Once the module has stopped the pump, the selection changes back to **Start Gas Module pump**.

Selecting the CO₂ scale

If EtCO₂ is above 6% (45 mmHg), change the scale for capnogram.

1. Select the CO₂ digit field.
2. Select an option from the **Scale** list.

Selecting the CO₂ unit

1. Select the CO₂ digit field.
2. Select the **%**, **kPa**, or **mmHg** from the **Unit** list.

Selecting the FiO₂ level

NOTE

FiO₂ and N₂O compensations must be selected manually when E-miniC is used.

The presence of a large concentration of oxygen causes the CO₂ level appear lower than the actual value. Use this option to compensate for the presence of O₂.

1. Select the CO₂ digit field.
2. Select an option from the **FiO₂ Level** list.

Selecting the N₂O level

NOTE

FiO₂ and N₂O compensations must be selected manually when E-miniC is used.

The presence of N₂O causes the CO₂ value to appear higher than the actual value. Use this option to compensate for the presence of N₂O.

1. Select the CO₂ digit field.
2. Select an option from the **N₂O Level** list.

Selecting the CO₂ sweep speed

This selection affects the waveform.

1. Select the CO₂ digit field.
2. Select an option from the **CO₂ Sweep Speed** list.

The smaller the value, the slower the sweep speed.

Selecting airway gases measurement source

1. Select the CO₂ digit field.
2. Select the **Measurement Source**. The available options are **Automatic (A)**, **Gas Module (Mod)**, **Anesthesia (Ext)**.

When you select the **Automatic (A)**, the source of gas module is prioritized.

Setting CO₂ limit alarms

1. Select the CO₂ digit field.
2. Select the **Alarms** tab.
3. Check that the **Alarm** is turned on.
4. Set the alarm limits for **EtCO₂**, **FiCO₂**, and **RR(CO₂)** with arrows.

Setting CO₂ alarms on/off (anesthesia source)

When the measurement source is anesthesia machine, the alarms of related parameters depend on the external data. You can not adjust the alarm limits on the monitor, but only turn the related alarms on or off.

1. Select the CO₂ digit field.
2. Select the **Alarms** tab.

3. Select the **EtCO₂, FiCO₂, RR(CO₂), Anes Apnea & Tech Alarms** alarm **ON** or **OFF**.

Using O₂ measurement

Setup the parameter to normal screen, if need:  >  **Screen Setup**.

Turning on the O₂ measurement

If **Measurement off** is shown on O₂ waveform field or **OFF** is shown on O₂ digit field, you need to select O₂ measurement on.

1. Select the O₂ digit field.
2. Select **ON** from the **Measurement** list.

Selecting the O₂ scale

If the difference between FiO₂ and EtO₂ is more than 6%, change the O₂ scale.

1. Select the O₂ digit field.
2. Select an option from the **Scale** list.

Selecting the O₂ sweep speed

This selection affects the waveform.

1. Select the O₂ digit field.
2. Select an option from the **O₂ Sweep Speed** list.

The smaller the value, the slower the sweep speed.

Setting O₂ limit alarms

1. Select the O₂ digit field.
2. Select the **Alarms** tab.
3. Check that the **Alarm** is turned on.
4. Set the related alarm limits with arrows.

Using AA and N₂O measurement

Setup the parameter to normal screen, if need:  >  **Screen Setup**.

Turning on the agent and N₂O measurement

If **Measurement off** is shown on Agent/N₂O waveform field or **OFF** is shown on Agent/N₂O digit field, you need to select Agent/N₂O measurement on.

1. Select the Agent digit field.

2. Select **ON** from the **Agent Measurement** list for Agent.
Or/and,
3. Select **ON** from the **N2O Measurement** list for N₂O.

Selecting the agent scale

1. Select the Agent digit field.
2. Select an option from the **Agent Scale** list.

Selecting the agent sweep speed

This selection affects the waveform.

1. Select the Agent digit field.
2. Select an option from the **Agent Sweep Speed** list.

The smaller the value, the slower the sweep speed.

Setting agent limit alarms

1. Select the Agent digit field.
2. Select the **Alarms** tab.
3. Check that the **Alarm** is turned on.
4. Set the related alarm limits with arrows.

Using MAC, MACage and ET Balance measurement

Setup the parameters to main screen if need:  >  **Screen Setup**.

The MAC or ET Balance value can be shown on the digit field.

If MACage calculation is set, the MACage value will be shown instead of MAC value.

Setting MACage calculation

1. Select the  >  **Service** > enter **Username** and **Password**.
2. Select **Parameter Settings** > **Others** tab > **MAC Type**
For more information, see the supplemental information manual.
3. Select information area > **Demographics**, check or setup **Age, Years**.
4. Connect the temperature sensor to user.

Preventing operating room pollution

When N₂O and volatile anesthetics are used, prevent operating room pollution by connecting the sample gas outlet (gas exhaust) of the module to the scavenging system.

Scavenging through the ventilator reservoir

1. Connect an exhaust line to the sample gas outlet (gas exhaust) on the module's front panel.
2. Attach the other end of the line to the ventilator reservoir. Make sure that the reservoir tube diameter is at least 2 to 3 times larger than the exhaust line.

Scavenging through the anesthesia gas scavenging system

Anesthesia machines are equipped with an anesthesia gas scavenging system (AGSS), and in some machines you can connect the sample gas outlet directly to it. See the anesthesia machine's user documentation to find out where and how the sample gas can be connected.

Connecting directly to the scavenging system

1. Connect the exhaust line to the module's sample gas outlet.
2. Connect the exhaust line only to an open scavenging system where gas is removed at room pressure.

NOTE

Do not connect the module directly to a strong vacuum scavenging system.

NOTE

If the E-miniC is used, do not return sample gas to the patient circuit.

Stopping the airway gases measurement

1. Remove the added adapters from the patient's breathing circuit and gas scavenging.
2. Check the patient's breathing circuit.
3. Select the gas digit field > **Measurement** > **OFF**.
4. Remove the gas module from the monitor when it is not used.

Basics of airway gases measurement

Airway gases measurement description, E-sCAiO, E-sCO, and N-CAiO modules

With E-sCAiO, E-sCO, and N-CAiO modules you can measure and monitor gases being delivered to the patient and exhaled by the patient through the breathing circuit. The modules consist of an infrared sensor for measuring CO₂ and N₂O, and paramagnetic O₂ sensor. The E-sCAiO and N-CAiO modules also include anesthetic agents measurement.

The gas sampling system samples the measured air to the module, and removes water and impurities from it. The pump of the gas sampling system draws gas at a fixed rate through the sampling line into the gas measuring units. The gas enters the module through the water trap, where it is divided into two flows, a main flow and a side flow. The main flow goes into the analyzers. This flow is separated from the patient side by a hydrophobic filter. The side flow creates a slight sub-atmospheric pressure

within the water trap, which causes fluid removed by the hydrophobic filter to collect in the bottle. After the measurement, gas is exhausted through the sample gas out connector.

The module finds the time instant of the highest CO₂ concentration in each breath. Concentration at that instant is the ET CO₂ reading. Because nitrous oxide and anesthetic agents are measured by the same sensor as CO₂, the ET readings of those gases are obtained directly at the time instant of ET CO₂. For calculating ET readings of oxygen, the module synchronizes the O₂ waveform with the CO₂ waveform. The ET reading of O₂ is then determined as O₂ concentration at the time instant of ET CO₂. If no breaths are detected for a given time (20 s, for example), an apnea situation is triggered. During apnea, the ET values are updated every two seconds to the current concentration of each gas.

Total sample size volume during one respiratory cycle depends on the respiration rate. The following table shows different sample size volumes with a 120 ml/min sample flow and I:E ratio of 1:2.

Respiration rate	10	30	50	70
Duration of inspiration	2.0 seconds	0.7 seconds	0.4 seconds	0.3 seconds
Duration of expiration	4.0 seconds	1.3 seconds	0.8 seconds	0.6 seconds
Volume sampled during inspiration	4 ml	1.3 ml	0.8 ml	0.6 ml
Volume sampled during expiration	8 ml	2.7 ml	1.6 ml	1.1 ml
Total volume sampled	12 ml	4 ml	2.4 ml	1.7 ml

Airway gases measurement description, E-miniC

The E-miniC is designed for critical care environment to measure and monitor the expired and inspired CO₂ concentration (EtCO₂, FiCO₂) as well as the respiration rate (RR) up to 80 breaths per minute. E-miniC has a sample flow of 150 ml/min.

Respiration rate from the CO₂ parameter is counted from the frequency of end-tidal (peak) CO₂ measurements per minute. A sufficient respiration is defined as a difference of at least 1% (at least 7 mmHg) between the measured inspired fraction and end-tidal CO₂.

Total sample size volume during one respiratory cycle depends on the respiration rate. The following table shows different sample size volumes with a 150 ml/min sample flow and I:E ratio of 1:2.

Respiration rate	10	20	40	60
Duration of inspiration	2.0 seconds	1.0 seconds	0.5 seconds	0.3 seconds
Duration of expiration	4.0 seconds	2.0 seconds	1.0 seconds	0.7 seconds
Volume sampled during inspiration	5 ml	2.5 ml	1.3 ml	0.8 ml
Volume sampled during expiration	10 ml	5 ml	2.5 ml	1.7 ml
Total volume sampled	15 ml	7.5 ml	3.8 ml	2.5 ml

Sidestream gas sampling

The E-modules use a sidestream gas sampling method. It means that a sample of patient's respired gases from the sampling site is transported through a sampling line to the module for analysis.

A sidestream gas analyzer takes a constant sample from the patient airway adapter at the following sample rates:

- E-sCAiO, E-sCO, N-CAiO: 120 ml/min
- E-miniC: 150 ml/min

Total sample size volume during one respiratory cycle depends on the respiration rate.

Minimum Alveolar Concentration (MAC)

The use of either traditional MAC or MACage is selected during monitor configuration. The MACage provides age and temperature compensated measurement. To enable MACage calculations, enter patient's age to the monitor and attach a temperature sensor. If the patient's age is not given, the monitor shows normal MAC even if MACage has been selected.

NOTE

The MAC value displayed by the monitor is that of exhaled air, and it does not always correspond to the amount of anesthetic in the patient's organs.

MAC and MACage

The minimum alveolar concentration (MAC) concept is based on the assumption that in a steady state, the alveolar partial pressure of a gas is equal to the partial pressure in the effector organ of the central nervous system. MAC values are used to estimate the level of anesthesia caused by volatile anesthetics.

The MAC value can be displayed in digit field: 1 MAC is the alveolar concentration (end-tidal) of the agent at which 50% of patients do not respond to a noxious or surgical stimulus. The value is calculated from the actual measured anesthetic agent and N₂O values with empirical formulas based on statistical studies with anesthetized patients.

The monitor can display two different MAC values, MAC or MACage, based on different formulas. The use of MAC or MACage is selected during installation and configuration.

The MAC values correspond to those of healthy adults of about 40 years old, and cannot be applied to children or elderly patients. Age and some other individual factors influencing the effect of volatile agents are not taken into account.

The other calculation method, MACage, takes the patient's age into account. The age range is 0 to 150 years. The calculation uses 0 if age is less than 0, and 100 if age is more than 100. In addition, MACage calculations include the atmospheric pressure and the patient's (highest measured) temperature values. If no patient temperature is measured, 37°C is used instead. For volatile agents this calculation method means about 6.7% decrease of MAC value with each increasing decade of life. MACage is calculated if it is enabled in the care unit settings and the patient's age is given on the monitor. If no age is given, MAC is calculated despite the care unit setting.

References used for MAC and MACage values

The alveolar concentrations of traditional (MAC) and age dependent (MACage) values are based on the following references:

- References for anesthetic agent MAC values:
 - Mapleson W.W.: Effect of age on MAC in humans: a meta-analysis. Br. J. of Anaesthesia 1996; 76: 179-185
 - Rampil I.J.; Zwass M.; Lockhart S.; Eger E.I. II; Johnson B.H.; Yasuda N.; Weiskopf R.B.: MAC of I653 in surgical patients, Anesthesiology. 71 (3A):A269, September 1989
 - Scheller M.S., Partridge B.L., Saidman L.J.: MAC of sevoflurane in humans and the New Zealand white rabbit. Anesthesiology 1987; 67: A373

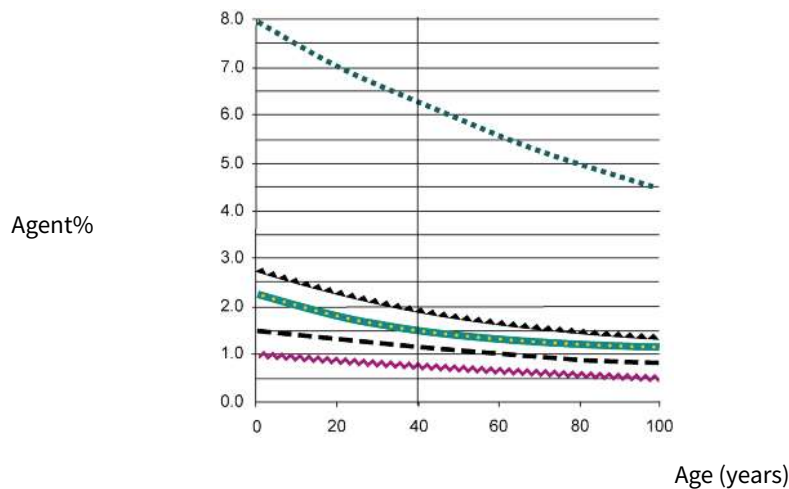
- ISO21647:2004 + C1:2005, Medical electrical equipment - Particular requirements for the basic safety and essential performance of respiratory gas monitors.
- References for MACage calculations:
 - Eger, E.I. II.: Age, minimum alveolar anesthetic concentration, and minimum alveolar anesthetic concentration-awake. Anesth. Analg. 2001; 93:947-953
 - Rampil I.J.; Zwass M.; Lockhart S.; Eger E.I. II; Johnson B.H.; Yasuda N.; Weiskopf R.B.: MAC of I653 in surgical patients, Anesthesiology. 71 (3A):A269, September 1989

MAC values of different anesthetics in oxygen

Normal values (40-year-old patient) and compensated values (65-year-old and 3-year-old patients):

	1 MAC	1 MAC (65 yrs)	1 MAC (3 yrs)
Halothane	0.75%	0.63%	0.97%
Enflurane	1.70%	1.43%	2.2%
Isoflurane	1.15%	0.97%	1.5%
Sevoflurane	2.05%	1.73%	2.65%
Desflurane	6.00%	5.05%	7.80%
N ₂ O	100%	82%	N/A

The following illustration shows the Agent% corresponding to 1 MAC as function of age:



Symbol	Anesthetic
■ ■ ■ ■ ■ ■ ■ ■	Desflurane
▲ ▲ ▲ ▲ ▲ ▲ ▲ ▲	Sevoflurane
● ● ● ● ● ● ● ●	Enflurane
× × × × × × × ×	Isoflurane
◆ ◆ ◆ ◆ ◆ ◆ ◆ ◆	Halothane

MAC values of different anesthetics in 65% N₂O

Normal values (40-year-old patient) and compensated values (65-year-old and 3-year-old patients).

	1 MAC	1 MAC (65 yrs)	1 MAC (3 yrs)
Halothane	0.27%	0.14%	0.51%
Enflurane	0.61%	0.31%	1.15%
Isoflurane	0.41%	0.21%	0.78%
Sevoflurane	0.73%	0.37%	1.40%
Desflurane	2.09%	1.1%	4.1%

ET balance gas

You can obtain a calculated value for balance gas, EtBal. End-tidal balance gas is the percentage of gas concentration not measured by the gas sensors. It is displayed in digit field with the MAC value.

An increased balance gas value may indicate the amount of nitrogen flushed out from the patient into the circuit. The increase may be due to an accumulation of nitrogen during low flow anesthesia.

The monitor calculates end-tidal balance gas when oxygen and CO₂ measurements are active. If oxygen or CO₂ status is invalid or agent identification fails, the monitor displays the balance gas value as invalid.

Automatic agent identification

NOTE

E-sCAiO, N-CAiO module only.

The modules with agent identification option will automatically identify and select Isoflurane, Desflurane, Sevoflurane, Enflurane and Halothane. The E-sCAiO module is able to identify two agents simultaneously and displaying them as primary and secondary agents. The N-CAiO module is able to identify and display one agent. The inspiratory and expiratory concentrations of the agent are displayed in digit field. Minimum concentration for the identification is 0.15 vol%. The agent selection remains active even if the concentration decreases below 0.15 vol%. Automatic agent identification is operational after the normal warm up of the module (approximately five minutes).

- If rapid agent concentration changes are required, fresh gas flow must be increased.
- Anesthetic agent concentration in the circuit is affected by patient uptake, breathing system volume and the fresh gas flow. It quantifies the speed of wash-in and wash-out anesthetic agents.

Basics of CO₂ measurement

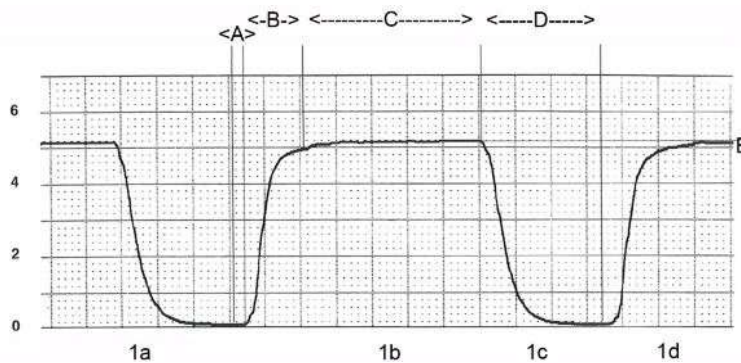
Normal CO₂ waveform

The CO₂ waveform is referred to as capnogram and it reflects the different stages in breathing. The capnogram of a healthy patient under controlled ventilation has a normal shape. Changes in the CO₂ waveform may indicate compromised patient respiratory and/or circulatory function or improper mechanical ventilator functionality.

The origin of the CO₂ waveform

The following illustration shows a normal capnogram. In this illustration, the letters indicate the following:

- **A:** The gas first exhaled is from the anatomical and apparatus dead-space. It contains no CO₂ because it has not been in the alveoli and no gas exchange has taken place.
- **B:** Briefly, the exhaled gas is a mixture of gas from the anatomical dead-space and gas from the alveoli.
- **C:** A plateau is reached when the gas exhaled is entirely from the alveoli. The end-tidal CO₂ (EtCO₂) concentration is measured at the end of this plateau.
- **D:** When the next inspiration starts the capnogram rapidly falls towards the baseline. The minimum level of CO₂ measured during the inspiratory phase is called the inspired CO₂ concentration (normally 0.0%).
- **E:** With a scale, the height of the capnogram tells you the end-tidal CO₂ concentration. The monitor automatically calculates and display the EtCO₂ in numbers. EtCO₂ approximates the alveolar CO₂ concentration because it is measured when the patient exhales virtually pure alveolar gas.



- 1a and 1c = inhalation
- 1b and 1d = exhalation

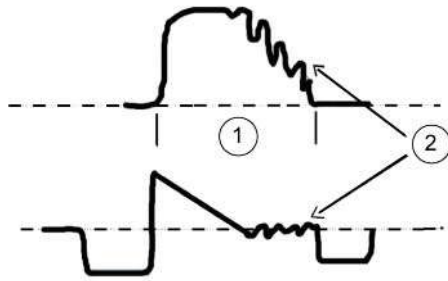
EtCO ₂ value %	EtCO ₂ value mmHg	Indicates
4.5% to 5.5%	34 mmHg to 41 mmHg	normocapnia
< 4%	< 30 mmHg	hypocapnia
> 6%	> 45 mmHg	hypercapnia

Dips in capnogram

The dips seen in the capnogram during expiration are related to the sidestream gas sampling, the continuous gas flow to the Y-piece, and patient's cardiac contractions, which cause intra-thoracic pressure changes and therefore flow variations.

The alterations in expired CO₂ waveform are cardiogenic movements of exhaled and circuit gas at the sidestream gas sampling site. When the respiratory gas flow drops below the gas sampling rate, a variable mixture of CO₂ free fresh gas and exhaled CO₂ rich gas is sampled. This causes variations in sampled CO₂ concentrations.

In the illustration below, CO₂ waveform is the one on top, and flow is the lower waveform.



1. Expiration
2. Cardiogenic oscillations

Cardiogenic oscillations appear when:

- A continuous fresh gas flow is fed into the patient Y-piece.
- Sidestream gas sampling is done at the Y-piece.
- The patient is ventilated with a long expiration time or low respiration times, and when there is a long zero flow at end-expiration for some other reason.

Oscillations can be eliminated by adding a spacer with a 5 ml dead space between the Y-piece and the airway adapter. Increased dead space creates a buffer volume between the Y-piece and the sampling point, preventing the inspiratory and expiratory air from mixing during gas sampling. Misinterpretation of EtCO₂ information can be avoided through identifying cardiogenic oscillation and understanding the reasons for it.

Oxygen measurement interpretation

The E-sCAiO, E-sCO, and N-CAiO modules' oxygen measurement provides:

- Inspired oxygen level, the actual inspired oxygen concentration
- End-tidal oxygen level, the expired oxygen concentration
- Inspiratory-expiratory oxygen difference reflects patient's consumed oxygen volume-percentage from the administered gas mix
- Oxygram, a diagnostic tool both in real time and as a trend

The patient oxygen provides breath-by-breath information about the breathing circuit, alveolar ventilation and some vital indicators of adequate oxygenation.

Oxygram is a mirror image of a capnogram in a steady state in normal patient. It is a graphic presentation of changes in O₂ concentrations in the airway gas. The oxygram reflects the oxygen uptake from the alveoli. To avoid patient administered hypoxic gas mixes the inspired fraction of oxygen (FiO₂) should never be lower than 21%.

Airway gases practicalities

Ventilation management

Normoventilation (adequate alveolar ventilation of a patient) can be maintained by monitoring the end-tidal carbon dioxide and oxygen concentrations, and adequacy of ventilation can be maintained by monitoring airway pressures, volumes and spirometry loops. Alveolar minute ventilation is usually adjusted to achieve normocapnia, where EtCO_2 is in the range of 4.5% to 5.5% (34 mmHg to 41 mmHg). This is called normoventilation as it is the normal situation in healthy people.

A low EtCO_2 concentration ($\text{EtCO}_2 < 4\%$ / 30 mmHg) indicates hyperventilation.

NOTE

A low EtCO_2 value in itself is dependent from the ventilation volume vs. circulation status (lung perfusion). This means that in case of low blood pressure (e.g. shock) or shunting low EtCO_2 values may be observed while using a “normal” TV/MV.

Increased EtCO_2 concentration ($\text{EtCO}_2 > 6.0\%$ / 45 mmHg) indicates hypoventilation or ineffective alveolar ventilation, which will lead to hypercapnia and respiratory acidosis. Increased inspiratory CO_2 (FiCO_2) concentrations may also be caused by:

- Exhausted CO_2 absorber.
- Malfunction of the breathing system valves.
- Rebreathing when a rebreathing system without a CO_2 absorber is used with inadequate fresh gas flows.

NOTE

During some surgical procedures, e.g. laparoscopy, CO_2 may be used to inflate the abdomen which may result in rise of PaCO_2 due to the absorption of CO_2 into the blood via the vascular wound bed. This may lead to an increase in the EtCO_2 .

Prevention of the breathing system contamination

You can use a microbial filter between the endotracheal tube and the airway adapter. Change the filter for every patient. Change the patient circuit at intervals given in the circuit manufacturer's documentation, and according to your hospital protocols.

How to prevent effects of humidity

In anesthesia, the lower the fresh gas flow, the more rebreathed gas recirculates through the CO_2 absorber and the more humidity and heat is produced through the chemical CO_2 absorption process.

- If a moisture exchanger is used, place it between the endotracheal or intubation tube and the airway adapter. In intensive care, the moisture exchanger must be replaced at least every 24 hours.
- Place all airway adapter ports upwards with a 20° to 45° tilt to prevent condensed water from entering the sensor interior and the tubings.

- The airway adapter should be emptied of clearly visible water droplets, or replaced with a dry and clean adapter.
- If active humidification is used, extra water collectors may be placed between the ventilator's inspiratory and expiratory breathing tubings. They are also useful for condensed water collection during long-lasting anesthesia.

Oxygen delivery, E-sCAiO, E-sCO, N-CAiO modules

Oxygen uptake and consumption

Oxygen consumption is the difference between the amount of oxygen delivered to the tissues by the arterial circulation and the amount of oxygen returned to the heart by the venous system. The formula for oxygen consumption is a simple restatement of the Fick equation, which identifies all of the pertinent variables of oxygen supply and demand. $VO_2 = CO \times Hb \times 13.8 \times (SaO_2 - SvO_2)$. Dependent from the patient's circulation status the mechanical ventilator settings for, amongst others, FiO_2 in the delivered gas mix (min. > 25%) should guarantee a sufficient PAO_2 and PaO_2 . Patients with fever may consume oxygen at considerably higher rates.

Oxygen supply to the breathing system must meet the metabolic need of the patient.

To prevent hypoxemia and to ensure safe and sufficient oxygen supply, the alveolar oxygen concentration (EtO_2) should be at the level of 25% minimum.

Nitrogen elimination

During the maintenance of minimal low flow anesthesia, a small amount of nitrogen may accumulate in the circuit. It may be detected as decreased concentration of other gases, and eliminated by temporarily increasing the fresh gas flow.

Flow reduction

Reduction of fresh gas flow may increase rebreathing in case of a CO_2 absorber malfunction or during the use of open anesthesia gas delivery systems.

The lower the fresh gas flow, the higher the oxygen concentration required in the fresh gas.

Level of anesthesia: E-sCAiO, N-CAiO modules

Anesthetic agent uptake

Fresh gas flow reduction decreases the total amount of anesthetic agent fed into the breathing system if agent concentration is maintained constant.

The lower the fresh gas flow rate, the longer the time required to reach the effect of a change in the fresh gas settings.

Spirometry (from interfaced Anesthesia machine)

Spirometry instruction

Connect the device to any compatible anesthesia machine, so that patient data can be intensively displayed on one device. If the parameter source is the anesthesia machine, the device can only display the messages from the anesthesia machine, but not send control commands to the anesthesia machine, e.g. silencing alarms on the anesthesia machine.

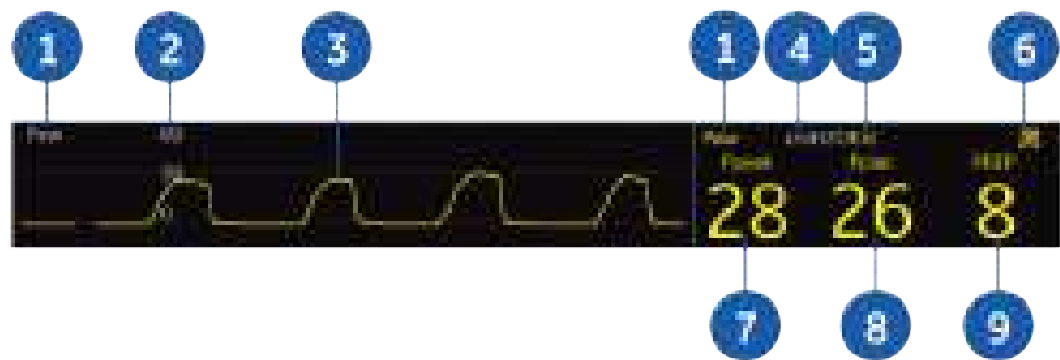
The source of spirometry should be compatible anesthesia machine runs Datex-Ohmeda Com 1.2 Protocol. For more information, see the supplemental information provided.

Spirometry measurement displayed on the monitor screen

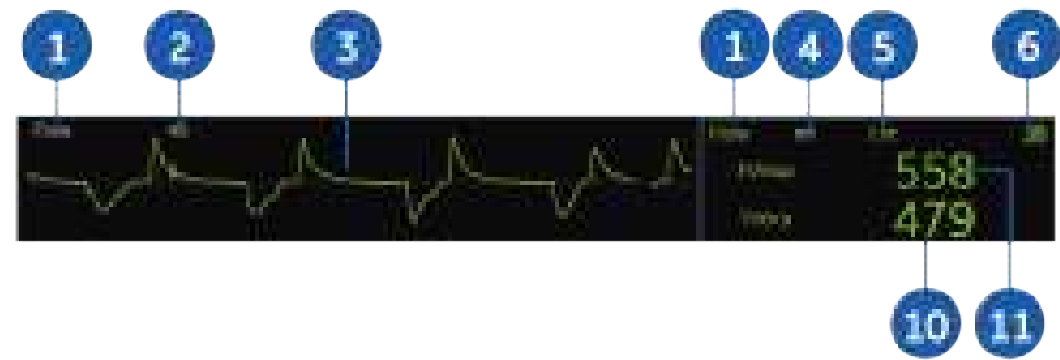
The message **Ext** appears in the certain area of screen when the data is from the external source.

You can setup following screen views from  >  **Screen Setup**.

- Split screen: displays the spirometry parameter digits
- Normal screen: displays the waveform field and digit field of **Paw** and **Flow**:



Paw parameter



Flow parameter

1.	Paw (Paw) or Flow (Flow): parameter or waveform label	7.	Ppeak (Ppeak): peak pressure
2.	waveform scale	8.	Pplat (Pplat): plateau (pause) pressure
3.	waveforms	9.	PEEP (PEEP): total positive end expiratory pressure
4.	cmH2O (cmH2O) or ml (ml): unit	10.	TVinsp (TVinsp): inspired tidal volume
5.	Ext (Ext): indicate external source	11.	TVexp (TVexp): expired tidal volume
6.	alarm status, alarm limits, or other messages		

 **NOTE**
Flow digit field displays **TVinsp**, **TVexp** when **Show Volume** is **TV**; displays **MVinsp**, **MVexp** when **Show Volume** is **MV**.

Spirometry supported data

The device supports the data of the following parameters:

- Waveforms
- Parameter digits
- Numeric trends (including vent settings)
- Alarm broadcast
- Printing output

- Transferring data to CARESCAPE network and HL7 network

Spirometry parameters

- Peak pressure (Ppeak): maximum pressure during one breath
- Plateau pressure (Pplat): pressure at the reversal point of the flow
- Mean pressure (Pmean): average pressure during one breath
- Positive end expiratory pressure (PEEP)
- Inspiratory and expiratory tidal volumes (TVinsp/TVexp)
- Inspiratory and expiratory minute volumes (MVinsp/MVexp)
- Compliance (Compl): calculated for each breath, indicates the pressure difference required to deliver a certain volume of gas into the patient
- Airway resistance (Raw): calculated from an equation describing the kinetics of gas flow between the lungs and a flow sensor
- (Paw): Real-time pressure waveform
- (Flow): Real time waveform

Vent settings in numeric trends:

Vent mode	Display parameters
Volume Control Ventilation (VCV)	TV, RR, I:E, PEEP
Synchronized Intermittent Mechanical Ventilation with Volume Control (SIMV VCV)	TV, RR, PEEP, Psupport, Tinsp
Synchronized Intermittent Mechanical Ventilation Pressure Control Volume Guaranteed (SIMV PCV-VG)	TV, RR, PEEP, Psupport, Tinsp
Synchronized Intermittent Mechanical Ventilation Pressure Control (SIMV PCV)	RR, PEEP, Pinsp, Psupport, Tinsp
Pressure Supported Ventilation with apnea protection (PSVPro)	RR, PEEP, Pinsp, Psupport, Tinsp
Pressure Control Ventilation - Volume Guaranteed (PCV-VG)	TV, RR, I:E, PEEP
Pressure Control Ventilation (PCV)	RR, I:E, PEEP, Pinsp
Continuous Positive Airway Pressure plus Pressure Supported Ventilation (CPAP + PSV)	RR, PEEP, Pinsp, Psupport, Tinsp

Spirometry points to note

Refer to the instructions supplied with the anesthesia machine for spirometry related information, such as safety precautions, limitations and points to note, measurement setup and check, clinical guidance.



NOTE

The monitor's data display may have delay compare with the anesthesia machine, please observe the patient frequently.

Spirometry measurement setup

Connecting to anesthesia machine

For the anesthesia machine to monitor connection, refer to [Connecting the anesthesia machine on page 67](#).

For the anesthesia machine to patient connection, refer to the instructions for use supplied with related device.

Using the patient spirometry measurement

Selecting the spirometry scales

You can change **Paw** and **Flow** waveform scales.

1. Select the spirometry digit field.
2. Select a value from the **Paw Scale** or **Flow Scale** list.

Selecting the spirometry sweep speed

1. Select the spirometry digit field.
2. Select a value from the **Paw Sweep Speed** or **Flow Sweep Speed** list.

The smaller the value, the slower the sweep speed.

Selecting the displayed spirometry show volume type

This setting determines which numeric data - tidal volumes (**TVinsp** and **TVexp**), or minute volumes (**MVinsp** and **MVexp**) will appear in the **Flow** digit field.

1. Select the spirometry digit field.
2. Select an option from the **Show Volume** list.

Setting the spirometry alarm on/off

1. Select the spirometry digit field.
2. Select the **Alarms** tab.
3. Set the **Ppeak**, **MVexp**, **TVexp**, **Apnea (Ane. Machine)** alarm **ON** or **OFF**.

Entropy

Entropy safety precautions

Entropy warnings

WARNING

PATIENT SAFETY.

E-ENTROPY module is defibrillation proof up to 3 kV. Ensure that the sensor is placed on the patient's forehead according to the instructions. Placing the sensor in a way other than instructed might result in risks during patient defibrillation.

WARNING

BURNS.

When using an electrosurgery unit, note that the measurement cables do not incorporate means to protect against burns in case of a defective ESU return electrode. To avoid burns at the monitor measurement sites, ensure the following:

- Proper contact of the ESU return electrode to the patient.

- ESU return electrode near the operating area.

- Measurement electrodes, leadwires and probes far from the surgical site and the ESU return electrode.

WARNING



DEFIBRILLATOR PRECAUTIONS.

Patient signal inputs labeled with the CF and BF symbols with paddles are protected against damage resulting from defibrillation voltages. To ensure proper defibrillator protection, use only the recommended cables and leadwires. Using other cables or leadwires may result in damage to the equipment and compromise patient and user safety.

WARNING

ELECTRIC SHOCK.

Make sure that the electrodes, sensor and connectors do not touch any electrically conductive material, including ground.

**WARNING****DEFIBRILLATOR PRECAUTIONS.**

Proper placement of defibrillator pads in relation to the electrodes is required to ensure successful defibrillation.

Entropy cautions

CAUTION**ERRONEOUS READINGS.**

Strong 30-40 Hz magnetic fields may cause erroneous Entropy measurement. Do not use devices with such a field close to the module or sensor.

CAUTION**ERRONEOUS READINGS.**

Diathermy and external interference may degrade the performance.

CAUTION**MISINTERPRETATION.**

The Entropy measurement is always to be used only as an adjunct to other physiological parameters. Clinicians are advised to use their knowledge and experience when making clinical judgements. Entropy values are not to be used as sole indicators of the patient status.

CAUTION**ERRONEOUS READINGS.**

Check the sensor expiration date on the sensor package. Do not use expired sensors to avoid the risk of erroneous readings.

CAUTION**SKIN IRRITATION.**

Do not use a sensor for more than 24 hours to avoid the risk of patient skin irritation.

CAUTION**SKIN IRRITATION.**

Long-term use of the electrodes may degrade condition of the skin especially on patients with liver diseases.

CAUTION**ERRONEOUS READINGS.**

Automatic sensor check may need to be disabled if the 70 Hz impedance check signal interferes with other equipment, such as EEG module with evoked potentials measurement.

CAUTION**ERRONEOUS READINGS.**

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

Entropy instruction

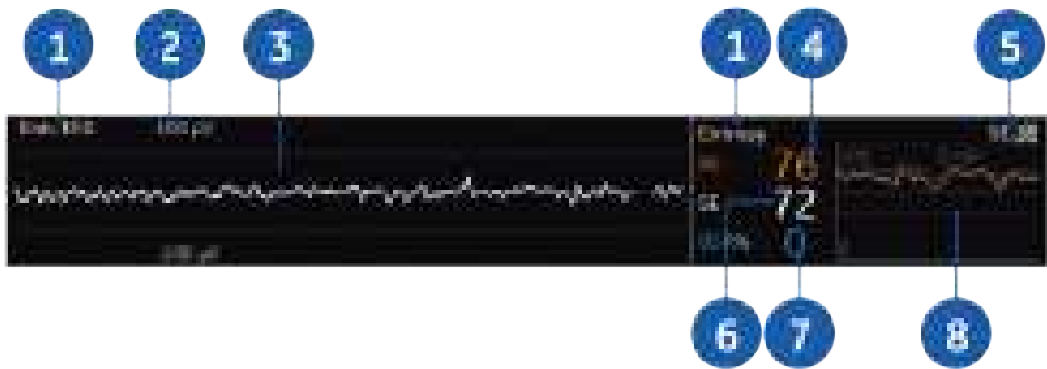
Entropy is a non-invasive parameter suitable for adults and pediatric patient population older than two years of age.

Entropy may be used as an aid in monitoring the effects of certain anesthetic agents on the patient's central nervous system (CNS) during general anesthesia. Displaying and using clinical information from Response Entropy (RE) and State Entropy (SE) may allow the clinician to tailor the anesthetic according to the individual needs of a patient.

The use of Entropy parameters may help the clinician to improve drug management. It may also enable a faster recovery from anesthesia and a more predictable wake-up and extubation.

Prior to using Entropy as an adjunct to guide anesthesia care, it is recommended to review important situations and limitations that can influence the Entropy number. GE recommends that clinicians review the following practice advisory that includes a section on brain function monitoring: The American Society of Anesthesiologists, Practice Advisory for Intraoperative Awareness and Brain Function Monitoring (Anesthesiology 2006; 104: 847-64). Clinicians are also recommended to maintain current knowledge of government regulatory, practice or research information on brain function monitoring and related topics.

Entropy measurement displayed on the monitor screen



1.	Entr. EEG (Entr. EEG): parameter/waveform label	5.	alarm limits, alarm status or other messages
2.	waveform scale	6.	SE (SE): State Entropy value
3.	Entropy EEG waveform	7.	BSR% (BSR%): Burst suppression ratio
4.	RE (RE): Response Entropy value	8.	Entropy microtrend



NOTE
For which digits display in digit field is depended on the **Display Format** settings configured in the Entropy menu.



NOTE
For the microtrend length display in digit field is depended on the **Entropy/SPI Trend Length** settings configured in the Entropy menu.

Entropy module keys

There are two keys on the module. Depending on the module version either the text only or symbol only appear on the keys, and the table below covers both versions.

 or Entropy	Opens the Entropy menu on the screen.
 or Check Sensor	Starts the manual sensor check.

Entropy measurement limitations

- This measurement is available in OR mode only.
- Entropy measurement is not indicated for pediatric patients younger than two years old.
- Entropy is not validated with patients undergoing sedation.
- Potential artifact may be caused by unusual or excessive electrical interference; high FEMG activity caused by shivering, coughing, muscle activity or rigidity, sustained eye movements, head and

body motion; or ECG in case of low EEG signal amplitude. Also, improper sensor placement and poor skin contact (high impedance) may cause artifact and interfere with the measurement.

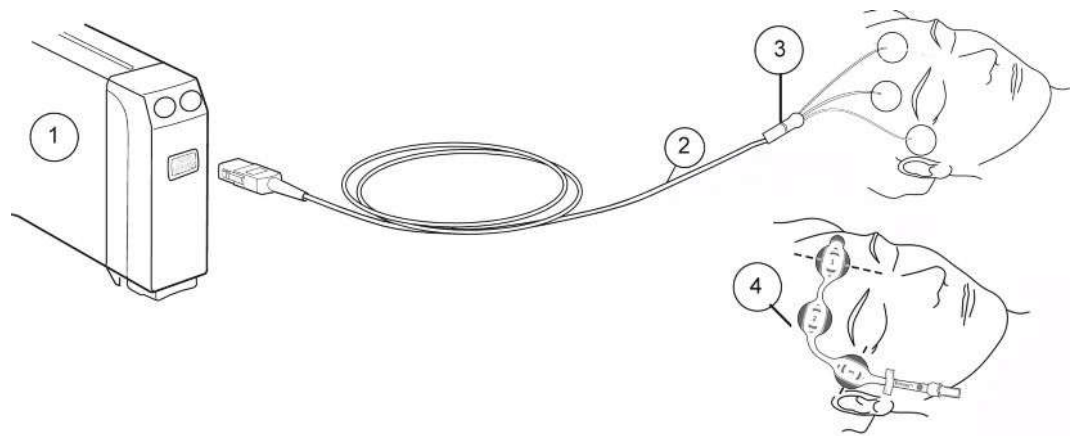
- During extended periods of electrocautery there may not be any good EEG epochs, and Entropy values will not be displayed.
- Entropy readings may be inconsistent when monitoring patients with neurological disorders, traumas or their sequelae.
- Entropy readings may be inconsistent when using benzodiazepines, nitrous oxide or ketamine as anesthetics.
- Psychoactive medication or very high opiate doses may suppress EEG and cause inconsistent Entropy readings.
- Cooling the patient may suppress their EEG and cause inconsistent Entropy readings.

Entropy points to note

- This equipment is suitable for use in the presence of electrosurgery, as tested according to IEC 80601-2-49 clause 202.8.102 Disturbances from HF Surgical Equipment.
- For information on materials used in accessories and their biocompatibility, refer to the instructions for use in the accessory package.
- A portion of the Entropy software is derived from the RSA Data Security, Inc. MD5 Message-Digest Algorithm.
- Entropy sensors are disposable, for single-patient use only, and not made with natural rubber latex.
- Make sure that the sensor connectors of the sensor cable are not in contact with fluids.
- Always ensure that the sensor is properly attached to the patient and connected to the cable.
- Prior to using Entropy as an adjunct to guide anesthesia care, it is recommended to review important situations and limitations that can influence the Entropy number. GE recommends that clinicians review the following practice advisory that includes a section on brain function monitoring: The American Society of Anesthesiologists, Practice Advisory for Intraoperative Awareness and Brain Function Monitoring (Anesthesiology 2006; 104: 847-64). Clinicians are also recommended to maintain current knowledge of all required regulatory, practice or research information on brain function monitoring and related topics.

Entropy measurement setup

Entropy equipment to patient connection



1.	E-ENTROPY module	3.	GE Entropy sensor
2.	GE Entropy cable	4.	Entropy EasyFit sensor

Preparing the patient for Entropy measurement

1. Connect the Entropy sensor cable to the module.
2. Clean the application site according to the sensor's instructions for use and let it dry before attaching the sensor.
3. Place the Entropy sensor on the patient's forehead; see sensor package for instructions.
4. Connect the sensor to the Entropy sensor cable.
5. Observe the results of the automatic sensor check in the digit field.
6. The measurement starts automatically after the sensor has passed the check.

Checking the Entropy measurement

1. Check that the sensor/electrode passes the sensor/electrode check when you are starting to monitor a new patient.

Using the Entropy measurement

Selecting the Entropy scale

1. Press the  module key, or select the Entropy digit field.
2. Select a value from the **Entr. EEG Scale** list.

Selecting the EEG sweep speed

This setting determines the drawing speed for the EEG waveform.

1. Press the  module key or select the Entropy/BIS digit field.
2. Select a value from the **EEG Sweep Speed** list.

The smaller the value, the slower the sweep speed.



NOTE

This setting can change the EEG sweep speed of BIS and Entropy parameters.

Selecting the display format for Entropy

You can select which Entropy parameters are shown in the digit field.

1. Press the  module key, or select the Entropy digit field.
2. Select an option from the **Display Format** list:
 - **RE** = Response Entropy
 - **SE** = State Entropy
 - **RE+SE** = both of the above
 - **RE+SE+BSR** = RE, SE and Burst Suppression Ratio (BSR)

Selecting the Entropy/SPI trend length

This setting affects the width of the Entropy and SPI microtrend in the digit field.

1. Press the  module key, or select the Entropy digit field.
2. Select a trend length from the **Entropy/SPI Trend Length** list.

Using the manual Entropy sensor check

Whenever required, you can perform the sensor check manually. Press the  module key, or:

1. Press the  module key, or select the Entropy digit field.
2. Select **Check Sensor**.
3. Observe the results on the screen. Do not press the sensor during the check to avoid signal noise.

The measurement continues automatically after the sensor has passed the check.

Using the automatic Entropy sensor check

Sensor impedance check is performed at the start up whenever a sensor or an electrode is attached. If the automatic sensor check has been selected on, the check is also performed periodically every 10 minutes.

1. Press the  module key, or select the Entropy digit field.
2. Select the **Automatic** check box for **Check Sensor**.

Bypassing the Entropy sensor check

If the sensor does not pass the impedance check, this option becomes selectable. It allows you to start the measurement without completing the sensor check. In this case, the measurement may be unreliable.

1. Press the  module key, or select the Entropy digit field.
2. Select **Bypass Check**.

Setting Entropy alarm limits

1. Press the  module key, or select the Entropy digit field.
2. Select the **Alarms** tab.
3. Check that the **Alarm** is turned on.
4. Set the related alarm limits with arrows.

Stopping the Entropy measurement

1. Remove the Entropy sensor from the patient.
2. Disconnect the sensor from the sensor cable.
3. Discard the sensor.

Entropy measurement basics

Entropy measurement description

EEG signals reflect the underlying state of brain activity. As a person falls asleep or is anesthetized, the brain function (activity) starts to decrease and becomes more orderly and regular. EEG changes from irregular to more regular patterns when anesthesia deepens. Similarly, frontal EMG quiets down as the deeper parts of the brain are increasingly saturated with anesthetics.

Entropy measurement is based on processing of raw EEG and FEMG signals by using the Entropy algorithm, a GE application of Spectral Entropy. The algorithm is published: Viertiö-Oja H et al. Description of the Entropy algorithm as applied in the Datex-Ohmeda S/5 Entropy Module. (Acta Anaesthesiologica Scandinavica 2004; Volume 48: Issue 2:154-161, 2004).

Entropy measures irregularity of EEG and FEMG. The GE Entropy measurement devices are responsible for EEG and FEMG signal acquisition, amplification, filtering and digitization and electrode impedance measurement.

Entropy parameters

RE is a fast reacting parameter, which measures EEG and FEMG in the frequency range 0.8 Hz to 47 Hz. Its reaction time is two seconds. It may give an indication of the patient's reaction to external stimuli, such as intubation and skin incision, if neuromuscular blocking agents are not used.

SE is a more stable and robust parameter, which measures EEG in the frequency range of 0.8 Hz to 32 Hz. Its reaction time is 15 seconds. SE may be used to assess the effect of certain anesthetic drugs on the brain.

Entropy frequency and display ranges

Parameter	Display range	Cortical EEG, frequency range	Facial EMG, frequency range
RE	0 to 100	0 Hz to 32 Hz	32 Hz to 47 Hz
SE	0 to 91	0 Hz to 32 Hz	no measurement

How to interpret the Entropy values

High values of Entropy indicate high irregularity of the signal, signifying that the patient is awake. A more regular signal produces low Entropy values, which can be associated with low probability of consciousness. A decrease in Entropy may enable the physician to observe the moment when the patient loses responsiveness. During continued anesthesia, both Entropies stabilize.

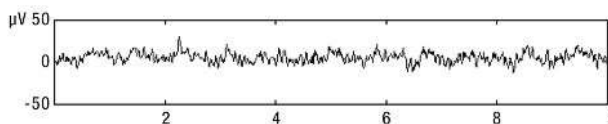
During general anesthesia with adequate anesthesia and hypnosis the RE and SE values will be within a narrow range or equal. The numbers will also merge during profound neuromuscular paralysis with neuromuscular blocking agents since the patient's facial muscles are unable to react.

RE is typically higher during periods prior to induction and before wake-up. If the numbers diverge (RE exceeds SE) during general anesthesia, it indicates that the facial muscles are activated. This may happen due to noxious stimuli. SE value may remain within a constant range if the level of hypnosis is adequate. A quick rise in RE may give an early warning of impending wake-up.

Patients emerging from general anesthesia will demonstrate a rise in both the RE and SE values.

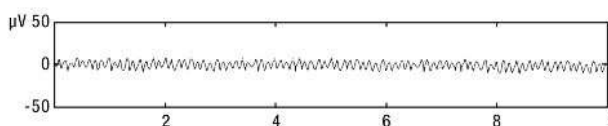
Relation of Entropy values to EEG and patient status

- Entropy values: High Entropy values
- EEG: Irregular EEG
- Patient Status: Awake
- Graphical display:



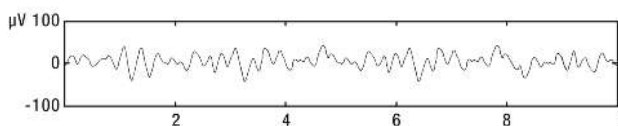
- Entropy values: High Entropy values
- EEG: Irregular EEG
- Patient Status: Deepening sedation

- Graphical display:



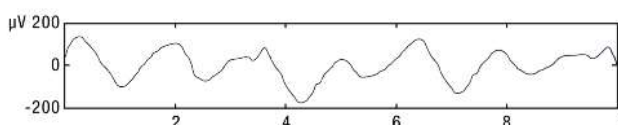
- Entropy values: Low Entropy values
- EEG: Regular EEG
- Patient Status: Moderate anesthesia

- Graphical display:



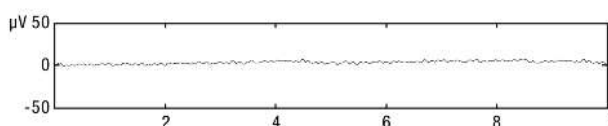
- Entropy values: Low Entropy values
- EEG: Regular EEG
- Patient Status: Very deep anesthesia

- Graphical display:



- Entropy values: Low Entropy values
- EEG: Regular EEG
- Patient Status: Suppressed EEG

- Graphical display:



Entropy range guidelines

NOTE

Individual patients may show different values. These are only guidelines.

RE	SE	Description
100	90	Awake
60–40	60–40	Low probability of recall, clinically adequate level for most surgical operations
<40	<40	Deep anesthesia
0	0	Suppressed EEG

Burst suppression ratio (BSR)

BSR is defined as the percentage of time of suppressed (isoelectric, flatline) EEG periods during the last minute of observation. Emergence of burst suppression pattern may indicate very deep anesthesia, hypothermia or ischemia.

Typically, during general anesthesia, in the absence of requirements for profound levels of anesthesia, BSR is 0%. Higher levels of burst suppression indicate very deep hypnosis/unconsciousness level.

Burst suppression generally emerges with Entropy values below 40, but may not appear even with very low Entropy values.

Entropy practicalities

- It is very important to ensure good contact between the sensor electrodes and skin. With careful skin preparation, correct sensor placement and use of correct cable, the skull and sinuses between the electrodes and the brain interfere minimally with the signal acquisition. See the sensor instructions for use for more detailed information.
- A high quality EEG signal is the prerequisite for successful Entropy calculation. Displaying the raw EEG within the Entropy EEG waveform adjacent to the Entropy values may help the user to confirm the signal quality. Raw EEG on the screen may also enable the clinician to view the EEG for recognizable and clinically relevant patterns of EEG activity.
- Do not use other sensors than Entropy sensors by GE.
- Entropy is not a parameter for monitoring neuromuscular blockade. Though RE may give an indication of the patient's reaction to external stimuli, such as intubation and skin incision, the level of neuromuscular blockade should be assessed with NMT, which is an active assessment of the effects of neuromuscular blockade agents on the neuromuscular junction.
- Neuromuscular blocking agents (NMBA) administered in surgically appropriate doses are not known to affect the EEG, but are known to have an effect on the EMG. RE values may drop in response to NMBA administration, due to paralysis of facial muscles.
- The Entropy sensors and cable are designed to be defibrillation-proof.

Entropy reference studies

Entropy reference studies supporting reduction of drugs

The following studies support the indication for reducing the amount of certain hypnotic drugs and enabling faster emergence from anesthesia:

- Vakkuri A, Yli-Hankala A, Sandin R, Mustola S, Hoymork S, Nyblom S, Talja P, Sampson T, Van Gils M, Viertiö-Oja H: Spectral Entropy monitoring is associated with reduced propofol use and faster emergence in propofol-nitrous oxide-alfentanil anesthesia *Anesthesiology* 2005, Volume 103, Issue 2:274-279, 2005

In the study reported by Vakkuri et al using propofol, Entropy monitoring helped in determining the titration rates of propofol especially during the last part of the procedures. This is indicated by higher entropy values, decreased consumption of propofol ($P < 0.001$), and shorter recovery times in the Entropy monitored group

- Aimé I, Verroust N, Masson-Lefoll C, Taylor G, Laloe PA, Liu N, Fischler M (2006): Does monitoring bispectral index or spectral entropy reduce sevoflurane use? *Anesth Analg* 103: 1469-77

In the study by Aimé et al, the authors reported that they were able to cut down the sevoflurane usage by 29% in the Entropy monitored group, when compared to the standard clinical practice.

Entropy reference studies supporting titration of drugs

The following studies support the indication that use of Entropy may help the user to titrate certain anesthetic drugs according to the individual needs of adult patients:

- Vanluchene A.L.G., Vereecke H, Thas O, Mortier E.P, Shafer S.L, Struys M. M. R. F Spectral Entropy as an Electroencephalographic Measure of Anesthetic Drug Effect: A Comparison with Bispectral Index and Processed Midlatency Auditory Evoked Response *Anesthesiology* 2004; Volume 101: Issue 1:34–42.

In this study by Vanluchene et al using propofol, the authors conclude that both SE and RE seem to be useful measures for anesthetic drug effect, with low baseline variability and accurate burst suppression detection.

- Vanluchene A.L.G, Struys M. M. R. F, Heyse B. E. K, Mortier E.P: Spectral entropy measurement of patient responsiveness during propofol and remifentanyl. A comparison with the bispectral index. *British Journal of Anaesthesia* 2004; Volume 93: Issue 5: 645–54.

In this study by Vanluchene et al using propofol, the authors conclude that loss of response to verbal command and loss of response to noxious stimulation were accurately detected by Entropy and BIS.

- Vakkuri A, Yli-Hankala A, Talja P, Mustola S, Tolvanen-Laakso H, Sampson T, Viertiö-Oja H: Time-frequency balanced spectral entropy as a measure of anesthetic drug effect in central nervous system during sevoflurane, propofol, and thiopental anesthesia *Acta Anaesthesiologica Scandinavica* 2004; Volume 48: Issue 2: 145-153, 2004.

In this study using sevoflurane, propofol and thiopental, the authors found that SE and RE distinguished excellently between conscious and unconscious states. The authors conclude that RE indicates emergence from anesthesia earlier than SE or BIS.

Reference studies regarding pediatric use of Entropy

Entropy has been used with pediatric patients in the following studies:

- Klockars JGM, Hiller A, Ranta S, Talja P, van Gils MJ, Taivainen T: Spectral entropy as a measure of hypnosis in children. *Anesthesiology* 2006, 104: 708-17.

In the study by Klockars et al using sevoflurane, the authors used Entropy monitoring on anesthetized children.

- Davidson A.J, Kim M.J, Sangolt G.K: Entropy and Bispectral Index During Anaesthesia in Children. *Anesthesia and Intensive Care* 2004; Volume 32: Issue 4: 485-493.

In this study by Davidson et al used Entropy Module on toddlers and children during isoflurane and nitrous oxide anesthesia.

- Davidson A, Huang G, Rebmann C, Ellery C: Performance of Entropy and Bispectral Index as measures of anaesthesia effect in children of different ages. *British Journal of Anaesthesia* 2005, 95: 674-9.

In this study by Davidson et al using sevoflurane, the authors concluded that there was no difference in performance of Entropy Module and BIS in children.

- Choi SR, Lim YH, Lee JH & Chung CJ: Spectral entropy monitoring allowed lower sevoflurane concentration and faster recovery in children. *Acta Anaesthesiologica Scandinavica* 54 (7): 850—862; Aug 10 2010.

Neuromuscular transmission

NMT safety precautions

NMT warnings

WARNING

PATIENT SAFETY.

Make sure that the measurement electrodes, sensor and connectors do not touch the patient during defibrillation.

WARNING

ELECTRIC SHOCK.

Make sure that the electrodes, sensor and connectors do not touch any electrically conductive material, including ground.

WARNING

BURNS.

When using an electrosurgery unit, note that the measurement cables do not incorporate means to protect against burns in case of a defective ESU return electrode. To avoid burns at the monitor measurement sites, ensure the following:

- Proper contact of the ESU return electrode to the patient.

- ESU return electrode near the operating area.

- Measurement electrodes, leadwires and probes far from the surgical site and the ESU return electrode.

WARNING

PATIENT SAFETY.

Do not place the NMT stimulating electrodes on the patient's chest. Application of the electrodes near the thorax may increase the risk of cardiac fibrillation.

WARNING

ERRONEOUS READINGS.

If used in close proximity to shortwave or microwave therapy equipment, stimulator output may become unstable.

WARNING**PATIENT SAFETY.**

Never subject a patient with an implanted electronic device to electrical stimulation without consulting a medical specialist first.

NMT cautions

CAUTION**ELECTRIC SHOCK.**

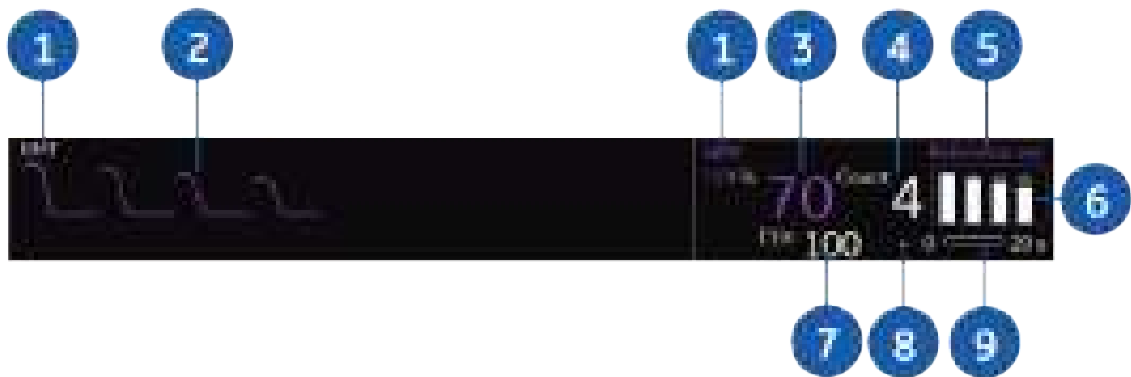
Always stop the NMT measurement before handling the stimulating electrodes or connectors.

NMT instruction

Neuromuscular transmission (NMT) is a non-invasive measurement suitable for adults and pediatric patient populations weighing more than 5 kg (11 lbs).

Quantitative neuromuscular transmission monitoring helps to optimize the administration of neuromuscular blocking agents (NMBA) according to the patient's individual needs. Monitoring the level of neuromuscular block enables follow-up and prediction of recovery, helps in correct timing of antagonism, and may also decrease the incidence of residual paralysis. In the recovery room, low current stimulation can be used for revealing possible residual block by observing the fade in the train of four (TOF). NMT monitoring also helps to determine when the patient can be extubated safely, and respiratory complications after extubation due to the effects of NMBAs can be prevented.

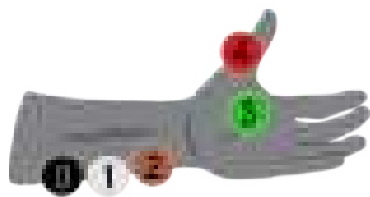
NMT measurement displayed on the monitor screen



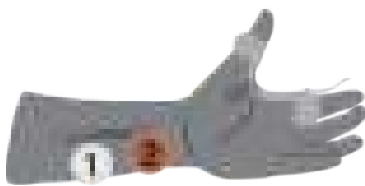
1.	NMT (NMT): waveform/parameter label	6.	NMT response bar
2.	NMT waveform	7.	T1% (T1%): T1 value
3.	TOF% (TOF%): TOF value. Different display according to stimulus mode selection. • TOF mode: TOF% ratio • DBS mode: DBS% ratio • ST mode: There only label Single TW.	8.	stimulus pulse asterisk, flash when a stimulus pulse is generated
4.	Count (Count): Count value	9.	cycle time progress bar, or last manual measurement time
5.	Reference set (Reference set): digit field messages		

The digit field have different view:

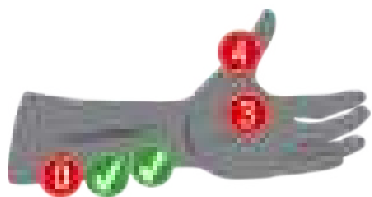
- Normal measurement view: see above
- Sensor check view: graphics indicates different type sensor is connected. If sensor failure identified, the related sensor will be in red to indicate, and the passed sensor will be display as .



EletroSensor



MechanoSensor



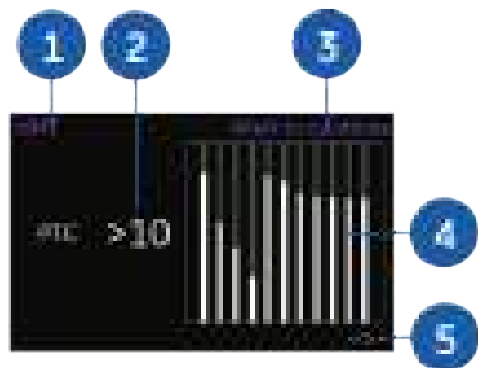
Sensor failure identified example

- Calibration view: when supramaximal current or reference (When not using supramax) search is started, current value and response bar will be displayed.



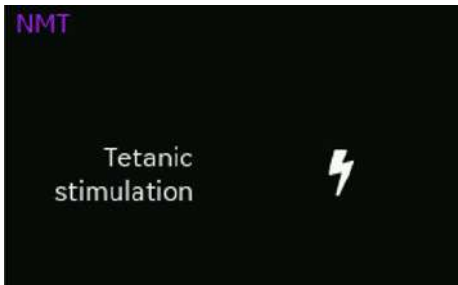
1.	NMT (NMT): parameter label
2.	response bar
3.	Supramax search (Supramax search): digit field messages
4.	current value with unit.

- PTC view: during and after PTC measurement, the count of detected responses, the measurement time, response bar will be displayed.



1.	NMT (NMT): parameter label
2.	PTC (PTC): the count of detected responses
3.	Wait to continue (Wait to continue): digit field messages
4.	response bar
5.	the measurement time

- Tetanic stimulation view: during the Tetanic stimulation (**Tetanic stimulation**), the corresponding will be displayed.



- Recovery microtrend view: the NMT microtrend (for TOF or DBS) shows the patient recovery trend for the past 50 minutes. It is also display the ratio and T1% value.



For microtrend:

- Vertical axis indicates the scale of 0 to 100 %.
- Horizontal axis indicates the time from 0 to 50 minutes.
- The target zone of 90 to 100 % is colored green.

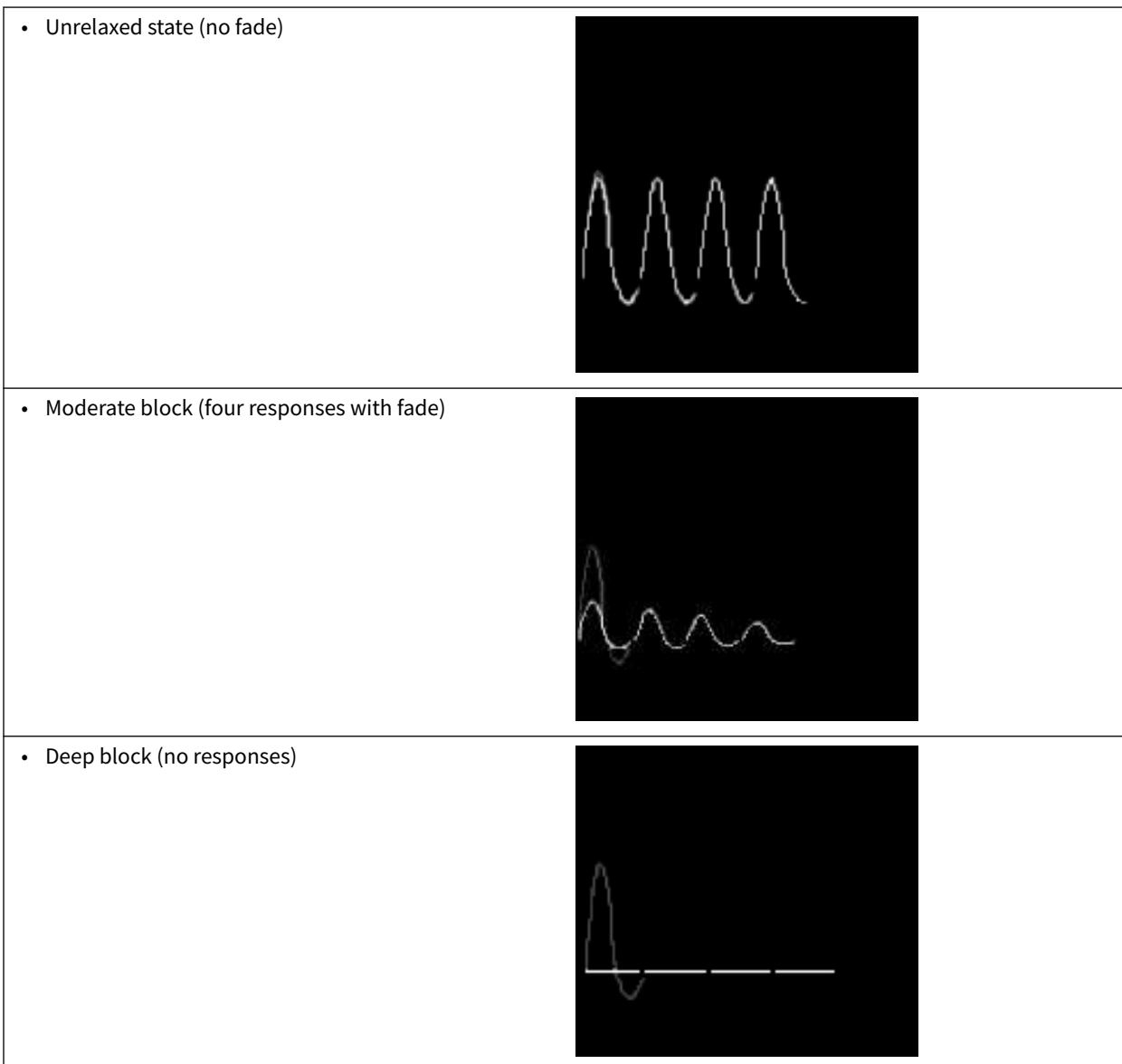
NMT waveforms on the monitor screen

Both ElectroSensor and MechanoSensor have a characteristic stimulus-response waveform that is available on the monitor waveform field.

Typical ElectroSensor TOF responses

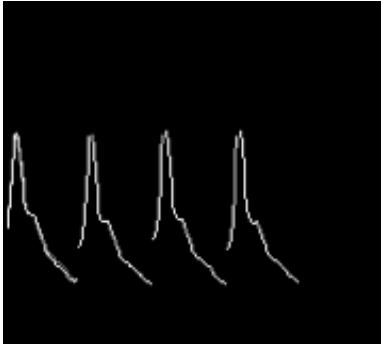
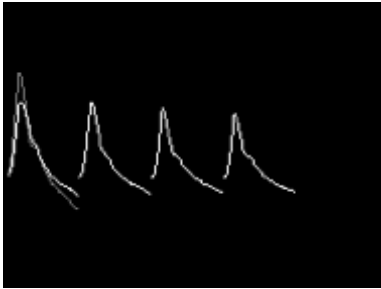
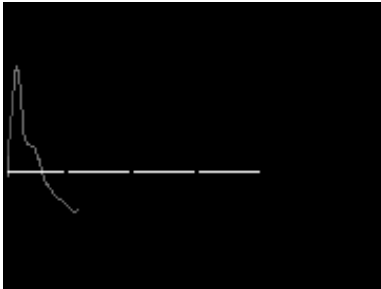
ElectroSensor measures the evoked electromyogram (EMG) response. A typical response is a compound muscle action potential (CMAP).

The following graphs present typical ElectroSensor TOF responses:



Typical MechanoSensor TOF responses

MechanoSensor measures the bending of the thumb. A typical response is a monophasic curve representing thumb bending (positive slope) and relaxation (negative slope). The following graphs present typical MechanoSensor TOF responses:

Unrelaxed state (no fade)	
Moderate block (four responses with fade)	
Deep block (no responses)	

NMT graphic trends on the monitor screen

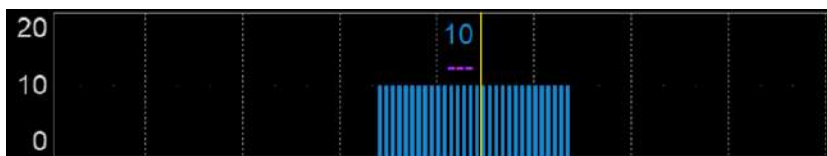
The NMT related parameters display in 2 fields of graphic trends, different NMT values have their own specific colors in the graphic trends. The values are shown as follows:

- NMT T1 & Ratio field:**



- White bars = Ratio% (TOF or DBS)
- Green dots = T1%

- NMT PTC & Count field:**



- Cyan dashed bars = PTC

- Magenta dashed bars = Count

NMT module keys

There are two keys on the module:

Start-up	• Starts the search for supramaximal current and reference level. • Proceeds with the selected measurement cycle.
Stop Continue	• Interrupts monitoring. • Restarts monitoring of the same patient. If the module has been disconnected, but you wish to continue the previous NMT monitoring, select Recall reference.

NMT measurement limitations

- This measurement is not available in neonatal mode.
- NMT measurement is not indicated for pediatric patients weighing less than 5 kg (11 lbs).
- Pediatric MechanoSensor is validated for children weighing 5 to 20 kg (11 to 44 lbs).
- Electrosurgery may cause incorrect measurement results.
- Refer to the accessory instructions for use for any limitations when defibrillating the patient.
- NMT measurement is not indicated for patients with known abnormal function of neuromuscular junction.

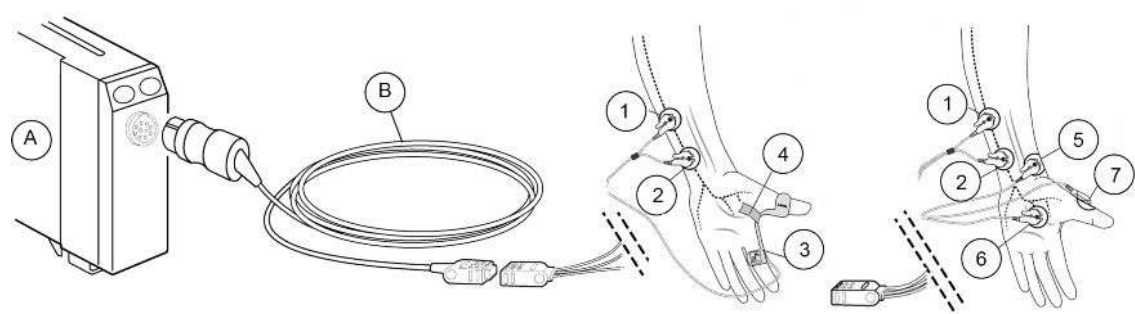
NMT points to note

- This equipment is suitable for use in the presence of electrosurgery, as tested according to IEC 80601-2-49 clause 202.8.102 Disturbances from HF Surgical Equipment.
- For information on materials used in accessories and their biocompatibility, refer to the instructions for use in the accessory package.
- For safe extubation after nondepolarizing neuromuscular block, the TOF% should be higher than 90. Also assess other clinical signs.
- Start monitoring before the administration of a muscle relaxant drug (but after the induction of sleep in general anesthesia) to prevent voluntary muscle contraction and tension from interfering with the reference search.
- When placing the electrodes, make sure that they do not touch each other.
- Do not place electrodes on areas with excessive body hair or lesions.
- If the electrodes are placed incorrectly, wrong nerves are stimulated and this causes wrong muscle response.
- When multiple nerves are stimulated, the measured response may be affected by electrical activity of other muscles.
- If the stimulation electrodes are placed very close to the palm of the hand, the muscles are stimulated directly by the stimulation pulses.
- Avoid trans-thoracic stimulation.

- Do not apply stimulation across or through the head, directly on the eyes, covering the mouth, on the front of neck (especially over the carotid sinus), or from electrodes placed on the chest and the upper back or crossing over the heart.
- Moving or touching the patient during measurement may cause incorrect results.
- For nondepolarizing neuromuscular block, use either TOF or DBS mode. For depolarizing neuromuscular block, use ST mode.

NMT measurement setup

NMT equipment to patient connection



A = Module with NMT measurement capability

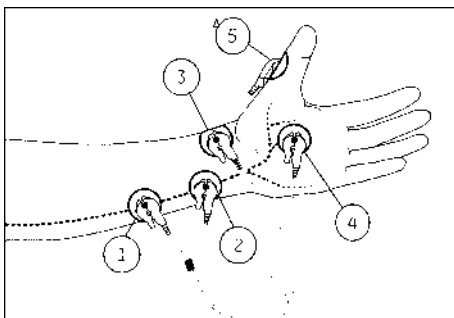
B = NMT sensor cable

1.	Electrode, white (stimulating)	5.	Electrode, black (ground)
2.	Electrode, brown (stimulating)	6.	Electrode, green (measuring)
3.	Sensor (measuring)	7.	Electrode, red (measuring)
4.	Tape		

Preparing the patient for NMT measurement

1. Connect the NMT sensor cable to the module.
2. Clean the skin at the NMT application area.
3. Apply the electrodes.
Ensure that:
 - the electrodes are not expired.
 - the entire surface of each electrode makes an optimal contact to the skin.
 - the electrodes do not touch each other.
4. Always check the correct electrode positioning.
5. Connect the leads in the correct order to ensure reliable measurement results.
6. Connect the sensor cable to the MechanoSensor or ElectroSensor leadwire set.

Preparing the ElectroSensor setup

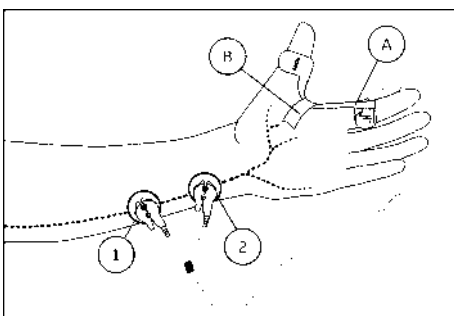


1.	White (stimulating)	4.	Green (measuring)
2.	Brown (stimulating)	5.	Red (measuring)
3.	Black (ground)		

--- = Ulnar nerve

1. Place two electrodes for white and brown lead connection along the ulnar nerve. Ensure that the entire electrode surface has optimal contact with the skin. Ensure that the electrodes do not touch each other.
2. Place the electrodes for red and green lead connection as indicated in the illustration above.
3. Place the electrode for black lead connection where convenient, preferably between the stimulating and measuring lead connection electrodes.

Preparing the MechanoSensor setup

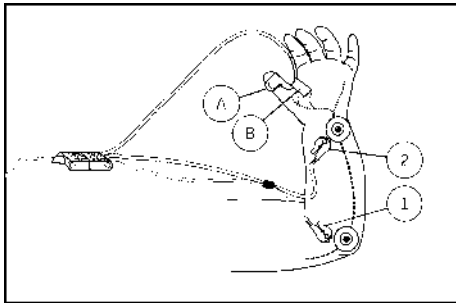


1.	White (stimulating)	A.	Sensor (measuring)
2.	Brown (stimulating)	B.	Tape

--- = Ulnar nerve

1. Place the two electrodes along the ulnar nerve. Ensure that the entire electrode surface has optimal contact with the skin. Ensure that the electrodes do not touch each other. Palpating the ulnar artery near the wrist area may be helpful in identifying the ulnar nerve.
2. Attach the sensor in the groove between thumb and index finger. Secure with narrow tape only, allowing free finger movement.
3. Make sure that the sensor sets tightly in the groove and that the thumb can move freely. Do not immobilize the hand.

Preparing the Pediatric MechanoSensor setup



1.	White (stimulating)	A.	Pediatric MechanoSensor
2.	Brown (stimulating)	B.	Tape

--- = Ulnar nerve

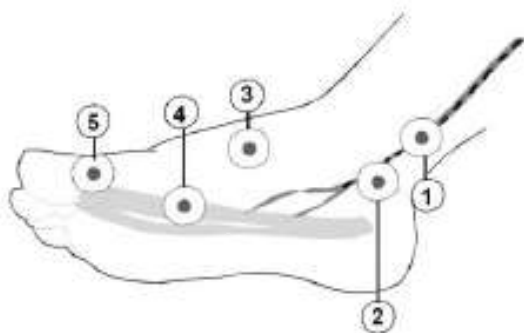
1. Place the two electrodes along the ulnar nerve. Ensure that the entire electrode surface has optimal contact with the skin. Ensure that the electrodes do not touch each other.
2. Attach the sensor in the groove between thumb and index finger. Secure with narrow tape only, allowing free finger movement. Bend the sensor along its middle groove.
3. Ensure that the NMT measurement is stopped before connecting the sensor clips to the electrodes.

Checking the NMT measurement

1. Always check the electrode quality.
2. Check that the electrodes are correctly positioned on the ulnar nerve and the message **Supramax search** is displayed. Ensure that you get a stimulus response. If the supramaximal stimulus current is not found, the message **Supramax not found** is displayed.

NMT alternative connections

If the patient's arm and/or hand cannot be used for NMT measurement, the foot may be an alternative measurement site. Place the electrodes for white and brown lead connection along the posterior tibial nerve (causing plantar reflexion of the great toe and foot) or peroneal nerve (stimulated behind the head of fibula). Place the electrodes for red and green lead connection site on the m. flexor hallucis brevis, and the electrode for black lead connection (ground) as indicated in the figure.



1.	White stimulating electrode	4.	Green measuring electrode
2.	Brown stimulating electrode	5.	Red measuring electrode
3.	Black ground electrode		

-- = Tibial nerve

Using the NMT measurement

Starting the NMT measurement

You can setup following settings at first time, and later press the **Start-Up** module key when each time need to start NMT measurement.

1. Select the NMT digit field > **Advanced** tab.
2. Select **Stimulus Mode** to **TOF**, **DBS** or **ST**.
3. Select **Setup** tab.
4. Select **Start-up Settings** > **AUTO**.
5. Select **Start-up NMT**.

Starting the NMT measurement with an already relaxed patient

If the patient is already in a relaxed state, you can start the measurement with the stimulus current set in **Current mA** and no reference level.

1. Select the NMT digit field.
2. Select **Stimulus Mode** to **TOF**, **DBS** or **ST**.
3. Select **Setup** tab.
4. Select **Start-up Settings** > **Relaxed Patient**.
5. Press the **Start-up** module key, or select **Start-up NMT**.

Changing the NMT stimulus current

You can either search for the supramaximal stimulus current or set the stimulus current manually. You cannot change the stimulus current after the NMT measurement has been started.

To search for the stimulus current, select the **Use Supramax** check box.

To select the stimulus current manually:

1. Select the NMT digit field.
2. Deselect the **Use Supramax** check box.
3. Select a value from the **Current mA**.

Changing the NMT cycle time

This selection also affects the recovery note.

1. Select the NMT digit field.
2. Select a value from the **Cycle Time** list.

Changing the stimulation type

1. Select the NMT digit field > **Advanced** tab.
2. Select a value from the **Stimulation Type** list.



NOTE

It is recommended to choose **Large Adult** when the wrist circumference is more than 25 cm.

Adjusting the NMT beep volume

You can set the beep value to best suit your care environment.

1. Select the NMT digit field > **Advanced** tab.
2. Set a value for the **Stimulus Beep Volume**.

Using the NMT recovery note

The recovery note option is designed to be used with the TOF stimulus mode. The recovery note alarms you with the **Block recovery** message when the count reaches the value you have selected. It indicates that the patient is responding more clearly to the stimuli and the neuromuscular block is decreasing.

The recovery note is activated when the count is equal to or greater than the selected limit within the last minute.



NOTE

The recovery note will not be shown if the count has already been equal to or greater than the selected limit within the last minute.

To take this feature into use:

1. Select the NMT digit field > **Advanced** tab.
2. Select the count limit that will activate the note from **Recovery Note** list.

Measuring deep relaxation

When no responses are detected for TOF stimulation, the post tetanic count (PTC) is the only way to measure the neuromuscular block. A tetanic stimulation (50 Hz) is generated for five seconds and post-tetanic responses to single-twitch stimulation are counted. The larger the PTC (the number of detected responses), the sooner the normal TOF responses return. To monitor the deep relaxation level, start the PTC measurement.



NOTE

The PTC measurement is enabled when the count is 1 or less.

1. Select the NMT digit field.
2. Select **Start PTC**.

Showing the NMT microtrend

You can display the patient recovery trend for the past 50 minutes as a microtrend.

If this feature has been activated, the NMT microtrend is shown after the following sequence has taken place:

1. The patient is in a deep relaxation state (the count is zero).
2. DBS% or TOF% reaches a value between 20% and 90%.
3. The patient starts to recover, and one of the following takes place:
 - 3.1. NMT measurement is started with the **Relaxed Patient** option or the reference was not found:
 - The DBS% or TOF% has been increasing for three consecutive measurements
 - 3.2. NMT measurement is started with an unrelaxed patient and T1% is available
 - The DBS% or TOF% has been increasing for two consecutive measurements and T1% is over 30%, or
 - The DBS% or TOF% is over 30 and T1% is over 50%



NOTE

If the measurement is started with an unrelaxed patient and MechanoSensor is used, the monitor measures T1% even though the values are not displayed on the monitor.

To activate the feature:

1. Select the NMT digit field > **Advanced** tab.
2. Select the **Show Ratio Microtrend** check box.

The microtrend is not shown if the patient is discharged/case is ended.

Continuing the NMT measurement

To continue interrupted NMT measurement with the same patient and monitor, press the **Stop Continue** module key, or:

1. Select the NMT digit field.
2. Select **Continue**.

Continuing the NMT measurement in OR after induction

When you move the patient with the module to the OR and want to continue the measurement with the already found and determined current and reference values, use the **Recall Patient** function. Connect the module to the monitor and:

1. Select the NMT digit field.
2. Select **Start-up Settings** to **Recall Patient**.
3. Select **Start-up NMT** or, press the **Start-up** module key.

Stopping the NMT measurement

Press the **Stop Continue** module key, or:

1. Select the NMT digit field.
2. Select **Stop**.

Once the measurement is stopped, unfasten the sensor clips. Remove the electrodes carefully pulling from their edge to avoid damaging the patient skin.

Restarting the NMT measurement

To restart the measurement with different settings:

1. Stop the NMT measurement
2. Select the NMT digit field.
3. Select **Enable Start-up**.
4. Change the settings as required.
5. Select **Start-up NMT** or, press the **Start-up** module key.

NMT measurement basics

NMT measurement description

The GE NMT measurement devices are used for monitoring the relaxation of the patient.

Neuromuscular transmission is the transfer of a motor nerve impulse over the neuromuscular junction. The GE NMT devices deliver stimulating electrical pulses to a motor nerve and the muscle response to these stimulations is measured.

Two electrodes are needed for electrical stimulation of a peripheral nerve. The resulting response can be measured either with a MechanoSensor, which measures the bending of the thumb, or an ElectroSensor, which measures the electrical activity of the muscle with three electrodes.

The monitor searches for the stimulus current needed to activate all the fibers of the stimulated (recorded) muscles. The search begins with a 10 mA stimulus and the response is measured. The current is increased in steps of 5 mA until the increase in the current no longer increases the response. This maximal current is then automatically increased by 15%, resulting in the supramaximal current.

If the supramaximal current is not found or the response is too weak for searching a supramaximal current, the current is set to 70 mA.

MechanoSensor and kinemyography (KMG)

Measurement with MechanoSensor is based on kinemyography principle. Two electrodes are placed on the ulnar nerve, and the innervating nerve is stimulated. The core of the MechanoSensor is a strip of piezoelectric polymer, housed inside the sensor. When this piezoelectric material changes shape due to muscle contraction as a result of nerve stimulation, the electrical charge in the material is redistributed, causing an electron flow to balance the charges. This flow can be measured as a potential change, which is proportional to the amount of material bending.

ElectroSensor and electromyography (EMG)

Measurement with ElectroSensor is based on evoked electromyography, which is the process of recording the electrical muscular fiber activity in response to the nerve stimulation. In addition to the two stimulus electrodes, two measuring electrodes and a grounding electrode are also placed on the patient, wherein one of the measurement electrodes must be above the muscle that is innervated by the stimulated nerve.

EMG captures the electric signal caused by the depolarization of the muscular membrane — the location just next to the neuromuscular junction, which is the site of action for the neuromuscular blocking agents. All other technologies, such as acceleromyography (AMG) and kinemyography (KMG) amongst others, measure the response caused by the muscle activity, being therefore indirect measurements for the actual drug effect and prone to inaccuracy, interference, and noise. Adequate recovery from nondepolarizing neuromuscular block, indicated by TOF% > 90%, can be reliably determined only with quantitative monitoring.

EMG train of four ratio (TOF%) is the gold standard for detecting nondepolarizing neuromuscular block in a clinical setting and is not interchangeable with, for example, AMG TOF^{1 2} that may overestimate the recovery by at least 15.1%. Therefore, residual neuromuscular block, defined as an EMG TOF% ratio of < 90%, cannot be excluded immediately on reaching an AMG TOF% of 90% or even 100%. Studies have shown that the implementation of quantitative EMG neuromuscular transmission monitoring resulted in a significant reduction of PACU patients that were incompletely recovered from NMBAs³.

EMG measurement is recommended for surgeries in which the arm is fixed tightly to the patient's body (for example, robotic surgery). Compared to other measurements, EMG allows measurement even with impaired movement of the hand.

References for the information in this section:

1. Liang et al. "An ipsilateral comparison of acceleromyography and electromyography during recovery from nondepolarizing neuromuscular block under general anaesthesia in humans." *Anesthesia & Analgesia* (2013): 117(2); 373-9
2. Naguib M et al. "Consensus Statement on Perioperative Use of Neuromuscular Monitoring." *Anesthesia & Analgesia* (2018): 127(1); 71-80
3. Todd et al. "The implementation of quantitative electromyographic neuromuscular monitoring in an academic anaesthesia department." *Anesthesia & Analgesia* (2014): 119(2); 323-31

Stimulation modes

- Train of four, TOF: Recommended for most cases. It is also the default setting.

- Double burst stimulation, DBS: Useful when using the MechanoSensor. It enables better visual observation of the fading in responses.
- Post tetanic count, PTC: Used for estimating the relaxation level with tetanic stimulation.
- Single twitch, ST: Single twitch mode is practical when using depolarizing relaxants: in these cases, TOF% does not give any additional information about the patient status.

How to interpret the NMT values

When neuromuscular block deepens, different stimulation modes may be needed to assess the relaxation status. The following table describes the depth of relaxation.

TOF%	100%	10%	---	
TOF Count	4	3 or 2	1	0
PTC			10	< 10
Relaxation	None  Deep			

Train of four (TOF) mode

In TOF stimulus mode, four stimulation pulses are generated at 0.5 second intervals. The response is measured after each stimulus and the ratio of the fourth to the first response of the TOF sequence is calculated, resulting in TOF%.

With the ElectroSensor, T1% is displayed. If the reference is successfully found, a scale is also included. Scale markers represent 0%, 30%, 60%, 90% and 120% reference values. When no reference is available, no T1% value is displayed and the bars are not scaled.

When relaxation deepens, the TOF% declines until the fourth response disappears and no TOF% is available. The degree of neuromuscular block is then estimated from the number of responses, the count, which represents the number of responses detected to the four stimuli. The fewer the responses, the deeper the relaxation.

Double burst stimulation (DBS) mode

DBS consists of two separate bursts. Each burst consists of three consecutive pulses at a 50 Hz frequency. The response ratio of the second to the first burst is calculated, resulting in DBS% (equivalent to TOF%).

Post tetanic count (PTC) mode

When the response to the fourth TOF stimulation pulse disappears or the first twitch is very weak, the TOF% is not available and only the counts can be observed.

When the stimulation pulses no longer give any stimulation response, the count also disappears. To monitor the relaxation level, you can then start tetanic stimulation and estimate the relaxation level from the post tetanic count, PTC. The PTC measurement is enabled when the count is 1 or less. Tetanic stimulation is a continuous stimulation of five seconds. After tetanic stimulation, single twitch stimulations are generated. The number of detected responses is counted and expressed as PTC. The fewer the responses, the deeper the relaxation.

If the responses do not fade away, a maximum of 11 responses are counted and the PTC value >10 is given.

After tetanic stimulation, NMT measurement is stopped and **Wait to continue** is shown for one minute. After that, the monitor automatically continues with the previously selected cycle.

Single twitch (ST) mode

In single twitch stimulation one pulse is generated and its response is measured.

NMT practicalities

- Normally, defasciculating doses of non-depolarizing neuromuscular blocking agents (precurarisation) do not affect the supramaximal current nor the reference value.
- Average lifetime of a MechanoSensor is two years, depending on the use. The sensor has been validated to last 700,000 twitches.

Inappropriate function of the measurement is often caused by incorrect accessory connection or misuse of the products. Therefore, note the following:

- Handle the sensor and cables carefully to maximize their lifetime.
 - Piezosensor inside the MechanoSensor is very sensitive to shocks.
- Attach the MechanoSensor correctly.
 - It is recommended to secure the MechanoSensor with a narrow tape. Wide tape might prevent adequate movement of the sensor with the thumb during the measurement.
- Check the quality of the stimulation electrodes.
 - Use GE approved NMT electrodes for stimulation. They are tested with the module and provide low impedance, which is crucial for accurate measurement. In addition, they provide a wider conducting surface than standard ECG electrodes, which ensures better measurement and improved signal output. Make sure that the wide conductive areas of the NMT electrodes do not overlap, as this can cause short circuits and loss of measurement.
 - Do not use the electrodes after their expiration date.
 - NMT electrodes are for single use only, do not reuse them as it could pose a risk for infection and/or result in measurement errors.
- Make sure the NMT lead wires are not of tension and do not pull on the electrodes.
- Perform a visual check of the MechanoSensor or ElectroSensor and cable.
 - Regular visual checking of the cable and sensor is recommended. If you see any signs of broken cables or joints of the MechanoSensor, replace those parts.

Bispectral index

BIS safety precautions

BIS warnings



WARNING

DEFIBRILLATOR PRECAUTIONS.

Patient signal inputs labeled with the CF and BF symbols with paddles are protected against damage resulting from defibrillation voltages. To ensure proper defibrillator protection, use only the recommended cables and leadwires. Using other cables or leadwires may result in damage to the equipment and compromise patient and user safety.

WARNING

ELECTRIC SHOCK.

Make sure that the electrodes, sensor and connectors do not touch any electrically conductive material, including ground.

WARNING

BURNS.

When using an electrosurgery unit, note that the measurement cables do not incorporate means to protect against burns in case of a defective ESU return electrode. To avoid burns at the monitor measurement sites, ensure the following:

- Proper contact of the ESU return electrode to the patient.

- ESU return electrode near the operating area.

- Measurement electrodes, leadwires and probes far from the surgical site and the ESU return electrode.

WARNING

EQUIPMENT DAMAGE.

Do not autoclave the signal processing unit (BISx) or the digital signal converter (DSC). Do not open it for any reason.

WARNING**PATIENT SAFETY.**

The sensor must not be located between defibrillator pads when a defibrillator is used on a patient connected to BIS devices.

WARNING**PATIENT SAFETY.**

This monitor uses a component modular device in deriving the Bispectral index (BIS) purchased from Medtronic. It is important to recognize this index is derived using solely that company's proprietary technology. It is recommended that clinicians have reviewed applicable information on its utility and/or risks in published articles and literature/web site information from Medtronic (www.medtronic.com) or contact that company itself if they have clinical-based BIS questions relating to this module portion of the GE monitor. Failure to do so could potentially result in incorrect administration of anesthetic agents and/or other potential complications of anesthesia or sedation. We recommend that clinicians also review the following practice advisory (that includes a section on BIS monitoring): The American Society of Anesthesiologists, Practice Advisory for Intraoperative Awareness and Brain Function Monitoring (Anesthesiology 2006; 104:847-64). Clinicians are also recommended to maintain current knowledge of government regulatory, practice or research information on BIS and related topics.

WARNING**PATIENT SAFETY.**

Misinterpretation of BIS can result in incorrect administration of anesthetic agents and/or other potential complications of anesthesia or sedation.

WARNING**PATIENT SAFETY.**

E-BIS module is defibrillation proof up to 250 V. Ensure that the sensor is placed on the patient's forehead according to the instructions. Placing the sensor in a way other than instructed might result in risks during patient defibrillation.

BIS cautions

CAUTION**PATIENT DISCOMFORT.**

Due to elevated surface temperature, do not place the BIS device in prolonged direct contact with the patient's skin, as it may cause discomfort.

CAUTION**ERRONEOUS READINGS.**

The BIS measurement based on measuring the EEG signal is inherently very sensitive. Radiated electromagnetic fields may cause erroneous measurements at various frequencies. Do not use electrical radiating equipment close to the BISx or DSC. Details regarding radiated field strengths are given in the technical specifications.

CAUTION**ERRONEOUS READINGS.**

Automatic sensor check may need to be disabled if the 1 nA 128 Hz impedance check signal interferes with other equipment, such as EEG module with evoked potentials measurement.

CAUTION**PATIENT SAFETY.**

The BIS module has been designed to operate with a disposable BIS sensor. Only use recommended sensors to ensure patient safety.

CAUTION**ERRONEOUS READINGS.**

Do not use the BIS sensor if the sensor gel is dry. To avoid dryout, do not open the pack until you are ready to use the sensor. Dry sensors may lead to erroneous readings.

CAUTION**ERRONEOUS READINGS.**

Check the sensor expiration date on the sensor package. Do not use expired sensors to avoid the risk of erroneous readings.

CAUTION**SKIN IRRITATION.**

If skin rash or any unusual symptom develops, discontinue the BIS measurement and remove the sensor.

CAUTION**EQUIPMENT DAMAGE.**

When connecting or disconnecting BIS, take care not to touch the exposed contacts of either connector. Damage due to electrostatic discharge may result to the equipment.

BIS measurement description

A sensor placed on the patient's forehead transmits EEG signals to the BIS module. The BIS module filters the data, analyzes it for artifact and processes it using digital signal processing techniques, then

sends the data to the monitor for display. The purpose of processing the EEG waveform data is to extract characteristic features from the complex signal in order to provide easier pattern recognition of changes over time during the recording.

The BIS is computed in real-time using three steps:

- 1. The raw EEG signal is broken down second by second, and the segments that have artifact are identified and removed.
- 2. The BIS is calculated by combining EEG features associated with anesthetic effect.
- 3. The index is modified to reflect the amount of suppressed EEG signal in the raw waveform.

BIS measurement displayed on the monitor screen



1.	BIS EEG (BIS EEG): waveform label	6.	SQI (SQI): Signal Quality Index, the quality of the EEG signal. ^{*1}
2.	Waveform scale	7.	Alarm status, alarm limits, or other messages
3.	BIS EEG waveform	8.	EMG (EMG): Electromyograph, the absolute power in the 70 Hz to 110 Hz frequency band, the range from 30 to 55 dB. ^{*2}
4.	BIS (BIS): parameter label	9.	SR (SR): Suppression ratio, the percentage of suppressed (flatline) EEG detected over the last 63 seconds.
5.	Bispectral Index (BIS index) value		

^{*1} When the SQI is in the range 15% to 50%, the BIS index value is displayed in gray.

^{*2} When the EMG value less than 30 dB, not display this EMG bar.

BIS module keys

There are two keys on the module:

	Opens or closes the BIS menu on the screen.
	Starts the manual sensor check.

BIS measurement limitations

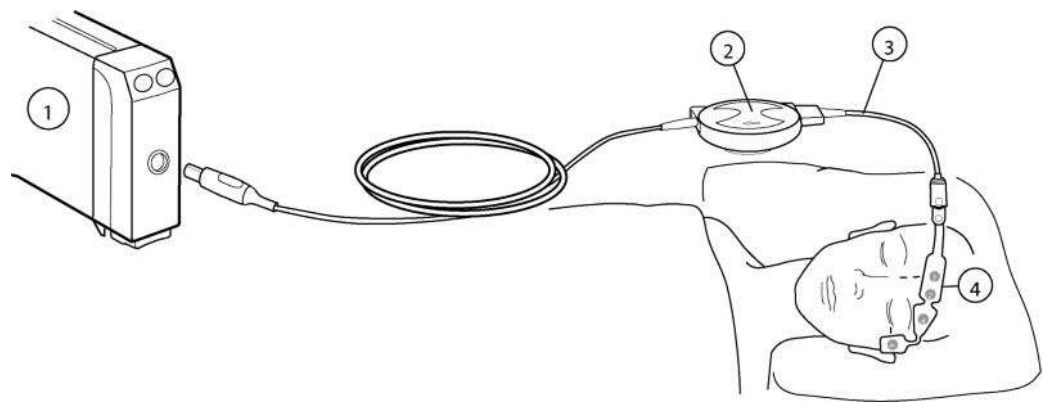
- This measurement is not available in neonatal mode.
- E-modules used for this measurement are not suitable for use with neonatal patients.
- BIS is a complex monitoring technology intended for use only as an adjunct to clinical judgment and training. Clinical judgment should always be used when interpreting BIS in conjunction with other available clinical signs. Reliance on BIS alone for intraoperative anesthetic management is not recommended.
- BIS values should be interpreted cautiously with certain anesthetic combinations, such as those relying primarily on either ketamine or nitrous oxide/narcotics to produce unconsciousness.
- External radiating devices may disturb the measurement.
- Poor signal quality may lead to inappropriate BIS values.
- Artifact may lead to inappropriate BIS values. Potential artifact may be caused by unusual or excessive electrical interference or high EMG activity like shivering, muscle activity or rigidity, sustained eye movements, head and body motion. Also, improper sensor placement and poor skin contact (high impedance) may cause artifact and interfere with the measurement.
- Due to limited clinical experience in the following applications, the BIS value should be interpreted cautiously in patients with known neurological disorders and those taking psychoactive medications.

BIS points to note

- This equipment is suitable for use in the presence of electrosurgery, as tested according to IEC 80601-2-49 clause 202.8.102 Disturbances from HF Surgical Equipment.
- For information on materials used in accessories and their biocompatibility, refer to the instructions for use in the accessory package.
- Defibrillator discharge may affect the BIS measurement. Defibrillation recovery time after discharge is ≤ 25 seconds.
- Make sure that the sensor connectors of the patient interface cable are not in contact with fluids.
- BIS sensors are disposable, for single patient use only, and not made with natural rubber latex.
- Check the sensor expiration date on the sensor package.
- Do not use a sensor for more than 24 hours.
- Use only Medtronic BIS sensors.

BIS measurement setup

BIS equipment to patient connection



1.	E-BIS module	3.	Patient Interface Cable, PIC Plus
2.	BISx	4.	BIS sensor

Preparing the patient for BIS measurement

1. Connect the digital signal processing unit (BISx) cable to the module.
2. Connect the patient interface cable to the BISx.
3. Secure the BISx to a convenient location, preferably close to the patient's head.
4. Clean the application site with alcohol and let dry.
5. Place the BIS sensor on the patient; see sensor package for instructions.
6. Connect the sensor to the patient interface cable.
7. Observe the results of the automatic sensor check in the digit field.
8. The measurement starts automatically after the sensor has passed the check.

Checking the BIS measurement

1. Check that the sensor/electrode passes the sensor/electrode check when you are starting to monitor a new patient.

Using the BIS measurement

Selecting the BIS waveform size

This setting determines the maximum drawing scale for BIS waveforms.

1. Press the  module key or select the BIS digit field.

2. Select a value from the **BIS EEG Scale μ V** list.

Selecting the EEG sweep speed

This setting determines the drawing speed for the EEG waveform.

1. Press the  module key or select the Entropy/BIS digit field.
2. Select a value from the **EEG Sweep Speed** list.

The smaller the value, the slower the sweep speed.



NOTE

This setting can change the EEG sweep speed of BIS and Entropy parameters.

Selecting the BIS smoothing rate

Smoothing rate affects the appearance of the BIS trend and the BIS value. It determines the amount of artifact-free data that is required for calculating the BIS value.

1. Press the  module key or select the BIS digit field.
2. Select a value from the **Smoothing Rate** list. The bigger the value, the “smoother” the trend.

Setting BIS filters

With BIS filters you can filter out disturbances from the EEG signal and improve the signal quality.

1. Press the  module key or select the BIS digit field.
2. Select the check-box of **Filters** to open the filters.

Using the manual BIS sensor check

Whenever required, you can perform the sensor check manually.

1. Press the  module key.
Or,
2. Press the  module key or select the BIS digit field.
3. Select **Check Sensor**.
4. Observe the results on the screen.

The measurement continues automatically after the sensor has passed the check.

Using the automatic BIS sensor check

1. Press the  module key or select the BIS digit field.
2. Select the **Automatic** check-box for **Sensor Check**.

The sensor check will start every 10 minutes.

Testing the BISx

In case the measurement does not work and checking the cables and sensors does not help, make sure that the BISx functions properly.

1. Press the  module key or select the BIS digit field.
2. Select **Test DSC**.
3. Observe the results on the screen.

After the test is completed, the result shown is **PASS** or **FAIL**.

Setting BIS alarm limits

You can set the alarm limits according to your needs.

1. Press the  module key or select the BIS digit field.
2. Select the **Alarms** tab.
3. Check that the **Alarm** is turned on.
4. Set the related alarm limits with arrows.

Stopping the BIS measurement

1. Remove the BIS sensor from the patient.
2. Disconnect the sensor from the patient interface cable.
3. Discard the sensor.

How to interpret the BIS values

The Bispectral Index is an absolute value, so baseline information about the patient is not required for BIS monitoring. The following table lists the BIS values and their significance.

BIS value	Clinical endpoint	Comments
100	Awake	Patient responds to normal voice.
80	Light/moderate sedation	Patient responds to loud commands or mild prodding/shaking.
40 to 60	General anesthesia	Patient has low probability of explicit recall and is unresponsive to verbal stimulus.
20	Deep hypnotic state	EEG suppression, or burst suppression as it is sometimes referred to, is an easily recognizable EEG pattern characterized by bursts of activity of varying shape alternating with episodes of flat-line activity.
0	Isoelectric EEG	No brain activity detected

This chart reflects a general association between clinical state and BIS values. Ranges are based on results from a multi-center study of the BIS involving the administration of specific anesthetic agents. BIS values and ranges assume that the EEG is free of artifact that can affect its performance.

Titration of anesthetics to BIS ranges should be dependent upon the individual goals for hypnotic state that have been established for each patient. These goals and associated BIS ranges may vary over time and in the context of patient status and treatment plans.

Low BIS values (below 40) may indicate overdosing of hypnotic medication, and high BIS (over 60 to 65) may indicate too low concentrations of the drug.

Data review tools

Patient data safety precautions

Patient data cautions

CAUTION

MISINTERPRETATION.

Changing the system time will result in time differences between stored and realtime data. Always check the time carefully to avoid the risk of misinterpretation.

CAUTION

MISINTERPRETATION OF HISTORICAL DATA.

Changing the date and time on one network device on the CARESCAPE Network will also update the date and time for all other devices on the same network. To avoid possible misinterpretation of historical data when viewing it, special attention should always be paid to the time and date information.

Patient data views

The device provides different tools to review patient data:

- graphic trends
- numeric trends
- snapshot
- alarm history
- OxyCRG
- full disclosure

The snapshot can be configured through  >  **Service > Snapshot**. These selections are password protected.

For more information, see the supplemental information manual.

The graphic trends include a predefined set of parameters. The numeric trend selections include all parameters that can be used. If you are viewing trends for parameters for which you do not have a license, trend labels are shown, but no new data is collected. Therefore, no data is shown in the trend view or printouts.

Graphic trends

Viewing graphic trends

Graphic trends contain 168 hours (7 days) of trend data. They contain four trend pages, each having up to four fields with different parameters.

If IBP or TEMP changes label, a dot line will display, only after dot line's data is for the latest label.

1. Select the .
2. Select  to shift to graphic trends view, if necessary.
 - To see more parameters, select vertical tabs **Page 1** to **Page 4**.
 - To see numeric values at a certain time, use **< >** at the bottom bar to that point of time. The numeric values are displayed next to the cursor.
 - To see more values for a previous time, use **<< >>** at the bottom bar.

Changing the graphic trend scales

1. Select the .
2. Select  to shift to graphic trends view, if necessary.
3. Select the  on the right corner of the bottom.
4. Select the **Scales** tab.
5. Select the **Time Scale** and parameter scales for graphic trends.

Graphic trend resolution

The graphic trend resolution depends on the time scale of the trend.

Time scale	Resolution
20 min	10s
1 h and 2 h	1 min
4 h	2 min
6 h	3 min
8 h	4 min
10 h	5 min
12 h	6 min
24 h	12 min
36 h	18 min
48 h	24 min
72 h	36 min

Time scale	Resolution
96 h	48 min
120 h	60 min
144 h	72 min
168 h	84 min

Setting the graphic trend pages

1. Select the .
2. Select  to shift to graphic trends view, if necessary.
3. Select the  on the right corner of the bottom.
4. Select the **Pages** tab.
5. Select the **Page 1**, **Page 2**, **Page 3** and **Page 4** vertical tab for trend pages.
6. Setup the parameters for related field.

Printing currently viewed graphic trends

1. Select the  > **Trends** tab.
2. Select the  to shift to graphic trends, if necessary.
3. Select the , check the scales for graphic trends.
4. Back to the trends menu, select vertical tab for desired parameters.
5. Select  (in the top right of trends menu) to start printing.
6. Select  to stop printing, if necessary.

Numeric trends

Viewing numeric trends

Numeric trends contain up to 7 pages with 168 hours (7 days) of trend data.
You cannot configure the layout of the **Numeric Trends** view.

1. Select .
2. Select  to shift to numeric trends view, if necessary.
 - To see more parameters, select their vertical tabs in the trend view.

- To see more numeric trend data, use << >> at the bottom bar.

Changing the time interval of numeric trends

Numeric trends display values according to the selected time interval. Numeric trends are updated with averaged measurement data once a minute independent of the selected time scale.

1. Select the .
2. Select  to shift to numeric trends view, if necessary.
3. Select the  on the bottom right corner.
4. Select a value from the **Trends Interval** list.

For example, a 5-minute interval will show data every 5 minutes, and a 30-minute interval will show data every 30 minutes. The data is displayed in columns on the screen. NIBP measurement will always add one column independent of the **Trends Interval** setting.

Printing numeric trends

Manual printing is possible only when the printing device is not processing another job at the same time.

1. Select the  > **Trends** tab.
2. Select the  to shift to numeric trends, if necessary.
3. Select the .
4. Check the value of **Trends Interval** for numeric trends.
5. Select a setting from the **Trends Printing** list. Choices are:
 - **Screen Data:** Print only current viewed data on screen for current tab's parameters.
 - **All Data:** Print all data for current tab's parameters.
6. Back to the trends menu, select vertical tab for desired parameters.
7. Select  (in the top right of trends menu) to start printing.
8. Select  to stop printing, if necessary.

Exporting numeric trends to USB disk

You can export the numeric trends to the USB storage device.



NOTE

Make sure the file system format for USB storage device should be FAT32.

1. Insert the USB storage device to the USB port of the monitor.
2. Select the  >  **Service** > enter **Username** and **Password**.

3. Select **USB Import/Export > Export trends to USB Disk**.
4. Enter an encryption **Key** for the trends' file, the length of key shall not be less than 6. (This key will be used when open the file in PC).
5. Select **Export trends to USB Disk**.
When finish to export trends, the screen returns and a message "**Export trends data to USB Disk successfully.**" displays on the menu.
The trends' file is named as "*_trends.7z", saved to the \B1x5\v2 folder of the USB disk.
6. To remove the USB disk, select **Safe to remove USB Disk**.

Snapshots

Description of snapshots

A snapshot is a set of measured data saved from a certain moment of time. Snapshots can contain waveform clips and trigger events. You can take up to 200 snapshots. The duration of the stored snapshot may not contain the entire duration of the physiological event that triggered it. The duration of each snapshot that gets displayed in the waveform box will be about 11.5 seconds for B105M-OR, 13.5 seconds for B125M-OR, and 18.5 seconds for B155M-OR.

Snapshot configuration

Snapshots can be configured for waveforms and whether create on alarms. Configure snapshot through  >  **Service > Snapshot** and these settings are password protected.

For more information, see the supplemental information manual.

Manually created snapshots

You can create a snapshot manually by selecting  on the main menu. The monitor saves the image of waveforms at that moment in time.

When a snapshot is taken manually, it is automatically numbered. A **Mark X** message is shown in the message field (xxx = the sequence number of the snapshot).

Automatically created snapshots

- You can create snapshots automatically on alarms if automatic snapshot creation is enabled. The alarm conditions for creation are: **Brady, Tachy, Art Sys high, Art Sys low, Art Mean high, Art Mean low, Art Dia high, Art Dia low**.

To enable this feature:



Service > Snapshot > Create on Alarms, this setting is password protected.

For more information, see the supplemental information manual.

- You can define automatic snapshot creation for each arrhythmia alarm separately. To select arrhythmia alarms that will automatically create a snapshot:

ECG digit field > **Alarms** tab > related arrhythmia alarms vertical tab.

For more information, see “Setting arrhythmia alarms” in the ECG chapter.

Viewing snapshots

1. Select the .
2. Select the **Snapshot** horizontal tab.

Three waveforms can be displayed on the snapshot page.

The lowest field in the **Snapshot** view shows the snapshot scale time, generate time, and alarm text.

You can see more snapshots by using << >> at the bottom bar.

Printing snapshots

1. Select the  > **Snapshot** tab.
2. Select  (in the top right of this menu) to start printing.
3. Select  to stop printing, if necessary.

The printed waveform speed is 12.5 mm/s, and duration is 20 s.

Alarm history

Viewing alarm history

Alarm history is a list that stores high, medium, and low priority alarms.

1. Select the .
2. Select the **Alarm History** horizontal tab.
 - The alarm history list displays the latest 100 alarms.
 - The color of each alarms indicate the alarm priority.
 - The  symbol means there is a snapshot created by the alarm, you can click the symbol to view the related snapshot.
 - The  symbol means there is a Full Disclosure data at the time of the alarm, you can click the symbol to view the related full disclosure.

Printing alarm history

Depends on the number of saved alarm history, one or more pages are printed.

1. Select the  > **Alarm History** tab.

2. Select  (in the top right of trends menu) to start printing.
3. Select  to stop printing, if necessary.

OxyCRG

OxyCRG description

The OxyCRG (oxycardiogram) provides services to view and review specific high resolution trends, high resolution beat-to-beat HR trend, high resolution beat-to-beat SpO₂ trend and compressed respiration waveform - simultaneously in the same view.

The device displays 8-minute OxyCRG function in the NEONATAL mode. Two types of views are provided: OxyCRG Snapshot view and OxyCRG Realtime view.

Viewing the realtime OxyCRG

1. Select the information area.
 2. Check **Patient Type** is **Neonatal**.
 3. Select **OxyCRG**.
- Or:
4. In NEONATAL mode, select the  >  **OxyCRG**.

Viewing OxyCRG snapshot

The OxyCRG snapshot is created when an OxyCRG event is triggered. The device can store up to 70 OxyCRG snapshots. OxyCRG snapshot includes the trend data 6 minutes before and 2 minutes after the OxyCRG event. If multiple OxyCRG events are triggered within 2 minutes, they will be detected as one OxyCRG event. During this time, only the first OxyCRG event will trigger OxyCRG snapshot creation.

1. In the NEONATAL mode, select the  >  **OxyCRG**.
2. Select the **OxyCRG Snapshot** tab.

The lowest field shows the snapshot triggered time and condition.

You can see more OCRG snapshots by using << >> at the bottom bar.

Setup OxyCRG snapshot

The OxyCRG snapshot will be triggered by any of HR, SpO₂ value and Apnea time is out of OxyCRG limits range. You can setup these limits.

1. In the NEONATAL mode, select the  >  **OxyCRG**.
2. Select the **OxyCRG Setup** tab.
3. Adjust each parameter's limits with the arrows.

Full Disclosure

Full Disclosure description

Full disclosure can display up to 72 hours ECG, SpO2, IBP and RESP waveform data.

Viewing Full Disclosure

1. Select the .
2. Select the **Full Disclosure** horizontal tab.
3. Select the vertical tab for more parameters.
 - To see the waveform data 1 second before current time, use <> at the bottom bar to that point of time.
 - To see the waveform date 1 page before/after current page, use << >> at the bottom bar.

Go to Full Disclosure view for specific time

1. Select the .
2. Select the **Full Disclosure** horizontal tab.
3. Select the  on the bottom right corner.
4. Select the values from **Date**, **Hour**, and **Minute** list.
5. Select **Go**.

Setting the sweep speed of Full Disclosure

1. Select the .
2. Select the **Full Disclosure** horizontal tab.
3. Select the  on the bottom right corner.
4. Select an option from the **Hemodynamics Sweep Speed** list.

Time change during a patient admit

Time adjustment is allowed during a patient admit if the monitor is configured to the CARESCAPE Network, independent on its connection status to the network. When the time is adjusted, the monitor shifts the timestamps of continuous data, but not discrete data (e.g. NIBP measurement).

After time adjustment, continuous and discrete data cannot be compared to each other, because their timestamps no longer match.

2 minutes before device is disconnected from network, the monitor may not be able to transmit the NIBP trends data to the CARESCAPE Gateway Server.

Erasing patient data

The patient's data is erased when:

- discharge a patient
- the monitor has been abrupt crash
- the data out of time or quantity

Erased snapshots cannot be recovered.

To erase patient data, you must discharge the patient.



NOTE

This will also return monitor settings to their defaults.

1. Select the information area.
2. Select **Discharge Patient**.

Clinical applications

Clinical applications safety precautions

Early Warning Score warning

WARNING

PATIENT SAFETY.

Consider EWS as a secondary source for deterioration of vitals. Early Warning Score and Clinical Response Message serve as guide to protocols at your facility. Do not replace patient physiological alarms with EWS. Appropriate alarm settings must be set and maintained to ensure patient safety.

Clinical applications description

The monitor provides some useful clinical guidelines and tools, which gathering parameter measurements together and provides comprehensive analysis results.

Clinical applications is not intended to replace the competent judgment of a clinician. It must be used in conjunction with observation of clinical signs and symptoms.

The monitor provides following clinical applications:

- Early Warning Score
- Customized Notification

Early Warning Score

Early Warning score (EWS) is an optional, license-based feature that helps to recognize the early signs of deterioration in medical patients.

EWS is a simple scoring system in which a score is allocated to physiological parameters measured in clinical practice. Some parameters for EWS may be entered manually.

EWS feature can help clinician to recognize the early signs of deterioration in medical patients, follow prompt and effective action, and minimize the occurrence of adverse events.

The device supports the following scores' protocol type:

- NEWS2 (National Early Warning Score 2)

GE provides the National Early Warning Score reference from the Royal College of Physicians to enable caregivers to track patient conditions. National Early Warning Score (NEWS)2: Standardizing the assessment of acute-illness severity in the NHS. Updated report of a working party. London: RCP, 2017.

- MEWS (Modified Early Warning Score)

Selecting the EWS type

The device is configured with a default EWS protocol. To change the EWS protocol type, through  >  **Service** (password protected) > **EWS** > **Protocol Type**.

Viewing EWS

The EWS can be set to digit field to display last score.

1. Select  >  **Screen Setup**.
2. Setup EWS to digit field.
 - For waveform layout: Select **Layout 1** or **Layout 2** horizontal tab > **Lower Area** vertical tab.
 - For large number layout: Select **Layout 3** or **Layout 4** horizontal tab.

Calculating EWS

1. Select  >  **EWS**.
2. Confirm if the patient meets the intended use.
3. Select the following items.
 - For NEWS2: **Hypercapnic Respiratory Failure** (check box), **Air or oxygen?**, **Consciousness**
 - For MEWS: **Consciousness**, **Hourly Urine for 2 hours**
4. Check other parameter values, if the parameter is not available on monitor; adjust values if necessary.
5. Select **Score** to do a single calculation.

If need to refresh parameter values entering and calculation, please select .

The EWS will display in menu and digit field.

Viewing EWS history

The EWS can be set to digit field to display last score.

1. Select  >  **EWS**.
2. Select **History** tab.
3. Select one historical score, you can review the detail parameters value for this EWS.

Viewing EWS clinical risk/patient risk



NOTE

Different EWS protocol type has different risk rating system. Please review the clinical risk/patient risk lists to make sure fully understand the score's meaning.

1. Select  >  **EWS**.
2. Confirm if the patient meets the intended use.
3. Select the **Clinical Risk** or **Patient risk** tab.
4. Select **Page 1** vertical tab to review thresholds and triggers.
5. Select **Page 2** vertical tab to review scoring system.

Viewing EWS guidance



NOTE

NEWS2 type only.

1. Select  >  **EWS**.
2. Select the **Guidance** tab to review EWS guidance.

Customized Notification

The device can provide visual notification when multiple parameters meet the customized conditions simultaneously.

The function is effective to detect adverse events which helps clinicians to make treatment decisions with multiple parameters.

Setting customized notifications

To use customized notifications, you should setup the notification group to customize conditions first. The following is the **Settings** menu.



No.	Items	Description
1.	Settings (Settings)	Menu tab.
2.		Delete the selected notification group.
3.		Edit the selected notification group's name.
4.		Create a new notification group.
5.	Notification group	Select a notification group. Swipe  or  to enable or disable this notification group.
6.	Group (Group)	Create a subgroup for multiple selected conditions.
7.	Ungroup (Ungroup)	Cancel the selected subgroup.
8.		Delete the selected group condition.
9.		Add a new condition for the notification group.
10.	AND (AND) and OR (OR)	Criteria softkey, select to switch AND and OR.
11.	Parameter (Parameter)	Select the specific parameter
12.	Condition (Condition)	Condition softkey, select to switch "<" and ">".
13.	Value (Value)	Set parameter's value with arrows.
14.	Delay (Delay)	Set delay time for notifications
15.	Cancel (Cancel)	Cancel the settings setup.

No.	Items	Description
16.	Apply (Apply)	Apply the settings and active current notification group.

1. Select  >  **Customized Notifications** > **Create Notification Group**.
 - First time to use: select **Create Notification Group**, The **Settings** menu appears.
 - Update settings or create new groups: select **Settings** tab.
2. Select , , or , to delete, edit, or create a notification group.
3. Setup conditions for the notification group:
 - 3.1. Select  to add a new parameter condition (item).
 - 3.2. Select  to delete the selected items, if needed.
 - 3.3. Setup the **Parameter**, **Condition**, and **Value**.
 - 3.4. Select the check box of items, then select **Group**.
A subgroup are generated for the selected items
 - 3.5. Select **AND** or **OR** to setup criteria of the subgroups.
The notification group conditions will be textual displayed on screen.
 - 3.6. Select the check box of items, then select **Ungroup** to release the subgroup.
 - 3.7. Enter the time of **Delay** for this notification group that all the conditions have been met.
 - 3.8. Select **Apply** to save changes.
The current notification group will be active.
You can also select **Cancel** to cancel the settings setup.
4. Swipe the  or  to enable or disable the selected notification group.

**NOTE**

If you want to update one group settings, should select  for this group first, then to do setup.

Customized notification displays on monitor's screen

The customized notification is displayed in the notification menu, or in the notification bar, which locate on the left side of the main screen. The notification bar also can be hidden or shown by left or right swiping the bar on screen.

There is a number represents how many instances have not been read. And the background color becomes pink indicating that there are instances happening.

You can select the group to review history instances, with their related parameter's graphic trends.

Viewing customized notification from menu

1. Select  >  **Customized Notifications**.

The all notification groups appears. The group name, unread instances count, last instance duration, and start and end time display for each group.

2. Select one of the notification groups, you can open the corresponding instance menu and find the list of all related instances on left side.

Start and end time, and duration display for each instance to help you to check.

A blue circle ● will appear on the upper left corner to indicate unread instances.

Viewing history instances

You can review history instances, with each related parameters' graphic trends.

1. Select a instance on the left side to open the related graphic trends.
2. Select  or  on the top left of the trends screen, to adjust the trends scale.
The trends scale is 1, 2, 4, 6, 8, 10, 12, and 24 h.
3. Select < or > at the bottom bar to move cursor to a specific time, the numeric values are displayed next to the cursor.
4. Select << or >> at the bottom bar to view more trends.

Viewing customized notification from notification bar

Setup the notification bar to the normal screen first:

1. Select  >  **Customized Notifications** > Swipe **Show Notification Bar**  to turn on.



NOTE

The split screen will be turned off with showing the notification bar instead.

2. Go to the normal screen.
On notification bar, display the group name and unread instances count.
A a blue circle ● will appear on the upper left corner to indicate unread instance.
3. Select one of the notification groups, you can open the corresponding instance menu and find the list of all related instances on left side.

Start and end time, and duration display for each instance to help you to check.

A a blue circle ● will appear on the upper left corner to indicate unread instance.

You can review history instances, with each related parameters' graphic trends.

Refer to [Viewing history instances on page 292](#).

Printing

Printing description

Depending on the system configuration, the following printing capabilities are available:

- Printing to a recorder connected directly to the monitor.
- Printing to a network laser printer.
- Printing to a remote recorder connected to a central station in the CARESCAPE Network.
- Printing to a remote laser printer connected to a central station in the CARESCAPE Network
- Printing to PDF and export to USB.



NOTE

Before you start printing, check that the printer is operational, make sure the recorder door is closed.



NOTE

Recordings on thermal paper may be destroyed when exposed to light, heat, alcohol, etc. Take a photocopy for your archives.

Printing device selections

Selecting printer

1. Select the  >  **Printing Setup**.
2. Select the **Devices** tab.
3. Select the printout type from the **Printout** list.

You may assign only one print location for each printout type.

- **Waveforms:** current waveforms
- **Alarm Waveforms:** waveforms triggered by alarms
- **All ECG Waveforms:** all ECG waveforms
- **Numeric Trends:** numeric trends according to **Trends Printing** settings in Trends menu
- **Graphic Trends:** graphic trends, the same as on screen
- **Snapshot:** Snapshot
- **Alarm History:** Alarm history

4. Select the location for the printout:

Devices	Option	Printout types for this location
Local recorder	Local	• Waveforms • Alarm Waveforms • All ECG Waveforms • Numeric Trends
Remote recorder or printer which connected to a central station in the network.	Remote	• Waveforms • Alarm Waveforms • All ECG Waveforms • Numeric Trends
Network printer	Network	• All ECG Waveforms • Numeric Trends • Graphic Trends • Snapshot • Alarm History

Changing the print location does not affect printing currently in progress.

5. According to your location selection above:
- If you selected **Remote**: Choose the central station from the **Care Unit** list, then select the print device from the **Remote Device** list.
 - If you selected **Network**: Select the print device from the **Network Device** list.

Checking the print status

You can view the assigned print locations for each type of printout and check the printer status for each print device.

1. Select the  >  **Printing Setup**.
2. Select the **Status** tab.

The location for each assigned printout and printer status are listed in the table.

Setting the printer

1. Select the  >  **Service** > enter **Username** and **Password**.
2. Select **Page 2** vertical tab.
3. Select **Printer**
4. Setup following settings if needed:
 - **Paper Size**: Network printer paper size
 - **ECG Printout Format**: all ECG waveform format
 - **Print Patient Name**: whether display patient name in printout

For more information, see the supplemental information manual.

Printing waveforms

Printing waveforms on alarms

The following are the default settings for alarm waveform printouts:

- The print delay is 10 seconds.
- The print duration is 30 seconds.
- The waveform speed is 25 mm/s.

An automatic printing of waveforms will be triggered by following alarms:

Asystole, Tachy, Brady, V Fib / V Tach, V Tach, Art Sys high, Art Sys low, Art Mean high, Art Mean low, Art Dia high, Art Dia low, ABP Sys high, ABP Sys low, ABP Mean high, ABP Mean low, ABP Dia high, ABP Dia low, UAC Sys high, UAC Sys low, UAC Mean high, UAC Mean low, UAC Dia high, UAC Dia low.

1. Select the  >  **Printing Setup > Waveforms** tab.
2. Choose a value from the **Start On Alarms** list:
 - **No**: Not waveform print during an alarm condition.
 - **High**: Waveforms print during high priority alarm conditions only.
 - **All**: Waveforms print during any alarm condition.

Starting a waveform printout

1. Select one of the following options to start a waveform printout:
 - Select the . Or,
 - Select the  >  **Printing Setup > Waveforms** tab > **Print Waveforms**.

If print length has been configured for **Continuous**, you will be required to stop the print request.

Stopping a waveform printout

1. Select one of the following options to stop printing a waveform:
 - Select the . Or,
 - Select the  >  **Printing Setup > Waveforms** tab > **Stop Printing**.

Setting the print delay

1. Select the  >  **Printing Setup > Waveforms** tab.

2. Select a value from the **Delay** list:
 - **10 s**: Manual waveform printing starts with 10 seconds of the most recently saved data first. After that, the real time data begins to print.
 - **0 s**: Manual waveform printing starts with real time data.

Setting the print speed

To select the sweep speed for the actual paper speed of a recorder:

1. Select the  >  **Printing Setup** > **Waveforms** tab.
2. Select a value from the **Paper Speed** list.

Setting the print duration

The length of the event shall determine the length of the printout.

1. Select the  >  **Printing Setup** > **Waveforms** tab.
2. Choose a time value from the **Length** list: **10 s**, **30 s** or **Continuous**.
If you select **Continuous**, waveforms continue to print until you stop the printing.

Selecting waveforms to print

1. Select the  >  **Printing Setup** > **Waveforms** tab.
2. Choose the desired ECG lead/parameter for waveforms 1-3.



NOTE

If choose 3 waveforms to print, the waveforms may not display entirely.

You can also print all ECG waveforms from ECG menu. See [Viewing and printing all ECG waveforms on page 127](#).

Printing trends, snapshots, and alarm history

For how to print trends, snapshots and alarm history, please refer to follow sections in "Data review tools" chapter for more details:

- [Printing currently viewed graphic trends on page 280](#)
- [Printing numeric trends on page 281](#)
- [Printing snapshots on page 283](#)
- [Printing alarm history on page 283](#)

Exporting patient data to USB disk in PDF format

The device can generate the network printer's printout as PDF report, and export to the USB storage device.

**NOTE**

Make sure the file system format for USB storage device should be FAT32.

1. Insert the USB storage device to the USB port of the monitor.
2. Select the > **Export Patient Data**.
3. Select the multiple options for which patient data to export.
4. Select the **Export Latest Data** for trend and snapshot.
5. Select **Export**.

When finish to export, a message "**Export success.**" displays on the menu.

The report files are saved to the \B1x5\v2\[Day]\ folder of the USB disk.

6. To remove the USB disk, select **Safe to remove USB Disk**.

If the file's encryption key (This key will be used when open the file in PC) haven't setup. There will be a **Set Key for Patient Data Export** menu. To enter this menu, need to enter password to **Login** first. Enter an encryption **Key** for the file, the length of key shall not be less than 6.

This menu also can reach from > **Service** (password needed) > **USB Import/Export**. You can modify key if necessary.

Printing format

Network laser printer print header

Laser printer print header can include:

- Patient name (displayed if configured through > **Service** > **Page 2** tab > **Printer**)
- Medical record number
- Second ID
- Unit and Bed number
- Date and time of the printout
- Title (e.g., Alarm History)
- Current page/total number of pages (e.g., 1/12)
- Identification field for a patient identification sticker
- Notes field for manually written notes

Recorder print header

Recorder print header for waveforms, alarm waveforms, and all ECG waveforms can include:

- Title
- Unit and Bed number
- Date and time of the printout

- Speed
- Parameter's value
- Alarm audio
- Alarm volume
- Alarm audio pause
- Patient name (displayed if configured through  >  **Service** > **Page 2** tab > **Printer**)
- Medical record number
- Second ID
- Alarm message

Recorder print header for numeric trends can include:

- Title
- Unit and Bed number
- Patient name (displayed if configured through  >  **Service** > **Page 2** tab > **Printer**)
- Date and time of the printout

Inserting recorder paper

1. Press the door latch to open the recorder door.
2. Remove the paper core.
3. Place a new paper roll between the tabs of the paper holder. Make sure the paper unrolls from underneath the paper roll.



4. Pull out 3 to 4 cm of paper, then close the door.
5. Select the  to print out a strip.

Viewing other monitored patients

About viewing other monitored patients

When the monitor is on the network, you can open a bed-to-bed view of other remote patient beds that are on the same network. You can choose to view a remote patient bed under an alarm condition, or simply view any available bed on your network.

WARNING

MISSED ALARMS.

Do not use automatic view on alarm (AVOA) as a replacement for a primary alarm source or as a central station as this may lead to missed alarms. To avoid missing any alarms and to ensure alarm delivery between AVOA and bed-to-bed monitors, configure the monitors to send and receive alarms to and from each other.

Up to six remote parameters' waveforms and numeric values, one remote alarm, and location information are displayed inside a separate bed-to-bed window. The bed-to-bed window is located on the left side of the display screen.

Function	Network features
View on alarm notification	Monitor alarms for up to 40 beds.
View remote beds	View one bed from up to 1023 beds.

Some settings related to remote alarm configuration are given through  >  **Service > Alarm Options > Remote Alarms** tab, and they are password protected:

- **From Remote Location:** Selecting which remote locations are allowed to pause audio alarms on this monitor
- **For Remote Bed:** Enabling or disabling audio pausing remotely for another monitor.
- **Allow Remote Pausing of:** Selecting alarm priorities that can be paused remotely.
- **Remote Alarm Light:** Use of the alarm light also for a remote alarm.
- **Show Remote Patient Name** (check box): Enabling or disabling the display of the remote patient name.
- **Remote Alarm Tone:** Selecting the remote alarm tone.
- **Remote Bed Selections** (check box) : Enabling or disabling the restoring of the remote bed selections after discharge.

For more information, see the supplemental information manual.

Automatic view of remote beds in alarm

You can set the monitor to automatically notify you with an alarm message or with a bed-to-bed window when selected remote patient beds go into an alarm condition. All automatically viewable

alarming beds are displayed or placed in a display queue in order from the highest to lowest alarm priority and from the newest to oldest alarms.

You can configure how the monitor notifies you of a remote patient bed alarm condition, and which remote patient alarm priority levels you want notification of. You can do this for individual beds, or for all remote beds of a selected care unit at once.

The remote alarm message field contains unit and bed name, alarm message, and  if more than one remote bed are alarming.

Selecting the alarm notification type

1. Select  >  **Other Patients**.
2. Select the **Receive Alarms** tab.
3. Select a care unit from the **Unit** list.
4. Select a patient bed from the display list.
5. Select the type of alarm notification desired from the **Alarm Notification** list:
 - **Off**: Remote alarm notification is turned off.

NOTE

All new monitors appear on the list automatically with the notification setting **Off** (default).

- **Message**: Remote alarm messages display in the alarm area. At any time, you can select a remote alarm message to open a bed-to-bed window and view the remote patient's data.
- **Auto View**: Bed-to-bed window opens immediately if no other procedure or setup window is currently open. Otherwise, a remote alarm message displays in the alarm message area. To open the bed-to-bed window and view the remote patient's data, close the currently open menu, or select the remote alarm message.
- **Auto View Always**: Immediately closes any open procedure or setup windows and opens a bed-to-bed window with the remote patient's data.

Selecting the notifying alarm priority level

1. Select  >  **Other Patients**.
2. Select the **Receive Alarms** tab.
3. Select a care unit from the **Unit** list.
4. Select a patient bed from the display list.
5. Select the type of alarm priority desired from the **Alarm Priorities** list:
 - **High**: Opens a bed-to-bed window or displays the alarm messages for remote patients in a high alarm priority condition.
 - **High, Medium**: Opens a bed-to-bed window or displays the alarm messages for remote patients in a high or medium alarm priority condition.
 - **High, Medium, Low**: Opens a bed-to-bed window or displays the alarm messages for remote patients in a high, medium, or low alarm priority condition.

Changing the settings for multiple beds

You can select a care unit and change all of the listed remote patient beds to a single notification setting and/or a single alarm priority setting. If there are more than 40 beds in the unit, the settings will be changed for the first 40 beds only.

1. Select  >  **Other Patients**.
2. Select the **Receive Alarms** tab.
3. Select a care unit from the **Unit** list.
4. Select a setting from the **Change All Notifications** list:
 - **Off**: Remote alarm notification is turned off.
 - **Message**: Remote alarm messages display in the alarm area.
 - **Auto View**: Bed-to-bed window opens immediately if no other procedure or setup window is currently open. Otherwise, a remote alarm message displays in the alarm message area.
 - **Auto View Always**: Immediately closes any open procedure or setup windows and opens a bed-to-bed window.
5. Select a setting from the **Change All Priorities** list: **High; High, Medium; High, Medium, Low**.

Next alarming remote bed to screen

If you have a bed-to-bed window open and another **Auto View** or **Auto View Always** bed goes into

alarm, the softkey  in bed to bed window becomes selectable. It allows you to view the next highest and newest alarming patient bed.

Viewing remote patient beds

You can select and view a networked alarming or non-alarming remote patient bed.

1. Select  >  **Other Patients**.
2. Select a care unit from the **Unit** list.
3. You can select to see a list of all patient beds in the care unit or a list of remote patient beds configured for alarm notification. Select an option from the **Show** list:
 - To show a list of all the remote beds in the care unit, select **All Patients**.
 - To show the list of remote patients configured for alarm notification, select **Notification Patients Only**.
4. Select a patient bed from the display list.
5. Select **View**.

The text **Manual View** is displayed when the remote patient bed viewing has been selected manually. If the automatic viewing is in use, the text is **Automatic View**.

6. You can stop viewing the selected patient bed and close the bed-to-bed window by selecting Exit key.

NOTE

Selecting the home key will not close any opened bed-to-bed view of an alarming or non-alarming patient bed.

Audio pause for a remote patient bed alarms

When remote alarms are received, you can pause active alarms remotely by selecting  from the bed-to-bed window. If the softkey is not displayed, this option has not been enabled during configuration. It is enabled through  >  **Service** > **Alarm Options** > **Remote Alarms** tab > **From Remote Location**, and they are password protected.

Manual printing of remote bed waveforms

Waveform data of a remote monitor can be manually printed by selecting  from the bed-to-bed window. The waveforms that appear on the printout are determined by the remote monitor's print configuration.

Periodic Maintenance

Maintenance safety precautions

Care warnings

WARNING

EQUIPMENT FAILURE.

Regular preventive maintenance should be carried out every 24 months. Failure to implement the recommended maintenance schedule may cause equipment failure and possible health hazards.

WARNING

SAFETY HAZARD.

To avoid risks to personnel and patient, or damage to the equipment, only perform maintenance procedures described in this manual. Unauthorized modifications can lead to safety hazards.

WARNING

ENVIRONMENTAL HAZARD.

Cleanup and disposal of broken displays must be in compliance with the safety and waste control guidelines regulating this product.

WARNING

ELECTRIC SHOCK.

Non-medical equipment does not provide the same level of protection against electrical shock. Do not touch the patient and any part of non-medical equipment at the same time. An example of non-medical equipment is external display.

Before any planned maintenance or regular checks

Make sure that the patient is not being monitored during maintenance or regular check procedures.

Planned maintenance for the monitor

Service personnel should perform the following checkout procedures every 24 months after installation. Refer to the technical manuals for planned maintenance procedures.

- Visual inspection

- Electrical safety tests
- Functional check

Planned maintenance for the module

For E-sCAiO, E-sCO, N-CAiO, and E-miniC module, service personnel shall perform the checkout procedures every 12 months after installation, unless otherwise indicated in the device service manual.

For E-COP, E-Entropy, E-BIS, and E-NMT module, service personnel shall perform the checkout procedures every 24 months after installation, unless otherwise indicated in the device service manual.

Refer to the service manuals for planned maintenance procedures.

- Replacement of planned maintenance parts, if needed
- Visual inspection
- Electrical safety tests, if needed
- Functional check

Recommended check schedules

Daily checks

- Check that the accessories, cables, cable connectors, monitor, module and display parts are clean and intact.
- Check the charge of the monitor battery.

Check every two months

- Change the water trap.
- Check the airway gases calibration if the measurement is in continuous use.

Check every six months

- Check the airway gases calibration if the measurement is in normal (not continuous) use.

Check every 24 months

- Check the calibration of temperature, NIBP and invasive blood pressure.
- Planned maintenance check



NOTE

The invasive blood pressure transducers should be calibrated whenever a transducer error occurs.

**NOTE**

Discharge patient before doing calibration and maintenance.

Regular calibration checks

Calibrating airway gases

To ensure that the measurement accuracy remains within specifications, follow the recommended calibration check intervals: every six months when used several hours a day on most days each week, and every two months in more continuous use, and whenever there are indications of errors in the gas readings.

NOTE

Ensure that the calibration gas and regulator are functioning properly before calibration. Perform annual maintenance of the regulator as required.

NOTE

Make sure that you are using a correct GE calibration gas, see the supplies and accessories provided. Do not use any other calibration gases.

NOTE

Calibration gas bottles with anesthetic agents must be disposed in compliance with the guidelines regulating the disposal of products containing anesthetic agents.

1. Turn on the patient monitor. For maximum accuracy, let the monitor warm up for 30 minutes.
2. Attach a regulator to the calibration gas cylinder.
3. Attach a new sampling line to the water trap. Connect the other end of the sampling line to the regulator on the gas container.
4. Select the  >  **Parameter Setup > Others tab > Gases > Gas Calibration.**
5. Wait until the messages **Zero OK** and **Feed gas** appear on the screen.
6. Open the regulator and feed gas until the adjust menu appears, then close the valve.
7. Check that the displayed values match the values on the calibration gas container. Adjust if necessary:
 - 7.1. Adjust the value with arrows until all gas values match with the desired values on the gas container.
8. Confirm by selecting **Accept**.
9. If the calibration is successful, the message **OK** is displayed and the last calibration time and date is updated for a few seconds. If the calibration fails, the message **Calibr. Error** appears instead. In this case, start a new calibration by selecting **Recalibrate**.

If the message **Zero error** appears, repeat the calibration procedure. If the problem persists, contact authorized service personnel.

NIBP, IBP, and Temperature calibration checks

The calibration check interval for NIBP, IBP, and Temperature is at least once every two years.

For calibration instructions, please see the Technical manual of the monitor.

Water trap care instructions

- Empty the water trap container when it is more than half full. With a sample gas temperature of 37°C, a room temperature of 23°C, and sample gas relative humidity of 100 %RH, the water trap should be emptied every 24 hours (applies when the sample gas flow is within 150 ± 25 ml/min for E-miniC).
- In anesthesia: Replace the D-fend or Mini D-fend water trap when the message **Replace water trap** appears. The maximum lifetime of the water trap is two months.
- E-sCAiO, E-sCO and N-CAiO module: If the sampled gas is returned to the patient circuit, ensure the protective function of the D-Fend Pro water trap by replacing it at least once a week, or immediately in case of a defective or missing HMEF bacterial breathing system filter.
- In critical care: Replace the D-fend Pro+ or Mini D-fend water trap for each new patient, when the message **Replace water trap** appears, or every 24 hours.
- Attach the water trap by pushing it firmly to its place, so that the locking latch makes a clicking sound.
- Remove the water trap by pressing the release latch and pulling the water trap out.
- Empty the container whenever it is more than half full by disconnecting it from the water trap cartridge. Do not use a syringe.
- The water trap cartridge is disposable. Do not dry, wash, or reuse an exhausted or occluded water trap.
- When taking a new water trap into use, mark the date on the appropriate label on the water trap cartridge: 
- Read the water trap instructions for use in the accessory package.

About battery care

Monitor battery

The monitor has one rechargeable lithium-ion battery to supply device operation without AC power.

- Condition battery: Connect device to the AC mains to charge battery. If the message **Condition battery** still persists, contact authorized service personnel to replace battery.
- Check battery status and performance: see [Checking the battery charge with monitor software on page 62](#).
- Recycle battery: When the battery fails, or its runtime is significantly less than the specification, it should be replaced. A **Replace battery** message may appear. Please contact authorized service personnel to replace the old battery, and properly dispose of the battery according to your local recycling guidelines.

Internal RTC battery

The monitor has one button cell to retain the correct time and date for the device.

If the message **Check RTC** appears, please contact qualified service personnel to replace this battery.

How to store devices

- Store the device in a clean and dry, well-ventilated area.
- Hang the device using a holder, if available.
- If cables are attached, they should hang straight. Do not coil cables tightly around the device.



NOTE

If the device will enter long-term storage after usage, fully charge the monitor battery beforehand.

Disposal instructions

The product described in this manual, as well as its accessories and packaging, must be disposed of according to local environmental and waste disposal regulations. Always consider your hospital guidelines as well.

For detailed information regarding the substances contained in the product and their treatment, please request WEEE Selective Treatment Passports from GE or its representatives.

This product contains lithium-ion batteries. At the end of their service life, batteries in this product must be recycled or disposed of in accordance with local or national regulations. Do not dispose of batteries as trash or unsorted municipal waste. Requirements and services for recycling of batteries vary between countries.

Cleaning and disinfection

About these instructions

The following cleaning and disinfection information applies to the devices and device components listed in this instruction and manufactured by GE. Follow these instructions to clean and disinfect the devices and parts that are not in direct contact with the patient, referred to as non-applied parts, unless there are separate part-specific instructions.

For details about cleaning, disinfecting and sterilizing accessories, see the instructions for use in the accessory package.

Always consider your professional healthcare facility guidelines as well.

For cleaning, disinfection, and care information for devices, device components, supplies, and accessories made by manufacturers other than GE, see the applicable instructions for use provided by the manufacturer. The information provided in this supplement does not supersede any instructions for use provided by the manufacturer or provided with a device, device component, supply, or accessory.

- Cleaning is physical removal of soil and contaminants.
- Disinfection reduces the number of viable microorganisms on a product to a level previously specified as appropriate for its use.

About cleaning and disinfection

Cleaning warnings

WARNING

EQUIPMENT DAMAGE.

Avoid using other chemicals than the ones described in this manual as they may damage device surfaces, labels, or cause equipment failures.

WARNING

EQUIPMENT DAMAGE.

To prevent liquids from entering the monitor, do not tilt the monitor. Any liquids entering the device may damage it.

WARNING

EQUIPMENT DAMAGE.

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

WARNING

EQUIPMENT DAMAGE.

Never immerse any part of the device, cables, or leadwires in liquids or allow liquid to enter the interior of the device.

WARNING

EQUIPMENT DAMAGE.

Do not autoclave any part of the system with steam (including cables or leadwires) or sterilize with ethylene oxide.

WARNING

EQUIPMENT DAMAGE.

To avoid the risk of damaging the devices, do not use any automated cleaning procedures. Always clean manually according to the instructions provided.

WARNING

EQUIPMENT DAMAGE.

Do not pour or spray any liquid directly on the device, cables, or leadwires or permit fluid to seep into connections or openings.

WARNING

EQUIPMENT DAMAGE.

Never use conductive solutions, oxidizing compounds, wax, or wax compounds to clean the device.

Cleaning cautions

CAUTION

EQUIPMENT DAMAGE.

Do not apply pressurized air or gas to any outlet or tubing connected to the monitor. Pressure may destroy sensitive elements.

Cleaning points to note

Observe these guidelines while cleaning the device.

- Your professional healthcare facility guidelines permitting, all cleaning activities can be carried out at the bedside.
- Be especially careful when cleaning the displays. They are more sensitive to rough cleaning methods than for example the monitor housing.
- Avoid contact with open vents, plugs, or connectors during the cleaning procedures.
- Always dilute cleaning agents according to their manufacturer's instructions. Always consider your professional healthcare facility guidelines as well.

- Prolonged contact of cleaning solutions with metal parts may cause corrosion.
- Do not clean any part of the system in automated cleaning.
- Do not use excessive drying techniques, such as oven, forced heat, or sun drying.
- Soiled devices must be separated from non-contaminated devices to avoid contamination of personnel or surroundings.
- Warranty does not cover any damages caused by using other than GE approved substances and methods.

Disinfection points to note

- Your professional healthcare facility guidelines permitting, all disinfection activities can be carried out at the bedside.
- Always clean before disinfecting.
- Always dilute disinfectant agents according to their manufacturer's instructions. Always consider your professional healthcare facility guidelines as well.
- Use only the permitted substances.
- Prolonged contact of disinfecting solutions with metal parts may cause corrosion.

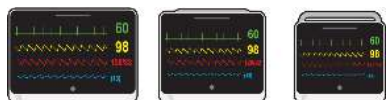
Visual inspection before cleaning and disinfection

Carefully inspect devices visually to verify proper function. Do not use improperly functioning, damaged, or excessively worn devices, or devices with unrecognizable markings or missing or worn device labeling or marking. Evidence of damage and wear on a device may include but is not limited to discoloration, excessive scratches, melting, dulling, distortion, wear, and cracks. If a device is extremely soiled and cannot be cleaned using the normal procedure, replace it. Contact qualified service personnel and follow your professional healthcare facility procedures.

If you discover any signs of deterioration or damage in the device, discontinue its use.

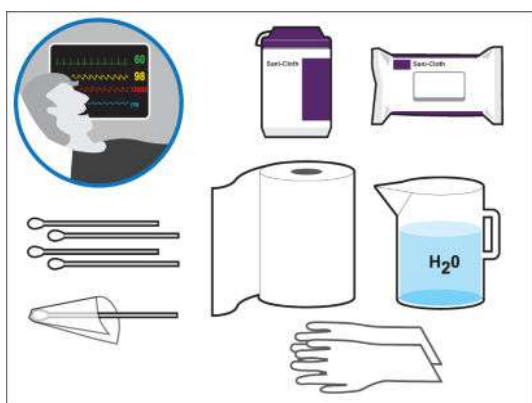
Cleaning and disinfection frequency

The following table indicates the frequency of visual inspection, cleaning, and disinfection procedures.

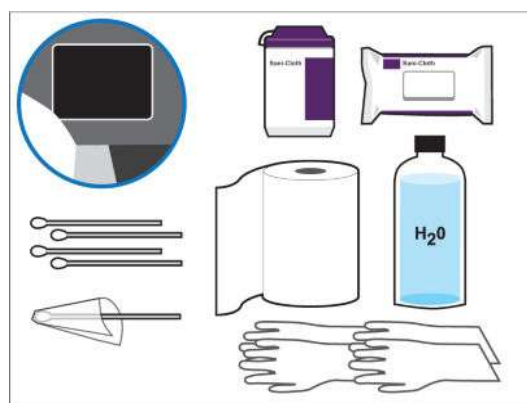
Device	Visual inspection	Cleaning	Disinfection
Monitor 	• Before and after each patient use • Before and after cleaning or disinfection	• After each patient use • When in use and visible soil is present	• After each patient use • Perform disinfection after cleaning, not before
B1X5-F2 Frame 	• Before and after each patient use • Before and after cleaning or disinfection	• After each patient use • When in use and visible soil is present	• After each patient use • Perform disinfection after cleaning, not before

Device	Visual inspection	Cleaning	Disinfection
B1X5-REC Recorder 	- Before and after each patient use - Before and after cleaning or disinfection	- After each patient use - When in use and visible soil is present	- After each patient use - Perform disinfection after cleaning, not before
E-modules 	- Before and after each patient use - Before and after cleaning or disinfection	- After each patient use - When in use and visible soil is present For instructions refer to: Cleaning and disinfecting the B1X5-F2 frame between patients on page 321	- After each patient use - Perform disinfection after cleaning, not before For instructions refer to: Cleaning and disinfecting the monitor between patients on page 317

Supplies needed for cleaning and disinfection



Cleaning supplies



Disinfection supplies

- Cleaning/disinfection wipes (commercial) or detergent/disinfectant
 - Water, if required for rinsing off the detergent/disinfectant.
 - Cleaning: Tap (utility) water is water that has not been processed. You can use tap water if it is not contaminated.
 - Disinfection: Critical water (sterile water, water that is extensively treated to ensure microorganisms, inorganic, and organic materials are removed).
 - Non-linting cloths
 - Cotton swabs
 - Disposable gloves
- Replace soiled or dry wipes or non-linting cloths as needed.



- Do not use sharp tools to clean the device.
- Do not damage or bend connector pins when cleaning or disinfecting.
- Do not use a dripping cloth on surfaces.

Permitted cleaning and disinfection agents

GE used Super Sani-Cloth wipes during cleaning and disinfection efficacy validation. This cleaning agent is not listed in preference to other available cleaning agents which may also perform satisfactorily.

The following products are compatible with the devices and may be used for cleaning and disinfection. It should be noted that the generic agents have not been validated.

All third party trademarks are property of their respective owners.

Trademark names and product availability may vary in different countries. Consult the column that lists ingredients to determine if an equivalent disinfectant is available in your country.

When using other than validated cleaning or disinfection agents, note the following:

- Use only soft, non-linting cloths.
- Prepare and use the agent according to the manufacturer instructions.
- Let the disinfectant remain on the device surface according to the manufacturer instructions.

Product	Manufacturer	Type of Disinfectant	Active Ingredients*
70-96%Ethanol	Generic	Alcohol	Ethanol (CAS 64-17-5)
Clinell wipes Universal - Green	GAMA Healthcare	Quaternary ammonium	• 2-Phenoxyethanol (CAS 122-99-6) ≤0.6% • Benzalkonium chloride (CAS 68424-85-1) ≤0.6% • Didecyltrimethyl ammonium chloride (CAS 7173-51-5) ≤0.6% • Biphenyl-2-ol (CAS 90-43-7) ≤0.1%
Terralin liquid	Shülke & Mayr GmbH	Alcohol	• Propan-1-ol (CAS 71-23-8) 35% • Ethanol (CAS 64-17-5) 25%
Oxivir TB wipes	Diversey	Hydrogen peroxide	• Benzyl alcohol (CAS 100-51-6) 1-5% • Hydrogen peroxide (CAS 7722-84-1) >0.1 - <1%
Incidine oxy wipes	Ecolab	Hydrogen peroxide	Hydrogen peroxide (CAS 7722-84-1) ≥ 1 - < 2.5
Mikrozid universal wipes	Shülke & Mayr GmbH	Alcohol	• Ethanol (CAS 64-17-5) 12.6% • Propan-2-ol (CAS 67-63-0) 17.4%

Product	Manufacturer	Type of Disinfectant	Active Ingredients*
Super Sani-Cloth® Germicidal Disposable Wipe (Purple)	PDI	Quaternary ammonium and alcohol	- Isopropyl alcohol (CAS 67-63-0) 55.5% - Quaternary ammonium compounds, C12-18-alkyl [(ethylphenyl) methyl] dimethyl, chlorides (CAS 68956-79-6) 0.25% - n-Alkyl Dimethyl Benzyl Ammonium Chloride (CAS 68391-01-5) 0.25%
Clorox hydrogen peroxide wipes	Clorox	Hydrogen peroxide	- Hydrogen peroxide (CAS 7722-84-1) 0.5-2% - Benzyl alcohol (CAS 100-51-6) 1-5%
Reynard premier detergent and disinfectant wipes	Reynard	Quaternary ammonium	- Didecyl dimethyl ammonium chloride (CAS 7173-51-5) <5% - C12/16 Alkyl dimethyl benzyl ammonium chloride (CAS 68424-85-1) <5% - C12/14 Alkyl dimethylethyl benzyl ammonium chloride (CAS 854090-23-0) <5%
Rely+on Virkon	LANXESS	Organic salts and organic acids	Concentrate is dissolved to a 1% solution. Concentrate contains: - Pentapotassium bis(peroxymonosulphate bis(sulphate)) (CAS 70693-62-8) >30 - <50% - Malic acid (CAS 6915-15-7) >20 - <30% - Sulphamidic acid (CAS 5329-14-6) >5 - <10% - Sodium dodecylbenzenesulfonate (CAS 25155-30-0) >1 - <5% - Potassium hydrogensulphate (CAS 7646-93-7) >1 - <5% - Dipotassium peroxodisulphate (CAS 7727-21-1) 1 - <5% - Dipotassium disulphate (CAS 7790-62-7) 1 - <5%
Bleach max. 5.25% by volume mixed with water in the ratio of 1:10	Generic	Chlorine	Sodium hypochlorite (CAS 7681-52-9) 0.525 %
70% IPA	Generic	Alcohol	Isopropyl alcohol (CAS 67-63-0)
Sani-Cloth Bleach Germicidal Disposable Wipes	PDI	Chlorine	Sodium hypochlorite (CAS 7681-52-9) 0.63%
PDI Easy Screen Cleaning Wipes	PDI	Alcohol	Isopropyl alcohol (CAS 67-63-0) 70%
Getinge Clean ^{*1}	Getinge	Enzymatic or neutral pH detergents	Enzymatic or neutral pH detergents
* Ingredients, if applicable. Listed as indicated in the disinfectant package or Material Safety Data sheet at the time of publishing this manual. All generic agents: check the minimum disinfection times as per your healthcare facility guidelines.			
^{*1} The agent can only be used for cleaning.			

Do NOT use any of the following to clean the device because they may damage its surfaces:

- Organic solvents
- Abrasive cleaners or solvents of any kind
- Acetone
- Ketone
- Betadine
- Sodium salts

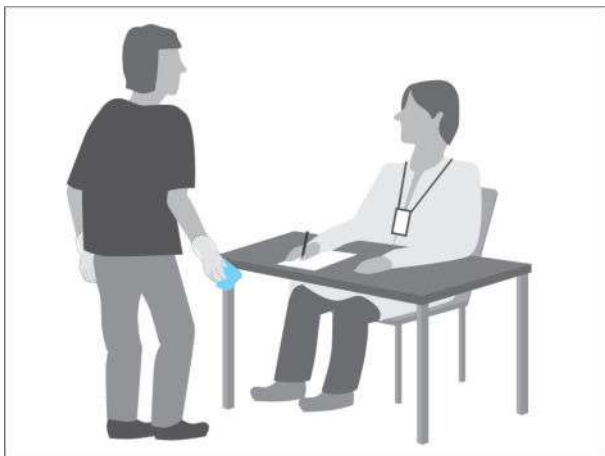
How to clean and disinfect

Before started

Your professional healthcare facility guidelines permitting, all cleaning activities can be carried out at the bedside.

Please consult clinical personnel to determine and operate the following options:

- Lock the touchscreen, if patient during monitoring. Or,
- Discharge patient, and disconnect cables or devices if between patients.



NOTE

It is recommended the cleaning/disinfection operation person ask the clinician whether can start your cleaning and disinfection process.

Cleaning during patient monitoring



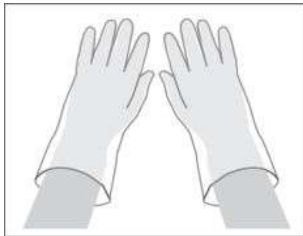
If cleaning is permitted during patient monitoring, do NOT clean any part of the system that is directly in contact with the patient. Otherwise, there may be a risk of contamination, loss of monitoring, or contact of detergents with the patient's skin.

**NOTE**

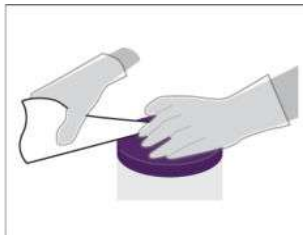
Follow this procedure only when there is a patient connected to the monitor.

Cleaning the monitor during monitoring

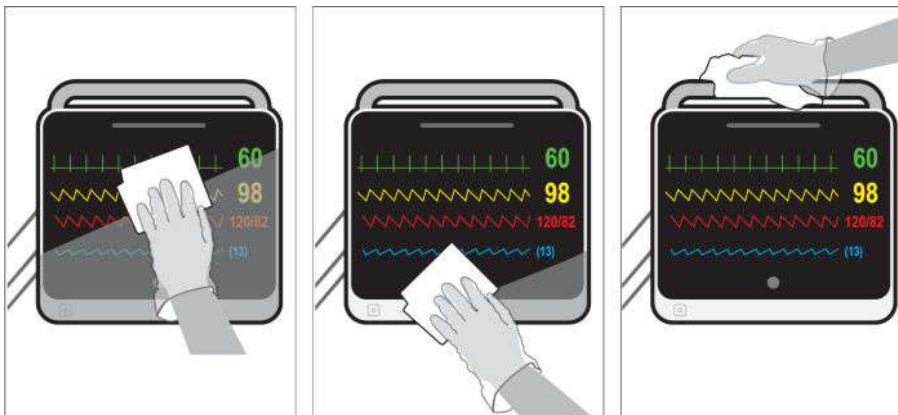
1. Put on new gloves.



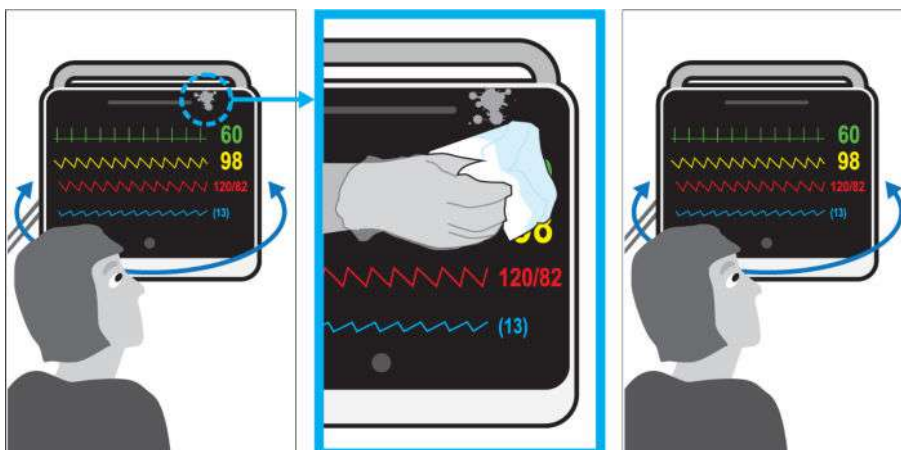
2. Get a new wipe or dampen a soft non linting cloth with one of the permitted detergents.



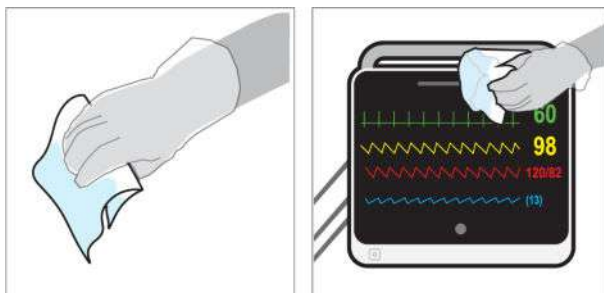
3. Wipe the device's exterior surface. Remove any soil by wiping the device until soil and organic matter have been visibly removed.



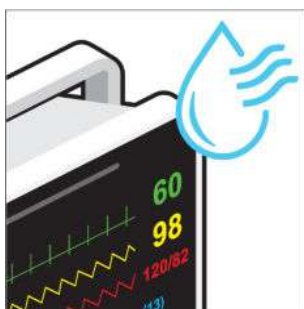
4. Inspect the device to ensure the complete removal of soil from surfaces, cavities, and movable parts. If visible soil remains, repeat cleaning procedure until the device is thoroughly clean.



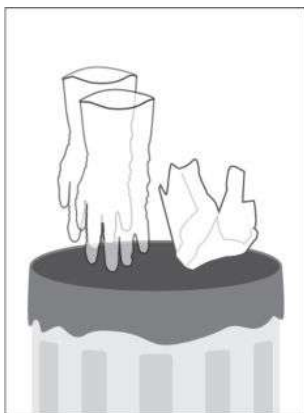
5. If required, rinse the device thoroughly using a soft non-linting cloth saturated with lukewarm water (temperature range 27 to 44 °C, 81 to 111 °F).



6. Allow the device to air dry until it is visibly dry. Drying times may vary based on the environmental conditions.



7. Discard disposable wipes and gloves according to your professional healthcare facility guidelines. Do not reuse wipes or gloves.



Cleaning and disinfection between patients



NOTE

Follow this procedure only when there is no patient connected to the monitor and no ongoing monitoring.

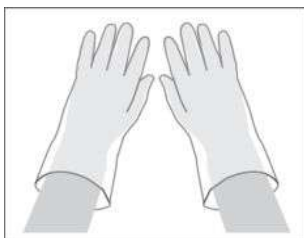
Cleaning and disinfecting the monitor between patients



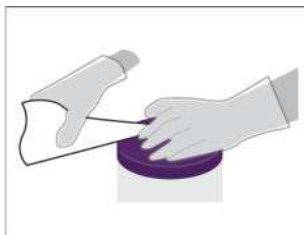
NOTE

Clean the devices thoroughly prior to disinfection. Follow these instructions.

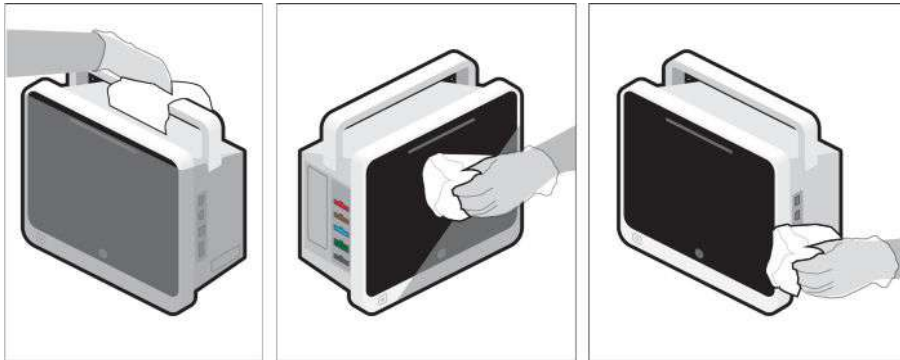
1. Put on new gloves.



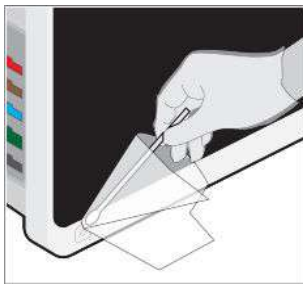
2. Get a new wipe or dampen a soft non linting cloth with one of the permitted detergents.



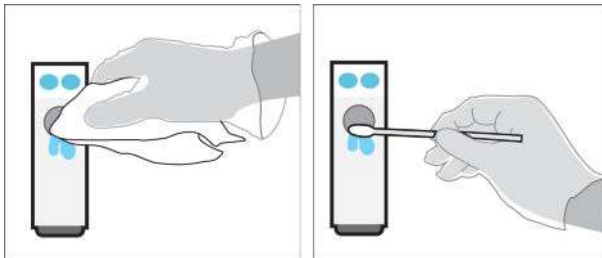
3. Wipe the device's exterior surface. Remove any soil by wiping the device until soil and organic matter have been visibly removed.



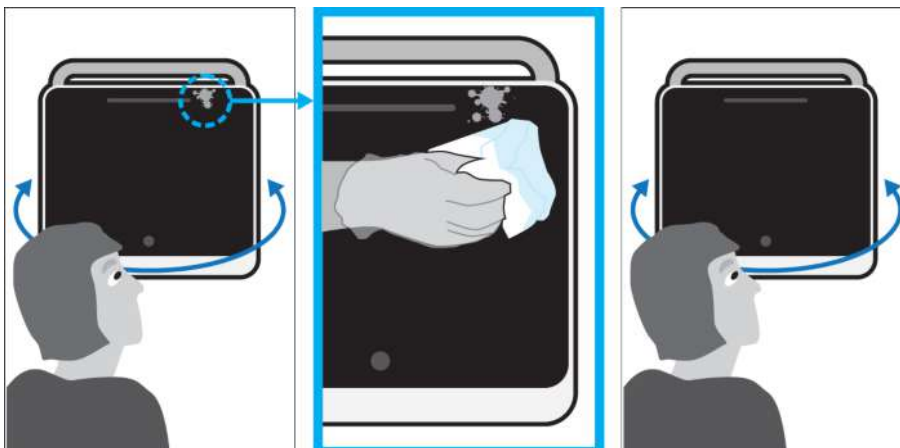
Pay special attention to hard-to-clean areas like grooves and crevices. Scrub these areas with a cotton swab inside a wipe.



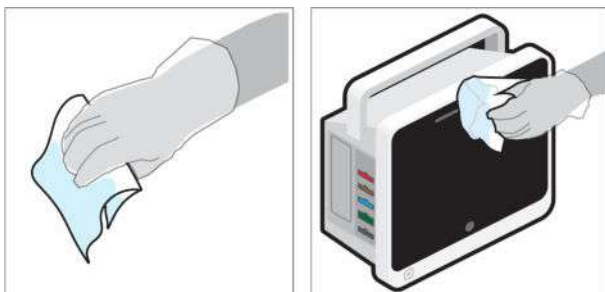
4. Ensure there is no liquid pooling around connection pins. If this happens, blot dry with a cotton swab or soft non-linting cloth.



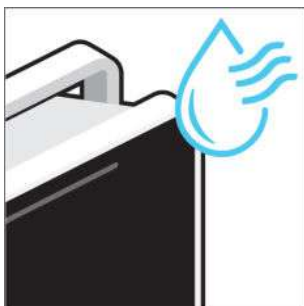
5. Inspect the device to ensure the complete removal of soil from surfaces, cavities, and movable parts. If visible soil remains, repeat cleaning procedure until the device is thoroughly clean.



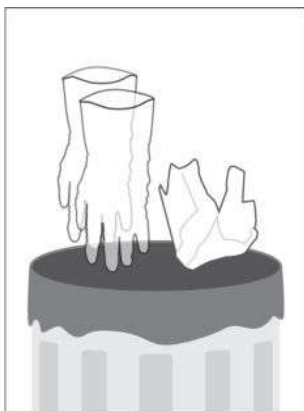
6. If required, manually rinse the device by wiping it for 30 seconds using a sterile, soft, non-linting cloth saturated with lukewarm water (temperature range 27 to 44°C, 81 to 111°F).



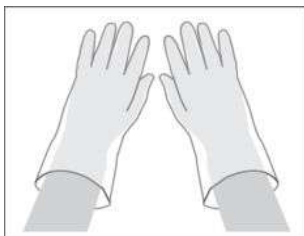
7. Allow the device to air dry until it is visibly dry. Drying times may vary based on the environmental conditions.



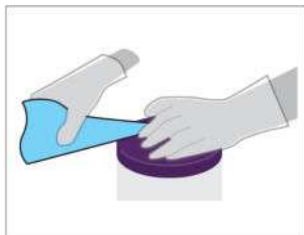
8. Discard disposable wipes and gloves according to your professional healthcare facility guidelines. Do not reuse wipes or gloves.



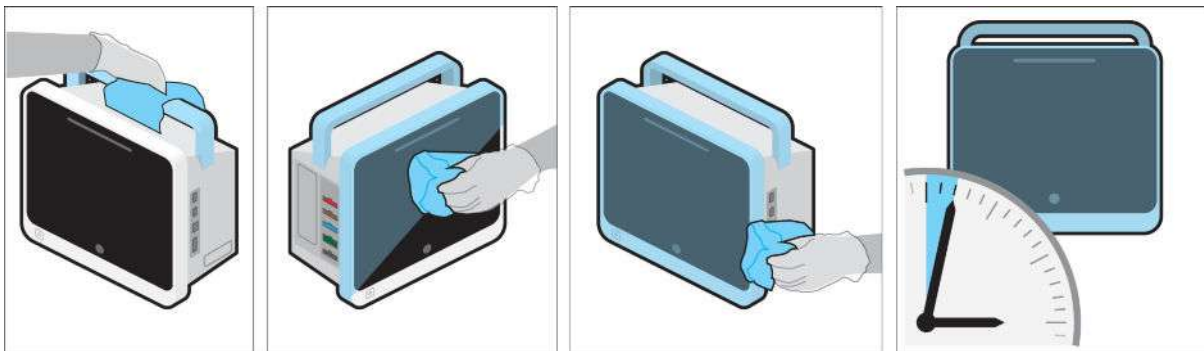
9. Start disinfection by putting on new gloves.



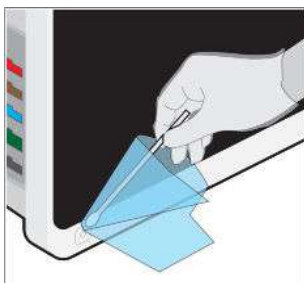
10. Get a new wipe.



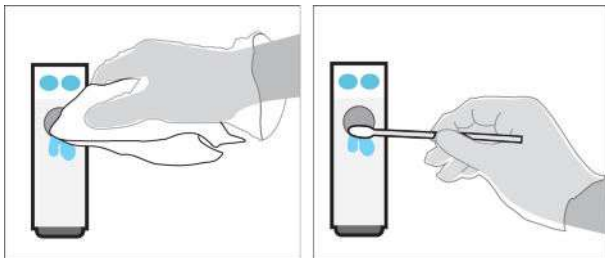
11. Wipe the device surface. Make sure all surfaces are uniformly wiped. Treated surfaces must remain visibly wet for a minimum of two minutes (Super Sani-Cloth) or according to the disinfectant manufacturer's instructions. To ensure this, use additional disinfectant wipes as necessary.



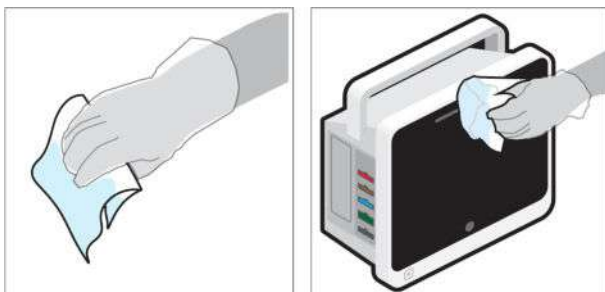
Pay special attention to hard-to-clean areas, like grooves and crevices. Scrub these areas using a cotton swab inside the wipe.



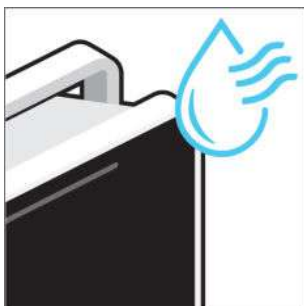
12. Ensure there is no liquid pooling around the pins. If this happens, blot dry with a cotton swab or soft non-linting cloth.



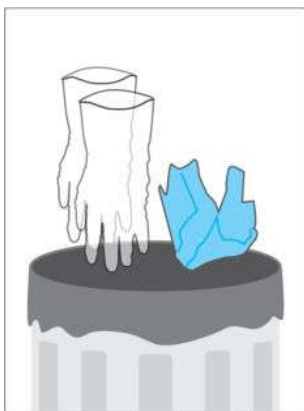
13. If required, manually rinse the device by wiping it for 30 seconds using a sterile, soft, non-linting cloth saturated with critical water (temperature range 27 to 44°C, 81 to 111°F).



14. Allow the device to air dry until it is visibly dry. Drying times may vary based on the environmental conditions.



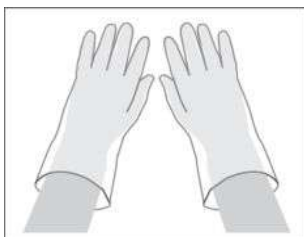
15. Discard disposable wipes and gloves according to your professional healthcare facility guidelines. Do not reuse wipes or gloves.



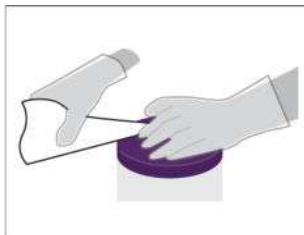
Cleaning and disinfecting the B1X5-F2 frame between patients

Following is the cleaning procedure between patients for B1X5-F2 frame.

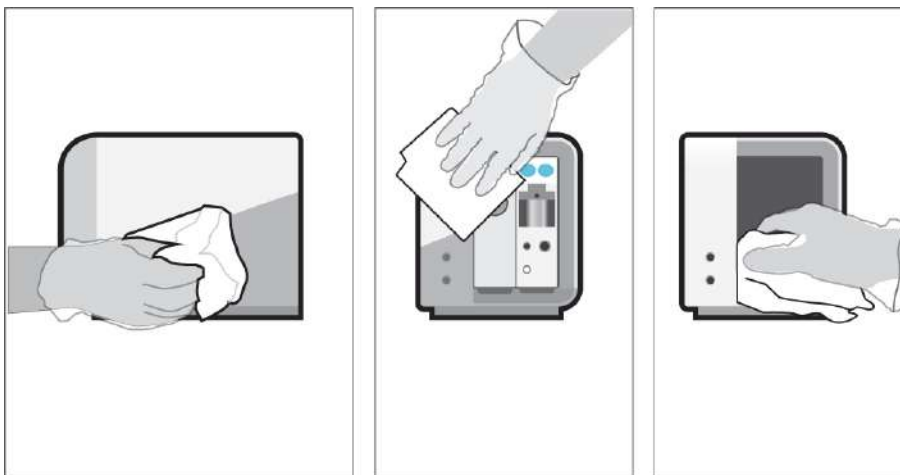
1. Put on new gloves.



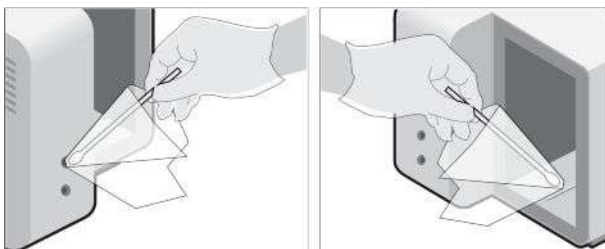
2. Get a new wipe or dampen a soft non linting cloth with one of the permitted detergents.



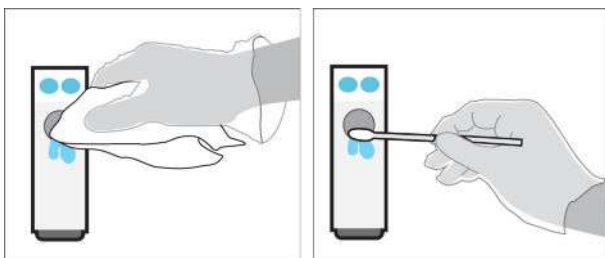
3. Wipe the device's exterior surface. Remove any soil by wiping the device until soil and organic matter have been visibly removed.



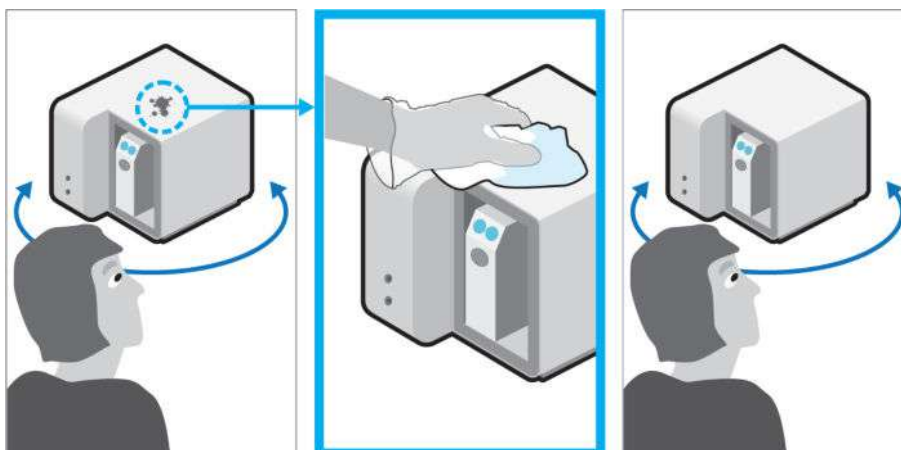
Pay special attention to hard-to-clean areas like grooves and crevices. Scrub these areas with a cotton swab inside a wipe.



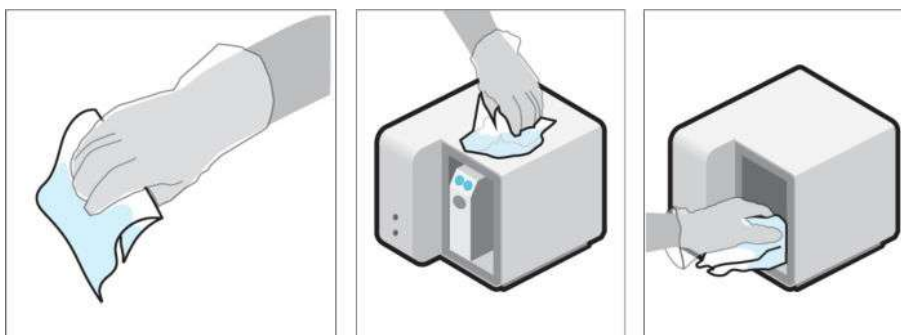
4. Ensure there is no liquid pooling around connection pins. If this happens, blot dry with a cotton swab or soft non-linting cloth.



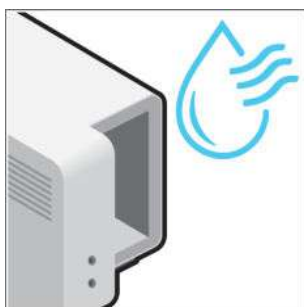
5. Inspect the device to ensure the complete removal of soil from surfaces, cavities, and movable parts. If visible soil remains, repeat cleaning procedure until the device is thoroughly clean.



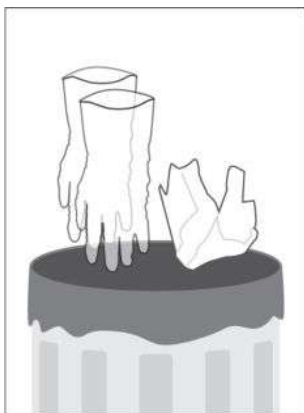
6. If required, manually rinse the device by wiping it for 30 seconds using a sterile, soft, non-linting cloth saturated with lukewarm water (temperature range 27 to 44 °C, 81 to 111 °F).



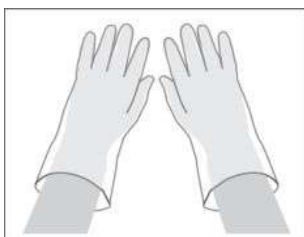
7. Allow the device to air dry until it is visibly dry. Drying times may vary based on the environmental conditions.



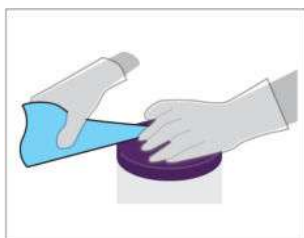
8. Discard disposable wipes and gloves according to your professional healthcare facility guidelines. Do not reuse wipes or gloves.



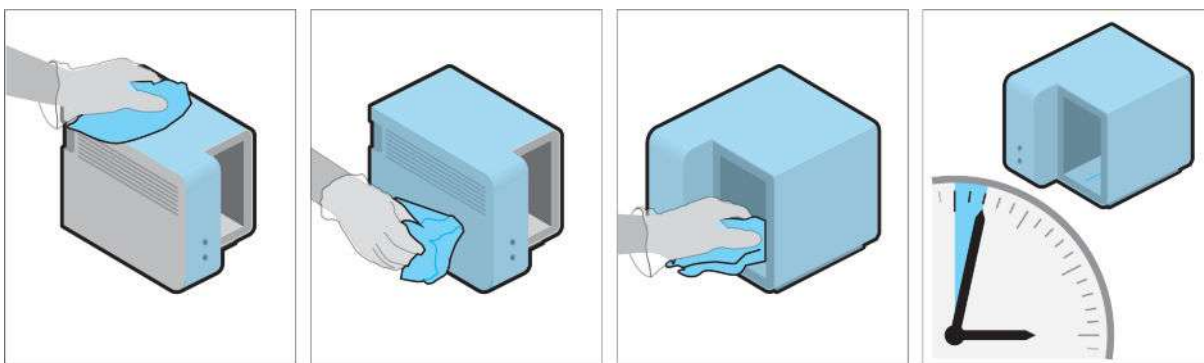
9. Start disinfection by putting on new gloves.



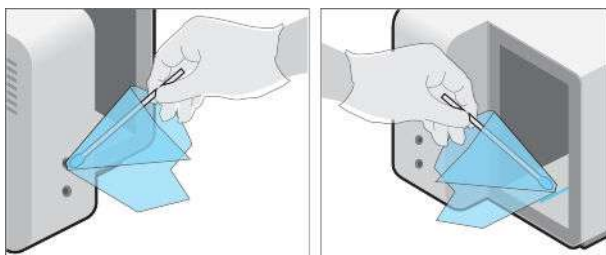
10. Get a new wipe.



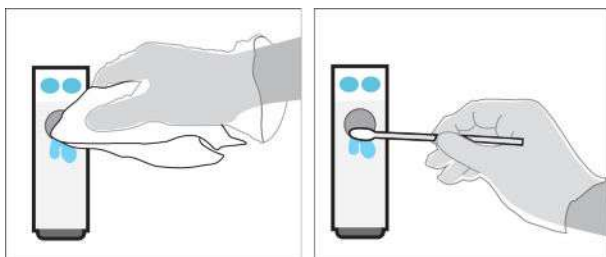
11. Wipe the device surface. Make sure all surfaces are uniformly wiped. Treated surfaces must remain visibly wet for a minimum of two minutes (Super Sani-Cloth) or according to the disinfectant manufacturer's instructions. To ensure this, use additional disinfectant wipes as necessary.



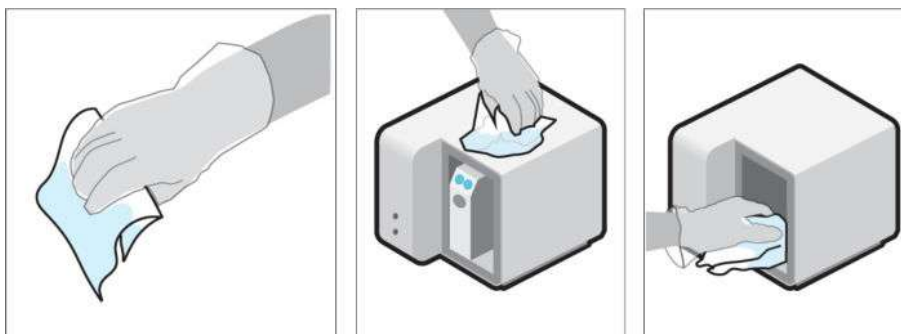
Pay special attention to hard-to-clean areas, like grooves and crevices. Scrub these areas using a cotton swab inside the wipe.



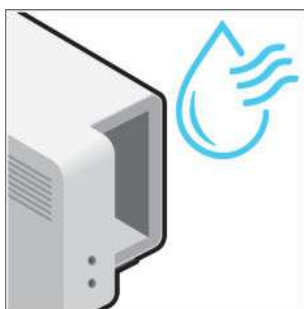
12. Ensure there is no liquid pooling around the pins. If this happens, blot dry with a cotton swab or soft non-linting cloth.



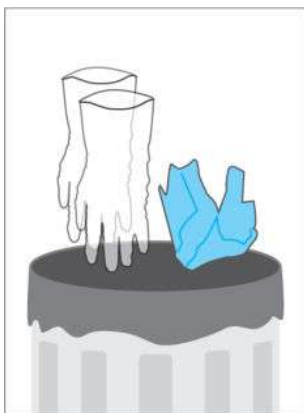
13. If required, manually rinse the device by wiping it for 30 seconds using a sterile, soft, non-linting cloth saturated with critical water (temperature range 27 to 44°C, 81 to 111°F).



14. Allow the device to air dry until it is visibly dry. Drying times may vary based on the environmental conditions.

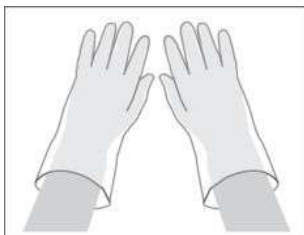


15. Discard disposable wipes and gloves according to your professional healthcare facility guidelines. Do not reuse wipes or gloves.

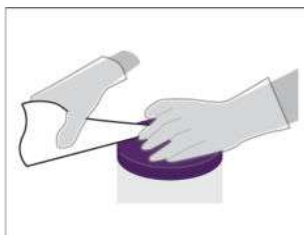


Cleaning and disinfecting the B1X5-REC recorder between patients

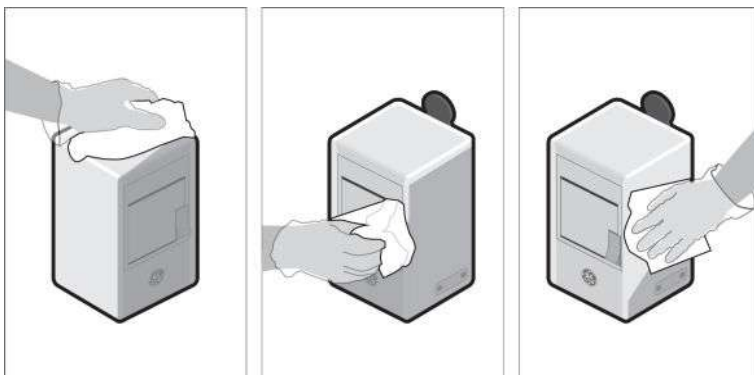
1. Put on new gloves.



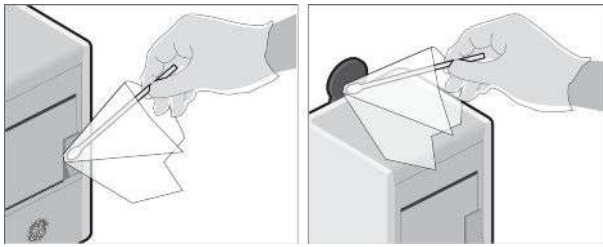
2. Get a new wipe or dampen a soft non linting cloth with one of the permitted detergents.



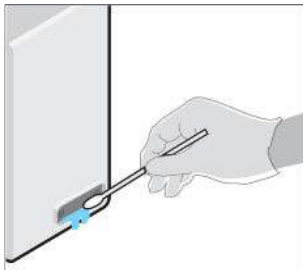
3. Wipe the device's exterior surface. Remove any soil by wiping the device until soil and organic matter have been visibly removed.



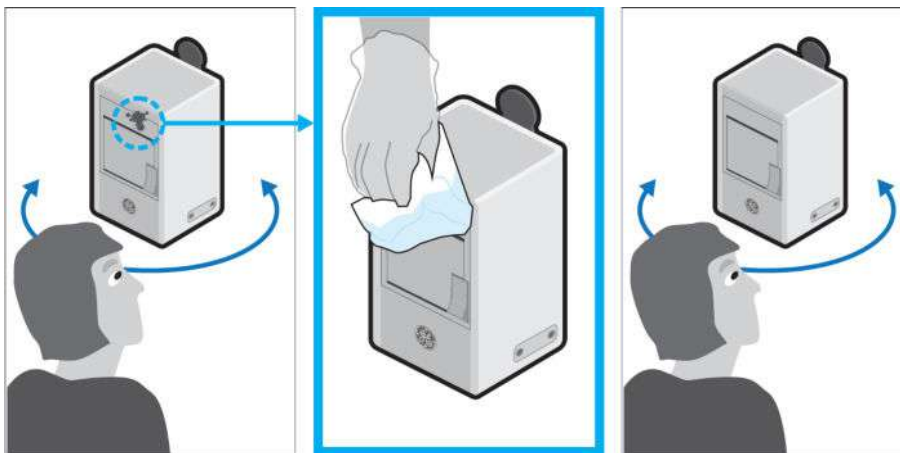
Pay special attention to hard-to-clean areas like grooves and crevices. Scrub these areas with a cotton swab inside a wipe.



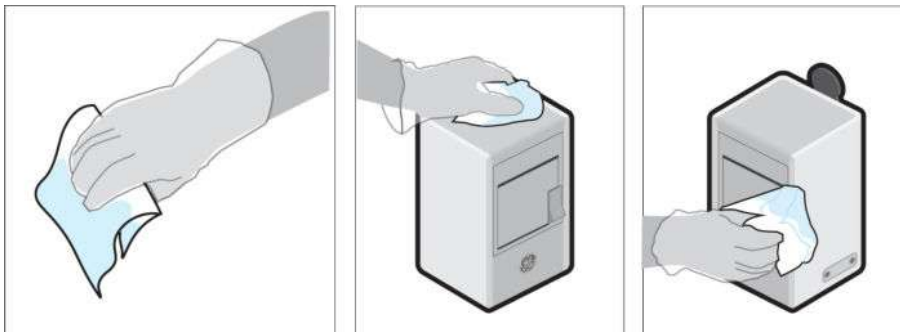
4. Ensure there is no liquid pooling around connection pins. If this happens, blot dry with a cotton swab or soft non-linting cloth.



5. Inspect the device to ensure the complete removal of soil from surfaces, cavities, and movable parts. If visible soil remains, repeat cleaning procedure until the device is thoroughly clean.



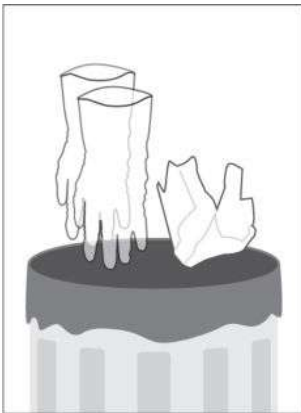
6. If required, manually rinse the device by wiping it for 30 seconds using a sterile, soft, non-linting cloth saturated with lukewarm water (temperature range 27 to 44 °C, 81 to 111 °F).



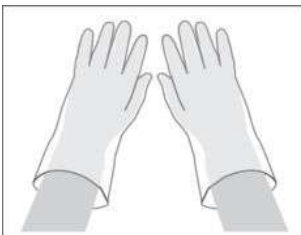
7. Allow the device to air dry until it is visibly dry. Drying times may vary based on the environmental conditions.



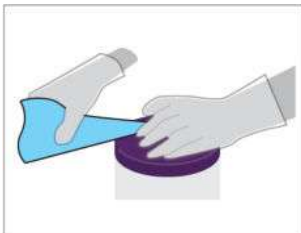
8. Discard disposable wipes and gloves according to your professional healthcare facility guidelines. Do not reuse wipes or gloves.



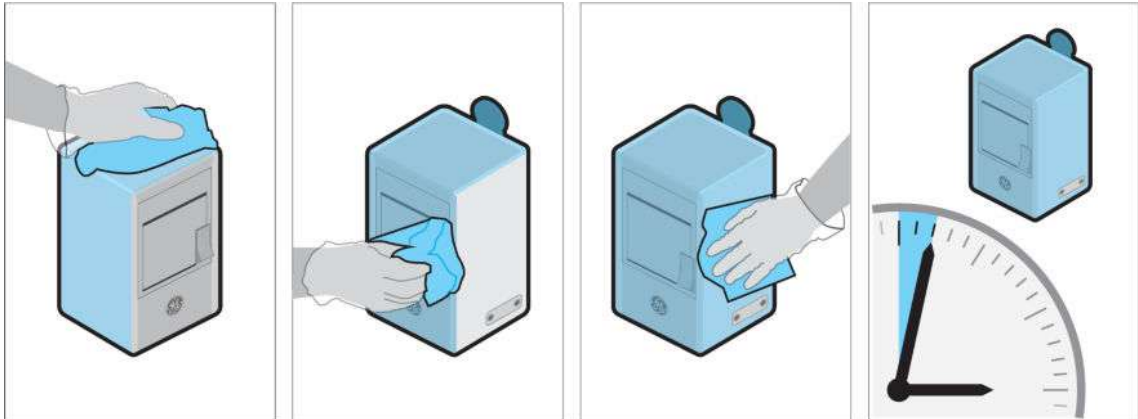
9. Start disinfection by putting on new gloves.



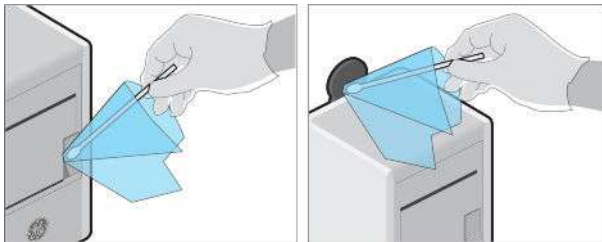
10. Get a new wipe.



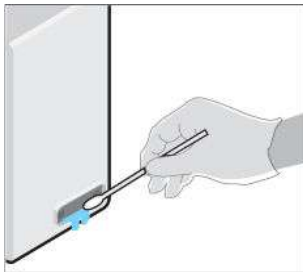
11. Wipe the device surface. Make sure all surfaces are uniformly wiped. Treated surfaces must remain visibly wet for a minimum of two minutes (Super Sani-Cloth) or according to the disinfectant manufacturer's instructions. To ensure this, use additional disinfectant wipes as necessary.



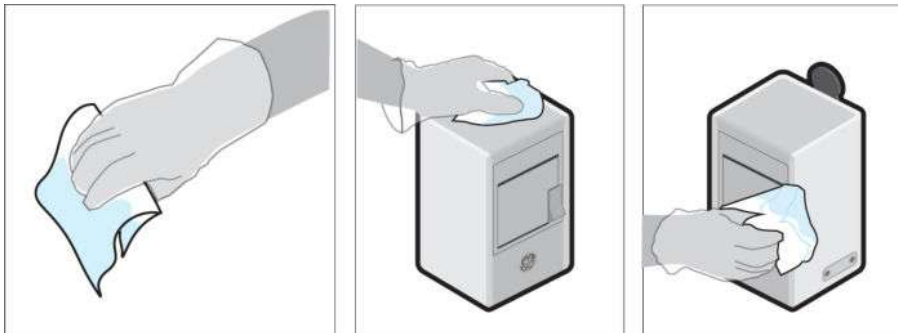
Pay special attention to hard-to-clean areas, like grooves and crevices. Scrub these areas using a cotton swab inside the wipe.



12. Ensure there is no liquid pooling around the pins. If this happens, blot dry with a cotton swab or soft non-linting cloth.



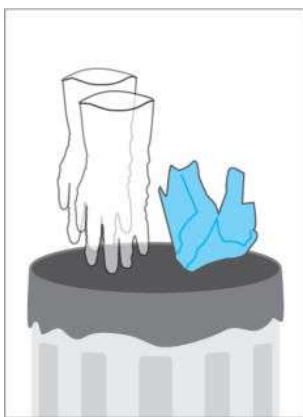
13. If required, manually rinse the device by wiping it for 30 seconds using a sterile, soft, non-linting cloth saturated with critical water (temperature range 27 to 44°C, 81 to 111°F).



14. Allow the device to air dry until it is visibly dry. Drying times may vary based on the environmental conditions.



15. Discard disposable wipes and gloves according to your professional healthcare facility guidelines. Do not reuse wipes or gloves.



Additional information

- The cleaning and disinfection information is provided in accordance with ANSI/AAMIST81, ISO 17664. The instructions have been validated as capable of preparing non-sterile medical devices. It remains the responsibility of the professional healthcare facility to ensure that the cleaning and disinfection are performed according to these instructions, using appropriate equipment, materials, and personnel, so that the desired result is achieved. This requires validation and routine monitoring of the process.
- Personnel should wear appropriate Personal Protective Equipment (PPE) when cleaning and disinfecting devices in accordance with their local blood-borne pathogen guidelines.

Troubleshooting

ECG troubleshooting

Problem	Solution
ECG signal is noisy or no QRS is detected	• Ensure that the patient is not shivering. • Select the correct filter by selecting the HR digit field > Advanced tab > Waveform Filter. • Check the electrode quality and positioning. Do not place electrodes on body hair, bones close to skin, layers of fat and major muscles. Pre-gelled electrodes are recommended. • Change the lead in ECG1 to the best available signal. • Consider using Size > 2x. • Try on alternative location for the V lead to improve signal quality. • Check all cable connectors.

Pacemaker detection troubleshooting

Problem	Solution
How does activating pacemaker detection impact monitoring?	• Beats that would otherwise be classified as ventricular are instead classified as V-paced if a ventricular pacemaker event is detected. • Residual pacemaker energy that might otherwise appear in the ECG is removed, and a pacemaker enhanced spike is placed in the ECG. • On the ECG waveform, pacemaker detection is indicated by uniform, upright pacemaker enhancement spikes in the ECG data, both displayed and graphed.
How can pacemaker detection be improved?	• Possible problems include: ◦ Heart rate double counting. ◦ Inaccurate alarms for low heart rate or asystole. ◦ Pacemaker spikes not recognized by the software. ◦ False PVC detections and arrhythmia alarms. • Possible solutions include: ◦ Relearn arrhythmia. ◦ Re-prepare the patient skin, replace the electrodes, and adjust the electrode placement. ◦ Try an alternate electrode placement. ◦ Switch to another pacemaker detection mode.

Problem	Solution
Why is the monitor double-counting the heart rate, alarming for a low heart rate, or not detecting pacemaker spikes?	The monitor is not detecting pacemaker activity. Causes may include: • The pacemaker signal is too weak for the monitor to detect. • The ECG signal is too weak for the monitor to detect. • The monitor is detecting atrial pacemaker artifact or non-QRS features as beats. If the monitor is alarming for low heart rate or asystole, assess the QRS amplitude: • View all ECG leads to assess the amplitude of the QRS complexes. To ensure correct HR readings, a 0.5 mV QRS amplitude is recommended for a normal ECG signal. If the QRS amplitude drops below 0.5 mV or an abnormal QRS width occurs (more than 120 ms), QRS detection may be reduced, leading to false asystole alarms. • If necessary, reprep the skin and reposition the electrodes. • Relearn ECG.

Arrhythmia troubleshooting

Problem	Solution
Why is the monitor alarming for asystole, bradycardia, or inaccurate heart rate when a visible QRS waveform is present?	The monitor may not be detecting sufficient QRS amplitude in all analyzed leads. Multiple leads are used for arrhythmia processing. 1. Assess the patient. 2. Check the ECG signal acquired from the patient. 3. View all ECG leads to assess the amplitude of the QRS complexes. To ensure correct HR readings, a 0.5 mV QRS amplitude is recommended for a normal ECG signal. If the QRS amplitude drops below 0.5 mV or an abnormal QRS width occurs (more than 120 ms), QRS detection may be reduced, leading to false Asystole alarms. 4. Relearn arrhythmia. It is important to relearn the patient's ECG pattern any time the electrode configuration is adjusted. 5. The ECG size settings affect the arrhythmia detection and heart rate calculation. Increase the ECG size by selecting a value from the Size list.
Why is the monitor calling V Tach when the patient is not in V Tach?	The monitoring system may be detecting a wider QRS complex or artifact in some of the analyzed ECG waveforms. In addition, the V leads may be exhibiting polarity changes, which may occasionally cause an inaccurate call. 1. Assess the patient. 2. Check the ECG signal acquired from the patient. • View all ECG leads to assess the width of the QRS complexes in the analyzed leads. • If artifact exists in any of the analyzed leads, reprep the patient's skin, replace electrodes, and adjust the electrode placement. • It may be beneficial to move V lead electrodes (chest lead) to alternate precordial electrode placements to improve detection. 3. Relearn arrhythmia. It is important to relearn the patient's ECG pattern any time the electrode configuration is adjusted.

Respiration troubleshooting

Problem	Solution
What can I do if the respiration measurement fails?	• Check electrode quality (e.g. that the gel is not dry) and positioning. • Other electrical devices may interfere with the measurement. Reposition as needed.

Problem	Solution
Respiration rate value variations are too fast.	Contact an authorized clinical user and ask them to increase the Resp Averaging Time in the UI.
Respiration rate value responds too slowly.	Contact an authorized clinical user and ask them to decrease the Resp Averaging Time in the UI.
Respiration rate values are too low and trigger false alarms	In some rare cases the respiration rate and pulse rate values of the patient may be very close to each other, resulting in too low respiration rate values and false alarms.
Respiration rate value is 0, but there is no apnea alarm.	Respiration rate may be shown as 0 without an apnea alarm if the patient's respiration frequency and amplitude are very low. Apnea alarm appears if there are no detected breaths during user-configurable apnea alarm time.
What if the respiration signal is poor?	The signal may be disturbed by motion, the electrode placement may be poor, or the electrode gel may be dry. Reposition the electrodes or replace the respiration patch as needed.
What does motion artifact look like, what problems can it cause, and how can it be corrected?	Motion artifact occurs with excessive motion of the patient. In other words, for example the patient moving his upper body can cause motion artifact. Motion artifact can be reduced, if not eliminated, by good skin to electrode contact and optimal placement of the respiration electrodes.

SpO₂ troubleshooting

Problem	Solution
SpO ₂ signal is poor	- Check the sensor and sensor position. - Make sure the patient is not shivering, moving, or does not have tremors. - The patient's pulse may be too low to measure.
Why does the pulse oximeter sometimes read differently to a blood gas analyzer?	Blood gas analyzers calculate the O ₂ saturation based on normal values for pH, PaCO ₂ , Hb, temperature, etc. (i.e., a normal oxyhemoglobin dissociation curve). Depending on the patient's physiological and metabolic status, this curve and all values may be shifted away from normal. Thus the oximeter, which measures O ₂ saturation, may not agree with the blood gas.
What effect can ambient light have on pulse oximetry monitoring?	Light sources such as surgical lamps, bilirubin lamps, fluorescent lights, infrared heating lamps, and sunlight can cause poor waveform quality and inaccurate readings. Error messages are possible. Shielding the sensor with opaque tape, a Posey wrap, or other dark or opaque material can increase oximetry accuracy, verified by good waveform and signal strength.
What does electrosurgical interference look like and how can it be minimized?	Electrosurgical interference is most obvious on the displayed waveform. It is a very spiky, erratic looking waveform caused by the electrosurgical unit's overwhelming interference. It can result in grossly inaccurate pulse oximeter results. Electrosurgical interference can be minimized by: - Making sure the pulse oximeter sensor is as far away from the return pad and operating site as possible. - Making sure the sensor is not between the return pad and operating site. - Keeping the power cord and sensor cable away from the power cord of the electrosurgical unit. - Plugging the electrosurgery unit into a separate set of outlets from the monitor.

Problem	Solution
What does motion artifact look like, what problems can it cause, and how can it be corrected?	For the device using Nellcor OxiMax technology, the main problem motion artifact can cause is erroneous SpO₂ readings. Motion artifact occurs with excessive motion of the sensor, the cable leading to the sensor, or the cable/sensor junction. In other words, anything that causes any of these things to move, like the patient moving his hands, or the cable lying across the ventilator tubing and being moved with every cycle, can cause motion artifact. A non-arterial, often erratic looking waveform and a pulse rate that does not coincide with the heart rate on the ECG will result. Motion artifact can be reduced, if not eliminated, by selecting a “quieter” site on the patient. An ear sensor if the hands do not remain still, an adhesive sensor on the toe, or an adhesive sensor on the little finger for an adult or on the sole of the foot in a newborn can help greatly. Cable movement can be reduced by applying the sensor with the cable leading toward the patient, then taping the cable to the side of the hand or foot. The cable and sensor can also be stabilized with a stress loop near the sensor. Tape the stress loop to the patient (excluding children). In the case of the butterfly sensor, the tape was designed to secure the cable to the finger. It has been noted that letting the patient view the SpO₂ waveform enables the patient to assist in reducing motion artifact.
Why is the digit field not displayed on the monitor after connecting the SpO ₂ interface cable and sensor?	No SpO₂ data is displayed due to hardware failure or an unrecognized or defective sensor. • Make sure the accessories are compatible with the monitor. • Make sure the sensor is attached to the interface cable and the cable is connected to the monitor. • Change the sensor. • Change the cable. If the problem persists, contact authorized service personnel.

SPI troubleshooting

Basic SPI troubleshooting

Problem	What to do
AoA Split Screen is not shown	• Configure the AoA Split Screen to the screen. • Make sure that both Entropy and SPI are being measured.
BalView dot is missing in the AoA Split Screen	• Make sure that both Entropy and SPI are being measured.
SPI color is gray	• Wait until the message Learning disappears. • Wait for the NIBP measurement to finish. • Try to ensure that the plethysmogram is as artifact-free as possible.
SPI measurement is not available	• Check that SPI is licensed in your configuration. • Configure SPI into a digit field. • Check the connections and compatibility.

Problem	What to do
SPI values seem incorrect	• Check the sensor contact and position on the finger. • Check the compatibility of the sensor and measurement device. • Assess the patient. Check that the plethysmogram is as artifact-free as possible. • SPI only works with fully anesthetized patients. • Anticholinergic agents may increase SPI values. Refer to SPI points to note on page 167 for other possible reasons why SPI values may seem incorrect.
SPI values shown as ---	• Check the connections and compatibility. • Wait for the measurement to start. • If possible, do not place the NIBP cuff on the same arm.
SpO ₂ signal is poor	• Assess the patient and the measurement site.

Advanced SPI troubleshooting

If you feel that a reading is not correct, first confirm the clinical status of the patient and consult the troubleshooting and messages tables, as well as the measurement limitations section.

- Check your sensor and the sensor site.
- Assess the trends and values of other monitored parameters, especially blood pressure, body temperature, capnogram.
- Confirm the use of anesthetics and other drugs.
- Assess for the possibility of clinical stimulation arising from a non-nociceptive origin (for example: severe hypovolemia or hypothermia may cause SPI responses similar to, but not originating from, nociception. They are not related to inadequate analgesia.)

After your assessment is complete, consider the appropriate interventions. These may include pharmacological or non-pharmacological interventions such as intravenous fluid administration, patient/sensor temperature factors, etc.

Factors that affect the hemodynamic stability of the anesthetized patient may affect the SPI, as well. In some special situations, the SPI may not correctly indicate the nociception-antinociception balance. These situations can be:

- Severe arrhythmia affecting pulse interval or pulse amplitude
- Medications directly affecting both the autonomic nervous system and the hemodynamic system
- A paradoxical response to treatment, for example in elderly hypotensive patients

NIBP troubleshooting

Problem	Solution
NIBP measurement does not work or the values seem unstable.	• Check that the cuff tubing is not bent, stretched, compressed, or loose. • Check the cuff position and cuff tube connection. • Prevent motion artifact. • Use NIBP cuffs of correct size.

Problem	Solution
Why does the mean value display while the associated systolic and diastolic values display as --?	Assess the patient and perform a visual inspection of the equipment to ensure system integrity. The following conditions may cause the mean value to display in the NIBP digit field while the associated systolic and diastolic values display as --: • Very low systolic and diastolic amplitude fluctuations (e.g., patient in shock). • Very small difference between the mean and systolic pressure or the mean and diastolic pressure. • Loss of system integrity (e.g., loose connections or worn parts)
Why is the monitor re-inflating the cuff automatically?	The cuff target pressure must be higher than the patient's systolic pressure to obtain an accurate systolic and diastolic measurement. If a systolic blood pressure cannot be found, a systolic reading is searched for by re-inflating the cuff to a higher pressure. During a systolic search, the maximum cuff inflation pressure will not exceed the normal pressure range of the cuff. For more information, refer to the technical specifications.

Invasive pressure troubleshooting

Problem	Solution
Invasive pressure readings seem unstable.	• Make sure there are no air bubbles in the transducer systems. • Flush and zero. • Place the transducer on the patient's phlebostatic axis.
Invasive pressure waveform is displayed but no numeric values are displayed.	• Zero the channel. Invasive pressure numeric values are displayed only for successfully zeroed channels.
Zeroing of invasive pressure channel(s) fails.	• Ensure that the channels are open to air.
The measurement values in the SPV and PPV parameter window are not displayed.	• Ensure that there are no arrhythmia present. • Check that the correct arterial site has been selected as the SPV source. • SPV and PPV is not available in NEONATAL mode. • The algorithm requires at least three pulse beats per each respiration cycle and when this is not true, the values are not shown.
Why are displayed pressure values different than expected?	• Check the patient. Values could be valid, the patient could be lying on the tubing, or the tubing could be kinked. • Check tubing for bubbles. • Remove excess tubing. • Check phlebostatic axis placement of transducer. • Rezero pressure.

Problem	Solution
Why are the arterial, non-invasive (oscillometric), and auscultated blood pressure readings indicating different values?	The three measurement methods use different technologies. Auscultation and oscillometric are both indirect methods of measuring blood pressure. In auscultation, changes in arterial sounds during cuff deflation are related to systolic and diastolic pressure. With oscillometric measurement, changes in measured pressure oscillations during cuff deflation are related to systolic, mean and diastolic pressures. Changes in the vascular tone of the arterial system can cause these two indirect methods to differ from one another and from direct arterial pressure measurements. Invasive arterial blood pressure is a direct method of measuring blood pressure. Differences between direct and indirect blood pressure measurements are expected. These differences occur because direct methods measure pressure and indirect methods measure flow. In addition, differences occur because the measurement location is not the same (e.g., brachial artery for NIBP vs. radial artery for invasive arterial pressure monitoring).
Why is the monitor alarming arterial line disconnect?	• Check the patient immediately in the event the catheter has been dislodged. • If the mean pressure falls below 10 mmHg, the monitor alarms. When zeroing a pressure line, start the zeroing process within 8 seconds. After that time the disconnect alarm is activated. • If zeroing, close the stopcock. Once the monitor detects the return of waveform and numeric data, the alarm will reset.
Why can't the monitor detect PA wedge?	The monitor must detect a 30% decrease in waveform amplitude to initiate a wedge. • Use the manual method for PA wedge measurement.
Why is the monitor displaying a message indicating that it is processing the wedge when the balloon has not been inflated?	• Begin wedge processing again. If a wedge is again detected due to respiratory artifact on the PA waveform, use the manual method for wedge measurement.
Why is monitor displaying the Deflate the balloon message after the balloon was inflated?	The monitor must detect a 30% decrease in waveform amplitude to initiate a wedge. If the waveform does not change accordingly, the message will continue to be displayed.
Why is the displayed wedge measurement different than expected?	• Repeat the wedge measurement, allowing a minimum of three respiratory cycles of data. • Verify end-expiration using the respiratory waveform on the display and observing the patient's breathing pattern. Vertical cursors help to identify the end-expiration and align it with the PA pressure waveform. • Adjust the PA wedge cursor to the end-expiratory wedge value if necessary.

Temperature troubleshooting

Problem	Solution
Temperature measurement fails	• Check that the temperature cable is properly connected to the monitor. • Check that the probe is properly connected to the temperature cable or interconnect cable. • Check that you are using the correct probe for the anatomical location being monitored. • Use a probe that is compatible with your system. • Try using a known good probe in case the sensor is damaged. • Check the patient connection. • Check that there are not two identical acquisition modules in the system. • If the problem persists, contact authorized service personnel.

C.O. troubleshooting

Problem	Solution
C.O. measurement fails?	The amount of injectate is too small or the injectate is too warm. • Inject smoothly and within 4 to 5 seconds.
What if the C.O. value is lower than expected?	Cardiac output must be computed within 20 seconds. Decreasing the volume and increasing the temperature will give you a smaller differential change and should increase the chance of computing a cardiac output within the 20-second period. • Decrease the volume injected. • Increase the temperature of the injectate.
What if the C.O. value is higher than expected?	Cardiac output must be computed within 20 seconds. Increasing the volume and decreasing the temperature will give you a greater differential change. • Increase the volume injected. • Decrease the temperature of the injectate.
What if a stable baseline temperature cannot be detected?	A message indicating a failure is displayed. • Check the patient and the C.O. setup (both the settings and the cables). • Check for a significant amount of respiratory variation and for rapid IV solution infusion, either of which may influence the baseline temperature. It may be necessary to stop or slow the solution infusion during C.O. measurement, however, use caution if the solution includes drugs/medication. • Check the injectate temperature (IT). There should be a minimum temperature difference of 10° C (18° F) between the patient blood temperature and the injectate solution temperature. Cool the injectate solution if needed to increase the difference. • Replace the injectate temperature cable. • The pulmonary artery catheter may be damaged. Replace it.

Problem	Solution
What if the cardiac output values are inaccurate?	When in-line is being used along with iced injectate, the initial temperature displayed will be the room temperature. However, when the solution is injected, the temperature displayed will decrease. • Technique. It is important to understand the technique used in performing a cardiac output since it is a major influencing factor in obtaining accurate cardiac output values. ◦ If room temperature solution is used, be sure the bag is not exposed to a supplemental heat source or touching other solutions or equipment. This is important so the solution temperature will be the same as the room air temperature sensed through the bath or in-line probe. Any difference in temperature could give an inaccurate reading. ◦ When injecting, always hold the syringe by the plunger and not by the barrel. The temperature of the solution increases at a slower rate if the barrel is not held, and therefore reduces the potential for error in a cardiac output value. ◦ It is recommended that you inject rapidly and smoothly into the proximal port of the pulmonary artery catheter, within 4 to 5 seconds. ◦ Allow the baseline to stabilize between injections. If automatic program is not being used, allow one minute between injections. If automatic program is being used, follow the monitor prompts to inject. ◦ It is also recommended that you inject at the patient's end expiration. This helps reduce any respiratory noise and therefore lessens error. ◦ A minimum difference of 10° C (18° F) between the patient blood temperature and solution/injectate temperature is recommended. • Respiration. The patient's inspiratory/expiratory cycle and placement of the catheter affects the cardiac output value. Whenever the patient inhales and exhales, the temperature in the lung changes. During inspiration, the patient's blood temperature decreases and during expiration it increases. Therefore, placement of the catheter in relation to proximity of the lung fields affects the baseline. If there is a significant amount of respiratory noise on the patient's baseline, cardiac output may be calculated even if no injection was performed. There is no differentiation between temperature change caused by breaths versus injections. It simply looks for a change in baseline temperature. • Baseline blood temperature. As little as a half a degree Celsius change in blood temperature due to respiratory noise may cause a C.O. value to be displayed when an injection has not been performed. Using auto mode looks for a stable baseline before allowing an injection. • Pulmonary artery catheter. The catheter itself may be damaged (e.g., defective thermistor or defective tubing). • Hemodynamics. The patient's rhythm can affect the cardiac output value. If cardiac output trials are being done at a time when the patient has arrhythmias, you may notice a discrepancy in the cardiac output values. • Rapid IV solutions. Any rapid IV solution that is infusing at the time when the solution is injected can alter the cardiac output value. Maintain a constant rate, or if possible, stop the solution 30 seconds before the C.O. injection and then restart the infusion after the cardiac output is calculated. • Injectate temperature fluctuation. If the injectate temperature is fluctuating, check the injectate temperature cable connection.
What if cardiac output is being calculated even though solution has not been injected?	There may be a change in the patient's blood temperature consistent with an injection. • Check the patient and the C.O. setup (both the settings and the cables). • Check for a significant amount of respiratory variation and for rapid IV solution infusion, either of which may influence the baseline temperature. It may be necessary to use the manual cardiac mode rather than the automatic mode.

Airway gases troubleshooting

Problem	Solution
Airway gas values seem too low	- Check the sampling line and connectors for leakage. - Check the patient status. - Check the arterial blood gas values.
Airway gas values seem too high	- Check the sampling line for blockage. - Check the patient status. - Check the arterial blood gas values.
Module does not work	- Check and clean the filter if necessary. - Check the water trap and water trap connectors. Liquid may have entered the module. Replace the module and have it checked by authorized service personnel.
No airway gas values	- Check that the gas sampling line is connected to the water trap. - Check that the gas sampling line is connected to the patient.
Gas measurement values show off and there is a message on screen indicating standby.	Turn on the gas module pump by selecting CO₂ digit field > Start Gas Module pump.
Why can we see dips in the capnogram during expiration?	The dips seen in the capnogram during expiration are related to the sidestream gas sampling, the continuous gas flow to the Y-piece, and patient's cardiac contractions, which cause intra-thoracic pressure changes and therefore flow variations.
Why can we see variations in the oxygram during inspiration?	Changes in the fresh gas flow rate and oxygen concentrations affect the shape of the oxygram during inspiration. Rule out any potential clinical complications such as hypoventilation, hyperventilation, circuit hypoxia, disconnection.
Why is the EtCO ₂ value considerably lower than the CO ₂ partial pressure determined by blood gas analysis?	- The major clinical reasons are dead-space ventilation, ventilation/perfusion mismatch, a drop in cardiac output, alveolar shunts, and incomplete emptying of the alveoli. - Also check the following technical issues: integrity of the breathing circuit; blood-gas analysis corrected to a lower temperature in case of hypothermia.
Why is the EtCO ₂ value unexpectedly higher than the CO ₂ partial pressure determined by blood gas analysis?	- Gas sensor is measuring gases in Dry (ATPD) conditions. Selecting Wet (BTPS) humidity compensation type activates calculations where the EtCO₂ value is normalized to assume 100 %RH and 37 °C. Wet compensation is not done if EtCO₂ is shown in %. - Check the humidity compensation type through  >  Service > Parameter Settings > Others > CO2 Numbers. This setting is password protected.

Spirometry troubleshooting

Problem	Solution
No measurement values	- Check that the device has license for this function. - Check connection to the anesthesia machine. - Check anesthesia machine's status.
Values seem unstable or erroneous.	The device only displays the reference data obtained from the anesthesia machine. For more clinical troubleshooting, see the instructions for use of the anesthesia machine.

Entropy troubleshooting

Problem	Solution
Entropy values seem unstable	• Check that the sensor is not dried out. • Check the sensor attachment and placement. • Check the patient status.
Entropy EEG signal is noisy	• Remove disturbing equipment from the proximity of the Entropy module or sensor. • Check the sensor's contact with skin. • Check electrodes.
Entropy EEG signal is poor	• Check the sensor's contact with skin. • Check electrodes.
Entropy EEG waveform and numbers do not correspond	• Check raw EEG as impedance check may cause a temporary increase in the numeric values. • Check the patient's overall status.
Entropy readings seem inconsistent with the patient status	• Check raw EEG for QRS or other artifact. • Check electrode placement.
There is a sudden drop in values.	A sudden drop in values can be caused by the following: • Bolus administration of intravenous anesthetics. • Increase in inhalation anesthesia level. • Administration of other medication affecting EEG/FEMG.
There is an unexpected increase in values.	An unexpected increase in values can be caused by the following: • Change in infusion pump settings for intravenous anesthetics. • Change in vaporizer settings, or fresh-gas flow rate. • Volume loading with infused fluids. • Fault in the operation of anesthetic delivery systems. • Impedance check.

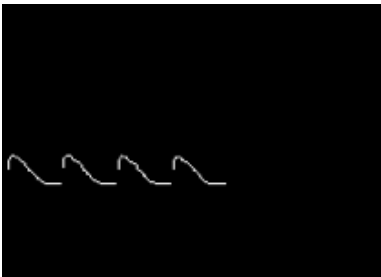
NMT troubleshooting

Verifying measurement reliability

Measurement reliability can be easily verified from the waveform display. Both the ElectroSensor and MechanoSensor have characteristic response waveforms as presented in other sections of this manual. If the waveforms do not follow the characteristic curves, the NMT measurement has failed and corrective action should be done.

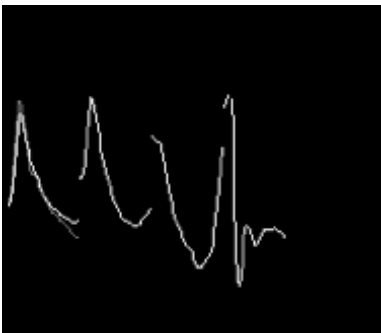
Faulty measurements with ElectroSensor

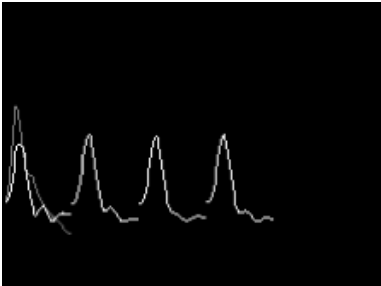
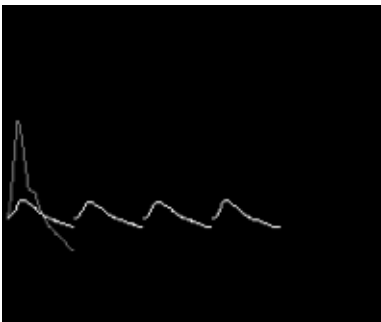
Examples of NMT waveforms produced by possibly faulty ElectroSensor measurements are displayed below:

Example waveform	Problem	What to do
	Ground electrode (black lead) is off.	Attach electrode.
	Ground electrode (black lead) contact is poor.	Fix electrode contact.
	Either of the measurement electrode contacts is poor.	Fix both electrodes.

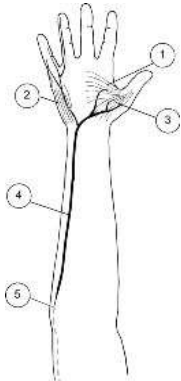
Faulty measurements with MechanoSensor

Examples of NMT waveforms produced by possibly faulty MechanoSensor measurements are displayed below:

Example waveform	Problem	What to do
	Faulty TOF measurement.	Repeat the measurement ensuring there is no external interference.

Example waveform	Problem	What to do
	MechanoSensor is not attached properly.	Fix attachment.
	Thumb bending is blocked.	Check hand and give room for bending.

Troubleshooting other problems

Problem	Solution
NMT reference search and measurement fail.	- Check the electrode quality and positioning. - Replace stimulating electrodes.
What can I do if the monitor does not find the supramaximal stimulation current?	- If the monitor is unable to find the supramaximal stimulation current, check the electrode placement. The nerve may be outside the dense current flow or both the ulnar and median nerves may be stimulated; progressively more muscle activity is detected as the increasing stimulation current activates new motor units. Consult the figure below when placing the electrodes:  - adductor pollicis - abductor digiti minimi (hypothenar) - flexor pollicis brevis (thenar) - ulnar medial - epicondyle - Also, supramaximal current may not be found if the patient has anatomical and/or physiological anomalies.

Problem	Solution
Difficulty in getting the response when locating the nerve for plexus stimulation	- You may try using the local muscle response as an indication of current in the needle. If there is no response, the needle may be broken. - Change the needle if necessary.

BIS troubleshooting

Problem	Solution
Measurement does not start	- Check sensor attachment to the patient and the sensor placement. - Check the sensor's contact with skin. - Check the sensor type. - Check all cable connections. - Check the digital signal processing unit.
BIS signal is poor	- Check the sensor's contact with skin. - Check the sensor. - Ensure that the digital signal processing unit is not close to any electrical radiating equipment.
What happens during the BISx self test?	The BISx self test tests the digital signal acquisition and conversion functions. The test reports pass/fail status, noise, high-pass blocked, high-pass normal and gain values. If any of the self tests fail, contact authorized service personnel.
What if the sensor does not pass the sensor check?	- The sensor check may fail for the following reasons: - Impedance too high. - Incorrect sensor application. - Poor sensor connection. - Defective patient interface cable or sensor. To correct the situation: - Recheck the sensor. - Reapply the sensor according to instructions. - Check sensor connection. - Replace patient interface cable or sensor.

Messages

Messages related to ECG measurement

For information regarding alarm priorities and escalation times, see the supplemental information manual.

Make sure you are familiar with the generic layout of the screen. This will help you identify where on screen the following messages appear. The message location is indicated with the following abbreviations:

- MF = message field
- WF = waveform field
- DF = digit field

Message	Location	Possible causes	Suggested actions
• Alarm setup changed from Central	• MF	Any of the ECG alarms (HR, ST alarms) are turned ON/OFF or its limits are adjusted from the Central.	• Check the alarm settings at the Central.
• Arrhythmia Paused	• WF	ECG channels have not been available for analysis for the last 20 seconds or the internal HR calculation has not been updated for the last 30 seconds due to excessive artifact.	• Check patient status. • Check electrode placement. • Prepare the patient's skin at electrode sites. • Change or move electrodes.
• Arrh Paused	• MF		
• Asystole	• MF, WF	Physiological alarm.	• Check patient status.
• ASY	• DF		
• Artifact	• WF	Muscle artifact or high/low frequency noise.	• Check electrode contact. • Check lead placement. • Perform skin preparation. • Reposition/replace electrodes. • Request the patient to remain still.
• Brady	• MF, WF	Physiological alarm.	• Check patient status.
• ECG measurements removed	• MF	Lost ECG measurement.	• If the problem persists, contact authorized service personnel.
• ECG module error	• MF	The ECG module communication problem.	• If the problem persists, contact authorized service personnel.
• Frequent PVCs • Frequent SVCs	• MF, WF	Physiological alarm.	• Check patient status.
• Incompatible ECG firmware	• MF	The ECG firmware is not compatible, or the version is too old.	• If the problem persists, contact authorized service personnel.
• Lead off	• MF	One or more leadwires or electrodes disconnected. Other ECG leads are available for arrhythmia detection.	• Check the leadwire and electrode connections.

Message	Location	Possible causes	Suggested actions
• LA/L lead off • LL/F lead off • RA/R lead off • RL/N lead off • V/C lead off • V2/C2 lead off • V3/C3 lead off • V4/C4 lead off • V5/C5 lead off • V6/C6 lead off	• WF		
• Lead changed	• WF	The monitor automatically switches the ECG1 waveform selection to a measurable ECG Lead (I, II, III, aVR, aVL, aVF, V1, V2, V3, V4, V5 or V6) if the current ECG1 waveform is not measurable.	• Check the lead. (Note that the ECG waveform changes according to the lead it is measured from.)
• Leads off	• MF, WF	One or more of the connected electrodes is disconnected and arrhythmia detection is not possible.	• Check the connections.
• ST Ant high • ST Ant low • ST Inf high • ST Inf low • ST Lat high • ST Lat low	• MF	Physiological alarm.	• Check patient status. • Adjust alarm limits if necessary.
• Tachy	• MF, WF	Physiological alarm.	• Check patient status.
• V Fib / V Tach	• MF, WF	Physiological alarm.	• Check patient status.
• V Tach	• MF, WF	Physiological alarm.	• Check patient status.
• VT > 2	• MF, WF	Physiological alarm.	• Check patient status.
• R on T	• MF, WF	Physiological alarm.	• Check patient status.
• V Brady	• MF, WF	Physiological alarm.	• Check patient status.
• Couplet	• MF, WF	Physiological alarm.	• Check patient status.
• Bigeminy	• MF, WF	Physiological alarm.	• Check patient status.
• Accel. Ventric.	• MF, WF	Physiological alarm.	• Check patient status.
• Trigeminy	• MF, WF	Physiological alarm.	• Check patient status.
• Multifocal PVCs	• MF, WF	Physiological alarm.	• Check patient status.
• A Fib	• MF, WF	Physiological alarm.	• Check patient status.
• Irregular	• MF, WF	Physiological alarm.	• Check patient status.
• Missing Beat	• MF, WF	Physiological alarm.	• Check patient status.
• Pause	• MF, WF	Physiological alarm.	• Check patient status.
• SV Tachy	• MF, WF	Physiological alarm.	• Check patient status.

Messages related to impedance respiration measurement

For information regarding alarm priorities and escalation times, see the supplemental information manual.

Make sure you are familiar with the generic layout of the screen. This will help you identify where on screen the following messages appear. The message location is indicated with the following abbreviations:

- MF = message field
- WF = waveform field
- DF = digit field

Message	Location	Possible causes	Suggested actions
• Apnea (Imped.) • Apnea • APN	• MF • WF • DF, WF	No breathing detected.	• Check patient status. • Check the ventilator and the patient's breathing status.
• Apnea deactivated	• DF	The case has recently been patient admitted on the monitor, or the measurement has just been started.	• No action required. The message disappears after the monitor detects breaths.
• Check electrodes	• WF, DF	The electrodes touch together.	• Check the electrodes and their connections.
• Lead I failed • Lead II failed • Lead RL-LL failed	• WF, DF	One of the electrodes is off.	• Check the electrodes and their connections.
• Learning	• WF, DF	The patient's breathing pattern is being learned because the measurement has just been started or because of very large artifacts in the signal.	• Wait until the message disappears.
• Measurement off • OFF	• WF, DF • DF	ECG leads are not connected to the patient. Measurement has been turned off from the setup menu.	• Connect the ECG leads to the patient to start the impedance respiration measurement. • Turn on the measurement from the setup menu.
• Resp artifact	• WF, DF	Artifact has been detected.	• Check patient status. • Check electrode placement and skin to electrode contact. • Select alternate leads to monitor. • Adjust average time.
• RR (Imped.) high • RR (Imped.) low	• MF	Measurement values are equal to or outside the set alarm limits.	• Check patient status. • Adjust alarm limits if necessary.
• Small resp curve	• DF	Signal amplitude < 0.4 Ohm	• Check patient status. • Check the electrodes placement.

Messages related to SpO₂ measurement

For information regarding alarm priorities and escalation times, see the supplemental information manual.

Make sure you are familiar with the generic layout of the screen. This will help you identify where on screen the following messages appear. The message location is indicated with the following abbreviations:

- MF = message field
- WF = waveform field
- DF = digit field

Message	Location	Possible causes	Suggested actions
• Check Device	• DF	Only for Masimo type. Module malfunction.	• If the problem persists, contact authorized service personnel.
• Check SpO₂ probe	• MF	There is no detectable SpO ₂ signal, the sensor is faulty or is detached from the patient.	• Check the sensor and connections.
• Check Probe	• DF		
• Faulty Probe	• DF	The sensor has failed, or not compatible.	• Replace the sensor.
• Identical SpO₂ modules	• MF	There are two or more identical SpO ₂ modules are connected to the same monitor.	• Remove identical SpO ₂ modules.
• Incompatible Probe	• DF	Only for GE TruSignal or Masimo type. The sensor is not compatible.	• Replace the sensor.
• Incompatible SpO₂ Probe	• MF	The sensor is not compatible.	• Replace the sensor.
• Interference	• DF	Only for Nellcor or Masimo type. The measurement is disturbed.	• Check the sensor.
• Low Perfusion	• DF	Only for Masimo type. Low perfusion at the measurement point.	• Check the sensor and sensor positioning. • Relocate the sensor to a better measurement site, if possible. • Make sure the patient is not shivering.
• Low signal quality	• DF	Only for Masimo type. The quality of the signal is questionable.	• Check the sensor and sensor positioning. • Relocate the sensor to a better measurement site, if possible. • Make sure the patient is not shivering.
• No SpO₂ probe • No Probe	• MF • DF	Sensor is not connected to the monitor. Sensor is not compatible.	• Check connection between the sensor and the monitor. • Replace the sensor.
• No SpO₂ pulse • No Pulse	• MF • DF	No pulses detected.	• Try another measuring site.

Message	Location	Possible causes	Suggested actions
• Poor Signal	• DF	Only for GE TruSignal type. When the low perfusion is detected.	• Check the sensor and sensor positioning. • Relocate the sensor to a better measurement site, if possible. • Make sure the patient is not shivering.
• Pulse Search	• DF	Defective or damaged sensor or cable. Sensor is off of the patient. Detection of a repeatable pulse has stopped.	• Check the sensor and cable. • Reposition or replace sensor.
• SpO2 faulty probe	• MF	The sensor has failed, or not compatible.	• Replace the sensor.
• SpO2 high • SpO2 low	• MF	Measurement values are equal to or outside the set alarm limits.	• Check patient status. • Adjust alarm limits if necessary.
• SpO2 measurement removed	• MF	Only for Nellcor or Masimo type. Lost SpO ₂ measurement.	• If the problem persists, contact authorized service personnel.
• SpO2 module error	• MF	Only for Nellcor or Masimo type. SpO ₂ module has encountered a communication problem.	• If the problem persists, contact authorized service personnel.
• STP module error	• MF	Only for GE SpO ₂ type. SpO ₂ module has encountered a communication problem.	• If the problem persists, contact authorized service personnel.
• Incompatible Masimo	• MF	The Masimo version is not compatible.	• Replace the sensor.
• Identical STP modules	• MF	Two or more GE STP modules are connected to the same monitor.	• Remove the identical STP modules.
• SpO2 probe off	• MF	The finger or earlobe may be too thin or the sensor is off the patient.	• Check patient status. • Reposition the SpO₂ sensor. • Replace the SpO₂ sensor.
• Probe Off	• DF		

Messages related to SPI measurement by GE TruSignal

For information regarding alarm priorities and escalation times, see the supplemental information manual.

Make sure you are familiar with the generic layout of the screen. This will help you identify where on screen the following messages appear. The message location is indicated with the following abbreviations:

- MF = message field
- WF = waveform field
- DF = digit field



NOTE

The SPI messages are shown in the **SE & SPI** digit field only if no Entropy messages are active at the same time.

Message	Location	Possible causes	Suggested actions
• Incompatible probe	• DF	The SpO ₂ and sensor combination are not compatible.	• Check the compatibility and change the sensor.
• Irregular pulse	• DF	Patient is having a cardiac arrhythmia. Since arrhythmia may affect pulse rate and amplitude, the SPI calculation is disabled.	• Check patient status.
• Learning	• DF	SPI is being initialized.	• When the measurement is started for the first time, the initialization will take 2 minutes.
• Noise	• DF	SpO ₂ signal or amplitude is poor. Artifacts are disturbing the measurement.	• Check the patient's hemodynamic stability. • Check the sensor contact and make sure nothing is pulling and/or rubbing against the sensor and that there is no constriction at the sensor site.
• NIBP cuff inflated	• DF	There may be some disturbances in the plethysmogram.	• See description of the measurement.
• No SpO₂ signal	• DF	There is no SpO ₂ sensor. The sensor or cable is faulty. The cable or sensor is not properly connected.	• Place the sensor on the patient's finger. • Replace the sensor or cable. • Check all connections.
• Place SpO₂ probe on finger for SPI measurement	• MF	The SPI measurement is not available for the new case.	• Attach the sensor on patient's finger.

Messages related to NIBP measurement

For information regarding alarm priorities and escalation times, see the supplemental information manual.

Make sure you are familiar with the generic layout of the screen. This will help you identify where on screen the following messages appear. The message location is indicated with the following abbreviations:

- MF = message field
- WF = waveform field
- DF = digit field

Message	Location	Possible causes	Suggested actions
• Call service: Error x where x = 0 - 18	• DF	Technical fault.	• Restart the monitor. • Contact authorized service personnel.
• NIBP call service error	• MF		
• Check NIBP	• MF	Systolic and/or diastolic results missing.	• Check patient status. • Check NIBP cuff and hoses. • Repeat the measurement.
• Cuff loose	• DF	Loose cuff or cuff hose.	• Check the cuff and cuff hose.
• Cuff occlusion	• DF	Occlusion during measurement or overpressured cuff.	• Check the cuff.

Message	Location	Possible causes	Suggested actions
• Cuff overpressure • NIBP cuff overpressure	• DF • MF	NIBP cuff has exceeded the maximum cuff pressure during an NIBP measurement.	• Check NIBP cuff and hoses.
• Long measurement time	• MF, DF	The measurement time is long. The triggering values vary according to the module and inflation limits in use: • >2 min for adult/ child, 75 s to 80 s for infant	• Check patient status. • Check the cuff and hose connections. • Restart the measurement.
• NIBP manual	• MF	During auto cycling • Loose cuff or cuff hose. • Long measurement time	• Check whether the cuff or the cuff hose are loose.
• NIBP cuff loose	• MF	Loose cuff or cuff hose.	• Check whether the cuff or the cuff hose are loose.
• NIBP cuff occlusion	• MF	Occlusion during measurement or overpressured cuff.	• Check the cuff.
• NIBP DIA high • NIBP DIA low • NIBP MAP high • NIBP MAP low • NIBP SYS high • NIBP SYS low	• MF	Measurement values are equal to or outside the set alarm limits.	• Check patient status. • Adjust alarm limits if necessary.
• NIBP measurement removed	• MF	Lost NIBP measurement.	• If the problem persists, contact authorized service personnel.
• Select cuff size	• MF	Cuff size has not been selected.	• Select a valid cuff size from NIBP menu.
• Unstable zero pressure	• DF	Pressure is unstable at start of the NIBP measurement.	• Check patient status. • Check hose and cuff position. • Repeat the measurement. • If the problem persists, contact authorized service personnel.
• Weak pulsation	• MF, DF	Weak or unstable oscillation signal.	• Check patient status. • Reposition the cuff. • Repeat the measurement.

Messages related to invasive pressures measurement

For information regarding alarm priorities and escalation times, see the supplemental information manual.

Make sure you are familiar with the generic layout of the screen. This will help you identify where on screen the following messages appear. The message location is indicated with the following abbreviations:

- MF = message field
- WF = waveform field
- DF = digit field

Message	Location	Possible causes	Suggested actions
• P1 over range • P2 over range • P8 over range	• MF	Measurement is over range, or the sensor is faulty. Transducer has not been zeroed correctly.	• Check the patient's pressure by alternative means. • Check the cable and connections. • Rezero the transducer. • Replace the sensor. • Replace the transducer. • If the problem persists, contact authorized service personnel.
• Over range > 320 mmHg • Over range > 43 kPa	• DF		
• P1 under range • P2 under range • P8 under range	• MF	Measurement is under range, or the sensor is faulty. Transducer has not been zeroed correctly.	• Check the patient's pressure by alternative means. • Check the cable and connections. • Rezero the transducer. • Replace the sensor. • Replace the transducer. • If the problem persists, contact authorized service personnel.
• P1, P2: Under range < -40 mmHg • P8: Under range < -30 mmHg • P1, P2: Under range < -5 kPa • P8: Under range < -4 kPa	• DF		
• ABP disconnect • Art disconnect • UAC disconnect	• MF	Invasive pressure line is disconnected.	• Check patient status. • Check connections. • If pressure drops because of zeroing, perform the zeroing process.
• ABP Sys high • ABP Sys low • ABP Mean high • ABP Mean low • ABP Dia high • ABP Dia low	• MF	Measurement values are equal to or outside the set alarm limits.	• Check patient status. • Adjust alarm limits if necessary.
• Art Sys high • Art Sys low • Art Mean high • Art Mean low • Art Dia high • Art Dia low	• MF	Measurement values are equal to or outside the set alarm limits.	• Check patient status. • Adjust alarm limits if necessary.
• Calibrated	• Menu	Channel calibrated successfully.	• Wait until the message disappears before starting a measurement.
• Calibrating	• Menu	Calibration of a channel is in progress.	• No action required.
• Failed	• Menu	Unsuccessful calibration.	• If the problem persists, contact authorized service personnel.
• Failed: P<100	• Menu	Unsuccessful calibration.	• If the problem persists, contact authorized service personnel.

Message	Location	Possible causes	Suggested actions
• CVP Sys high • CVP Sys low • CVP Mean high • CVP Mean low • CVP Dia high • CVP Dia low	• MF	Measurement values are equal to or outside the set alarm limits.	• Check patient status. • Adjust alarm limits if necessary.
• IBP1 Sys high • IBP1 Sys low • IBP2 Sys high • IBP2 Sys low • IBP8 Sys high • IBP8 Sys low • IBP1 Mean high • IBP1 Mean low • IBP2 Mean high • IBP2 Mean low • IBP8 Mean high • IBP8 Mean low • IBP1 Dia high • IBP1 Dia low • IBP2 Dia high • IBP2 Dia low • IBP8 Dia high • IBP8 Dia low	• MF	Measurement values are equal to or outside the set alarm limits.	• Check patient status. • Adjust alarm limits if necessary.
• ICP Sys high • ICP Sys low • ICP Mean high • ICP Mean low • ICP Dia high • ICP Dia low	• MF	Measurement values are equal to or outside the set alarm limits.	• Check patient status. • Adjust alarm limits if necessary.
• InvBP's not zeroed • Not Zeroed	• MF • DF	There is at least one invasive pressure channel that has not been zeroed.	• Perform zeroing for all channels.
• LAP Sys high • LAP Sys low • LAP Mean high • LAP Mean low • LAP Dia high • LAP Dia low	• MF	Measurement values are equal to or outside the set alarm limits.	• Check patient status. • Adjust alarm limits if necessary.
• No Px transducer	• MF	No transducer connected to the channel indicated in the message, or the sensor is faulty.	• Connect a transducer. • Check the cable and connections. • Replace the sensor. • Replace the transducer.

Message	Location	Possible causes	Suggested actions
- PA Sys high - PA Sys low - PA Mean high - PA Mean low - PA Dia high - PA Dia low	MF	Measurement values are equal to or outside the set alarm limits.	- Check patient status. - Adjust alarm limits if necessary.
STP measurements removed	MF	Lost GE SpO ₂ , Temperature, IBP measurement.	- Restart monitor. - If the problem persists, contact authorized service personnel.
- RAP Sys high - RAP Sys low - RAP Mean high - RAP Mean low - RAP Dia high - RAP Dia low	MF	Measurement values are equal to or outside the set alarm limits.	- Check patient status. - Adjust alarm limits if necessary.
- RVP Sys high - RVP Sys low - RVP Mean high - RVP Mean low - RVP Dia high - RVP Dia low	MF	Measurement values are equal to or outside the set alarm limits.	- Check patient status. - Adjust alarm limits if necessary.
- UAC Sys high - UAC Sys low - UAC Mean high - UAC Mean low - UAC Dia high - UAC Dia low	MF	Measurement values are equal to or outside the set alarm limits.	- Check patient status. - Adjust alarm limits if necessary.
- UVC Sys high - UVC Sys low - UVC Mean high - UVC Mean low - UVC Dia high - UVC Dia low	MF	Measurement values are equal to or outside the set alarm limits.	- Check patient status. - Adjust alarm limits if necessary.
Zero adj > 100 mmHg	DF	IBP channel zeroed to over 100 mmHg pressure.	- Repeat the transducer zeroing. - Replace the sensor. - Replace the transducer. - Re-zero the pressure channel.
Zeroed	DF	Zeroing was successful.	No action required. Message is automatically removed after 10 seconds.
Zeroing	DF	IBP channel is currently being zeroed.	No action required. Message is automatically removed and replaced with the zeroing results after completion.

Message	Location	Possible causes	Suggested actions
• Zeroing failed	• DF	Pulsating waveform detected. Defective transducer Offset is >150 mmHg.	• Open the transducer to room air and zero the channel. • Replace the transducer, open it to room air, and zero the channel.
• Zero ICP separately	• MF	The ICP channel must be zeroed separately from all other invasive pressures.	• Zero the channel using the Zero option found under the ICP channel setup menu.
• Out of range	• DF	Measurement is over range, or the sensor is faulty. Transducer has not been zeroed correctly.	• Check the patient's pressure by alternative means. • Check the cable and connections. • Rezero the transducer. • Replace the sensor. • Replace the transducer. • If the problem persists, contact authorized service personnel.

Messages related to temperature measurement

For information regarding alarm priorities and escalation times, see the supplemental information manual.

Make sure you are familiar with the generic layout of the screen. This will help you identify where on screen the following messages appear. The message location is indicated with the following abbreviations:

- MF = message field
- WF = waveform field
- DF = digit field

Message	Location	Possible causes	Suggested actions
• Performing temp test	• DF	Temperature is calibrating.	• No action required.
• STP measurements removed	• MF	Lost GE SpO ₂ , Temperature, IBP measurement.	• Restart monitor. • If the problem persists, contact authorized service personnel.
• T1 high • T1 low • T2 high • T2 low • Tblood high • Tblood low	• MF	Measurement values are equal to or outside the set alarm limits.	• Check patient status. • Adjust alarm limits if necessary.
• Temperature error • T1 temperature error • T2 temperature error	• DF • MF	Hardware or calibration test failure in the measurement device.	• Change the cable. • If the problem persists, contact authorized service personnel.

Messages related to C.O. measurement

For information regarding alarm priorities and escalation times, see the supplemental information manual.

Make sure you are familiar with the generic layout of the screen. This will help you identify where on screen the following messages appear. The message location is indicated with the following abbreviations:

- MF = message field
- WF = waveform field
- DF = digit field

For IBP8 and Tblood messages please refer to IBP and Temperature message section.

Message	Location	Possible causes	Suggested actions
• C.O. Complete	• C.O. menu	The C.O. measurement is completed but not ready for the next C.O. determination.	• Wait until the message disappears.
• C.O. measurement removed	• MF	E-COP module has been removed.	• Reconnect the module if necessary.
• C.O. module error	• MF	Communication between monitor and module contain errors.	• Reconnect the module. • If the problem persists, contact authorized service personnel.
• C.O. out of range	• C.O. menu	The measurement results are invalid.	• Perform a new measurement.
• Calibration Timeout	• C.O. menu	30 minutes have passed since the first intermediate measurement.	• Perform a new calibration.
• Confirm C.O.	• DF, MF	The C.O. measurement is stopped within 30 minutes since it started, or when the measurement data has not been confirmed.	• Perform a new measurement.
• Curve over range	• C.O. menu	Thermodilution waveform values are over the valid range.	• Wait for the blood temperature to stabilize and retry the measurement.
• Curve under range	• C.O. menu	Thermodilution waveform values are under the valid range.	• Wait for the blood temperature to stabilize and retry the measurement.
• Identical C.O. modules	• MF	There are two or more C.O. modules in the system.	• Remove all but one C.O. module.
• Inject now!	• C.O. menu	A prompt text during the C.O. measurement.	• Inject the injectate solution smoothly within 4 to 5 seconds.
• Irregular curve	• C.O. menu	Thermodilution waveform is irregular.	• Perform a new measurement.
• Irregular HR	• C.O. menu	HR measurement values are irregular.	• Check patient status.
• Measuring	• C.O. menu	Determining the C.O. value.	• Wait until the message disappears.
• No C.C. Check C.O. setup	• C.O. menu	The computation constant is not selected by user if catheter type is User Defined .	• Check the C.O. setup selections.
• No catheter	• C.O. menu	No catheter connected.	• Connect a catheter.

Message	Location	Possible causes	Suggested actions
• No HR for REF	• C.O. menu	REF measurement cannot be done. ECG source is telemetry.	- Check that the patient's heart rate is being monitored. - Add HR measurement if needed.
• No injectate temp probe	• C.O. menu	No injectate temperature probe connected.	Connect an injectate temperature probe.
• Noisy baseline	• C.O. menu	Changes in patient's blood temperature affect C.O. measuring.	- Check patient status. - Check the blood temperature connector.
• No module	• C.O. menu	No C.O. module connected.	Connect a C.O. module to measure cardiac output.
• Please wait	• C.O. menu	A failed, canceled, or stopped C.O. determination and the module not yet ready for the next measurement.	Wait until the message disappears.
• Press Start C.O.	• C.O. menu	A prompt text during the C.O. measurement.	Proceed with the measurement by selecting Start C.O. You can also use the Start C.O. module key.
• Press Start C.O. Serial	• C.O. menu	A prompt text during the serial C.O. measurement.	Proceed with the measurement by selecting Start C.O. You can also use the Start C.O. module key.
• REF out of range	• C.O. menu	The result of REF measurement is invalid.	Perform a new measurement.
• Service C.O. module	• MF	Blood temperature is inaccurate.	- Check the catheter position. - Check that there is no heat or cold source near the catheter. - The temperature sensor may be damaged; replace the catheter.
• Tblood over range	• C.O. menu	Blood temperature is over the limit: 43°C (109.4°F)	- Check the catheter position. - Check that there is no heat or cold source near the catheter. - The temperature sensor may be damaged; replace the catheter.
• Tblood under range	• C.O. menu	Blood temperature is under the limit: 17.5°C (63.5°F)	- Check the catheter position. - Check that there is no heat or cold source near the catheter. - The temperature sensor may be damaged; replace the catheter.
• Tinj high	• C.O. menu	Injectate temperature is too close to blood temperature or too warm.	Use colder injectate.
• Tinj low	• C.O. menu	Injectate temperature is too low for current catheter.	Use warmer injectate.
• Unstable Tblood	• DF, C.O. menu	Measurement in auto mode detects the unstable baseline patient temperature.	- Check patient status. - Change C.O. measurement to manual mode and repeat the measurement.

Messages related to gases measurement

For information regarding alarm priorities and escalation times, see the supplemental information manual.

Make sure you are familiar with the generic layout of the screen. This will help you identify where on screen the following messages appear. The message location is indicated with the following abbreviations:

- MF = message field
- WF = waveform field
- DF = digit field

Message	Location	Possible causes	Suggested actions
• Agent Mixture	• MF	Mixture of halogenated agents is detected.	• Check the ventilator and agent vaporizer settings.
• Agent inaccurate	• MF	For E-sC(Ai)O and N-CAiO module: Agent inaccurate and $\text{FiO}_2 \leq 100\%$	• Check gas levels. • Check patient status.
• Apnea • Apnea (CO₂) • APN	• WF • MF • DF	No breathing detected.	• Check patient status. • Check the ventilator and breathing status.
• Apnea deactivated	• DF	A new patient has been admitted, or the measurement has been started and the apnea alarm is not active yet.	• Wait. The message disappears after the monitor detects 3 breaths during the last minute.
• Calibrating gas sensor	• WF	Due to the module warm-up, CO ₂ measurement is not available during the first minute after the module has been connected.	• Wait until the warm-up has been completed.
• Check sample gas out	• MF, WF, DF	The water trap is not connected, the sample gas outflow is blocked, or there is a leak inside the module.	• Check water trap connection. • Remove the blockage from the sample gas outlet. • Change module, if needed.
• Check water trap and sample gas out. Wait 30 sec and press Home to continue.	• WF	The water trap is not connected, the sample gas outflow is blocked, or there is a leak inside the module.	• Check patient status. • Check water trap connection. • Remove the blockage from the sample gas outlet. • Change module, if needed.
• Check water trap	• MF, WF, DF		
• Continuous blockage. Check sample line and water trap.	• WF	The gas sampling line is blocked or the water trap is occluded.	• Change sampling line and water trap.
• Sample line blocked	• MF, WF, DF		
• CO₂ over scale	• WF	Gas signal exceeds the maximum waveform field.	• Check patient status. • Select a larger scale for waveform.
• CO₂ inaccurate	• MF	For E-sC(Ai)O and N-CAiO module: CO ₂ inaccurate and $\text{FiO}_2 \leq 100\%$ For E-miniC module: EtCO ₂ value > 20%.	• Check gas levels. • Check patient status.

Message	Location	Possible causes	Suggested actions
• Failure in Agent ID	• MF • DF	An unknown agent or three or more agents detected. Vaporizer may contain a mixture of agents.	• Flush the breathing circuit with O₂ flush (O₂ +, 100% O₂). • Empty the vaporizer and refill from an unopened container.
• EtCO2 high • EtCO2 low • EtO2 high • EtO2 low • EtHal high • EtEnf high • EtIso high • EtSev high • EtDes high • EtHal low • EtEnf low • EtIso low • EtSev low • EtDes low	• MF	Measurement values are equal to or outside the set alarm limits.	• Check patient status. • Adjust alarm limits if necessary.
• FiCO2 high • FiCO2 low • FiO2 high • FiO2 low • FiHal high • FiEnf high • FiIso high • FiSev high • FiDes high • FiHal low • FiEnf low • FiIso low • FiSev low • FiDes low	• MF	Measurement values are equal to or outside the set alarm limits.	• Check patient status. • Adjust alarm limits if necessary.
• FiN2O high	• MF	FiN2O ≥ 82%	• Check patient status.
• Gas measurements removed	• MF	Acquisition module has been removed.	• Connect the module if you want to restart the measurement.
• Gas module standby	• MF	Acquisition module has shut down the gas pump.	• No action required. • To exit the standby mode, touch any field of screen. • If needed, you can also turn on the pump from CO₂ menu.
• Standby	• DF		
• Gas module standby. Touch to activate. • Gas module standby. Start from CO2 menu.	• WF		
• Identical gas modules	• MF	There are two or more identical gas modules in the system.	• Remove all but one gas modules.

Message	Location	Possible causes	Suggested actions
• Low gas sample flow	• MF	Sample flow is less than 80% of the module's nominal flow value. This can happen if nebulized medications are given without disconnecting the sample line.	• Check the sample line. • If the problem persists, contact authorized service personnel.
• Multiple agents present	• MF, WF, DF	Mixture of 2 agents are detected.	• Check if the anesthetic agents are more than one. • Check patient status.
• N2O inaccurate	• MF	For E-sC(Ai)O and N-CAiO module: N ₂ O inaccurate and FiO ₂ ≤ 100% and EtN ₂ O or FiN ₂ O > 2%.	• Check gas levels. • Check patient status.
• O2 inaccurate	• MF	O ₂ inaccurate and FiO ₂ ≤ 100%.	• Check gas levels. • Check patient status.
• Replace water trap	• MF	Water trap is partially blocked.	• Replace the water trap.
• RR (CO2) high • RR (CO2) low	• MF	Measurement values are equal to or outside the set alarm limits.	• Check patient status. • Adjust alarm limits if necessary.
• Service gas module	• WF, MF	Ambient pressure is too high or too low. No response from the gas module, high temperature inside the module, or EEPROM checksum failure.	• If the problem persists, contact authorized service personnel.

Messages related to spirometry measurement

For information regarding alarm priorities and escalation times, see the supplemental information manual.

Make sure you are familiar with the generic layout of the screen. This will help you identify where on screen the following messages appear. The message location is indicated with the following abbreviations:

- MF = message field
- WF = waveform field
- DF = digit field

Message	Location	Possible causes	Suggested actions
• Ppeak low / Ppeak high • MVexp low / MVexp high • TVexp low / TVexp high	• MF	Measurement values are equal to or outside the set alarm limit.	• Check the patient status. • Adjust alarm limits if necessary.
• Anes: Apnea	• MF	No breathing detected.	• Check the patient status. • Check the equipment connections.
• Anesthesia interface removed	• MF	The anesthesia machine has been disconnected from the monitor.	• Reconnect the cables if you want to restart the measurement.
• Anesthesia incompatible device	• MF	The connecting device is not compatible.	• Replace with a compatible device. For information regarding the compatible devices, see the supplemental information.

Messages related to Entropy measurement

For information regarding alarm priorities and escalation times, see the supplemental information manual.

Make sure you are familiar with the generic layout of the screen. This will help you identify where on screen the following messages appear. The message location is indicated with the following abbreviations:

- MF = message field
- WF = waveform field
- DF = digit field

Message	Location	Possible explanations	Suggested actions
• Artifacts	• DF	Signals contain noise or artifact.	• Check sensor contact. • Remove sources of excessive noise.
• Automatic check off	• DF	Automatic sensor check has been turned off.	• If required, activate the automatic check from the Entropy menu.
• Cable off	• DF	The Entropy sensor cable is not connected to the Entropy module.	• Connect the Entropy cable to the Entropy module.
• Entropy cable off	• MF		
• Checking sensor	• DF, WF	Sensor check is in progress.	• Wait until the check is over. Check results are displayed.
• Confirm sensor electrode 1 • Confirm sensor electrode 2 • Confirm sensor electrode 3	• DF	One of the sensor electrodes has poor contact.	• Confirm proper sensor electrode 1, 2 or 3 contact as indicated in the message.
• Confirm sensor electrodes	• DF	More than one of the sensor electrodes have poor contact.	• Confirm proper electrode contact.
• Entropy measurement removed	• MF	Acquisition module has been removed.	• Connect the module if you want to restart the measurement.
• Entropy RE high • Entropy RE low	• MF	Measurement values are equal to or outside the alarm limits.	• Check patient status. • Adjust alarm limits if necessary. • Adjust drug titration.
• Entropy SE high • Entropy SE low	• MF	Measurement values are equal to or outside the alarm limits.	• Check patient status. • Adjust alarm limits if necessary. • Adjust drug titration.
• Entropy sensor check failed	• MF	The sensor has not passed the impedance check.	• Check sensor placement and attachment. • Confirm proper contact of each electrode in the sensor. • Replace the sensor.
• Sensor check failed	• DF		
• Entropy sensor off	• MF	The sensor is connected to the cable but not attached to the patient, or the sensor type is not correct.	• Check that the sensor is properly attached to the patient. • Check that the sensor is an Entropy sensor.
• Sensor off	• DF		

Message	Location	Possible explanations	Suggested actions
• Identical Entropy modules	• MF	There are two or more Entropy modules in the system.	• Remove all but one Entropy module.
• Isoelectric EEG	• DF, WF	Isoelectric (flatline) EEG detected in Entropy measurement.	• Check the patient status. The patient's anesthetic status may be unnecessarily deep.
• Low signal	• DF	Measured EEG signal is too low for reliable Entropy calculation.	• Check sensor placement. • The patient may be in total suppression; check the patient status.
• No sensor	• DF	The Entropy sensor is not connected to the cable, or the sensor and cable are not compatible.	• Check connection between Entropy sensor and cable. • Check that the cable and sensor are compatible.
• No Entropy sensor	• MF		
• Noise	• WF	Unreliable Entropy calculation or distorted EEG waveform may appear during electrosurgery or other high frequency noise.	• Interpret Entropy values with caution.
• Starting up	• DF	The sensor check has been passed and the Entropy measurement is starting.	• Wait for about 30 seconds. Entropy values appear automatically.

Messages related to NMT measurement

For information regarding alarm priorities and escalation times, see the supplemental information manual.

Make sure you are familiar with the generic layout of the screen. This will help you identify where on screen the following messages appear. The message location is indicated with the following abbreviations:

- MF = message field
- WF = waveform field
- DF = digit field

Message	Location	Possible causes	Suggested actions
• Block recovery	• MF	Count number has reached the value you have selected for the recovery note function.	• Check patient status.
• Check electrodes	• DF	Adjusted stimulus current could not be delivered properly due to a broken connection of the stimulating electrode or cable.	• Check the white and brown stimulating electrodes and their connections. • Check the cable. • Change the cable if necessary.
• Identical NMT modules	• MF	There are two or more NMT modules in the system.	• Remove all but one NMT module.
• Measurement off	• DF	The measurement has been stopped.	• Restart the measurement if required.
• NMT cable removed • Sensor off	• MF • DF	The NMT cable and sensor have been disconnected from the module.	• Reconnect the cable and sensor if you want to restart the measurement.

Message	Location	Possible causes	Suggested actions
• NMT measurement removed	• MF	Acquisition module has been removed.	• Connect the module if you want to restart the measurement.
• Reference not stable	• DF	Reference setting fails because responses differ more than 10%: • The patient has been given relaxants. • There are movement artifacts.	• Stop measurement, reposition electrodes and restart the measurement.
• Reference set	• DF	The reference setting has been set.	• Wait until the message disappears.
• Response too weak	• DF	The measurement cannot be performed because the response is too weak. The maximum gain is insufficient to increase the response signal amplitude to a measurable level: • Stimulus electrodes are loose. • Response electrodes are attached to a wrong place.	• Check electrode placement and connections. • Replace dry electrodes. • Check that the stimulus current is not too weak.
• Setting reference	• DF	Automatic reference search is in progress.	• Wait until the reference search is completed.
• Start measurement	• DF	Sensor check has been passed.	• Wait until the message disappears.
• Supramax not found	• DF	Supramaximal stimulus current was not found. 70 mA is used as stimulus current.	• Stop measurement, reposition the stimulating or recording electrodes and restart the measurement.
• Supramax search	• DF	Supramaximal stimulus current search is in progress.	• Wait until the search is completed.
• Wait to continue	• DF	Waiting period after tetanic stimulation and/or PTC is started.	• Wait until the message disappears.

Messages related to BIS measurement

For information regarding alarm priorities and escalation times, see the supplemental information manual.

Make sure you are familiar with the generic layout of the screen. This will help you identify where on screen the following messages appear. The message location is indicated with the following abbreviations:

- MF = message field
- WF = waveform field
- DF = digit field

Message	Location	Possible explanations	Suggested actions
• Artifact	• WF, DF	Signals contain noise or artifact.	• Check sensor contact. • Remove sources of excessive noise.
• Automatic check off	• DF	Automatic sensor check has been turned off.	• If required, activate the automatic check.

Message	Location	Possible explanations	Suggested actions
• BIS Apply sensor • Apply sensor	• MF • DF	The sensor connection to the patient may be loose.	• Press the BIS sensor electrodes to improve connection.
• BIS high /BIS low	• MF	Measurement values are equal to or outside the alarm limits.	• Check patient status. • Check the dosage of anesthetics. • Adjust alarm limits if necessary.
• BIS DSC error	• MF	The BISx is not communicating or operating properly.	• Test the BISx. • Replace the BISx unit.
• DSC error	• DF		
• BIS measurement removed	• MF	The module or BISx is disconnected.	• Connect the module or BISx to start the measurement.
• BIS module error	• MF	The module is not working properly.	• Check cable and connections. • Replace the BISx unit. • Replace the module.
• Module error	• WF, DF		
• BIS sensor check failed	• MF	The sensor has not passed the impedance check.	• Check sensor placement and connection.
• Sensor check failed	• WF, DF		
• BIS sensor expired	• MF	The sensor date has expired, the sensor has been used too many times, or the validity time for the sensor cannot be determined.	• Replace the sensor.
• Replace sensor	• DF		
• Checking sensor	• WF, DF	The sensor checking is ongoing.	• The checking results are displayed after the checking ends. • If the test fails, check electrode connections.
• Demo data	• WF, DF	BIS simulator is connected.	• Disconnect the BIS simulator.
• High BIS impedance	• MF	The BIS impedance is too high.	• Check electrode connections.
• Identical BIS modules	• MF	There are two or more BIS modules in the system.	• Remove all but one BIS module.
• Incompatible sensor	• WF, DF	An non-BIS sensor is connected.	• Make sure that you are using a Medtronic BIS sensor.
• No BIS sensor	• MF	The sensor is not connected to the digital signal processing unit BISx.	• Check the sensor connection to BISx and PIC (patient interface cable).
• No sensor	• WF, DF		
• Poor signal	• WF, DF	The BIS cannot be calculated because the SQI is below 50.	• Check electrode connections.
• Testing DSC	• WF, DF	The BISx test has been activated.	• Wait until the check is completed. • If the test result is FAIL, repeat the test. • If the problem persists, replace the BISx.

Messages related to trends, snapshots, OxyCRG, and full disclosure

For information regarding alarm priorities and escalation times, see the supplemental information manual.

Make sure you are familiar with the generic layout of the screen. This will help you identify where on screen the following messages appear. The message location is indicated with the following abbreviations:

- MF = message field
- WF = waveform field
- DF = digit field

Message	Location	Possible causes	Suggested actions
• Check OxyCRG	• MF	A new OxyCRG snapshot has been created. (After a warm start and continuing to monitor the previous patient, this message is still present.)	• Check OxyCRG snapshot, if needed.
• Creating OxyCRG snapshot	• MF	HR is out of limit SpO ₂ is out of limit Apnea time is out of limit	• No action required.
• End of 20 min trend data	• MF	There is more trend data available but not with current resolution.	• Change the time resolution in graphic trends to be more than 20 minutes (e.g., 1 hour, 2 hours). • Scroll the trends to see past data.
• No storage Full disclosure disabled	• MF	The storage disk not recognized by monitor.	• If the problem persists, contact authorized service personnel.
• No more space Full disclosure disabled	• MF	Insufficient disk storage for full disclosure data.	• Contact authorized service personnel.
• Mark X (where xxx = snapshot sequence number)	• MF	A snapshot has been taken manually.	• No action required.
• Snapshot created	• MF	A snapshot has been created.	• No action required.
• Snapshot memory full. Oldest snapshot erased.	• MF	You are trying to save a snapshot but the memory capacity is full.	• No action required.
• Storage fail Full disclosure failure	• MF	Writing to storage failed.	• If the problem persists, contact authorized service personnel.

Messages related to various situations

For information regarding alarm priorities and escalation times, see the supplemental information manual.

Make sure you are familiar with the generic layout of the screen. This will help you identify where on screen the following messages appear. The message location is indicated with the following abbreviations:

- MF = message field
- WF = waveform field
- DF = digit field

Message	Location	Possible causes	Suggested actions
• Alarm setup changed from Central	• MF	The alarm setup is retrieved from the central station.	• Check the alarm settings and adjust if necessary.
• Alarms reset remotely	• MF	The alarms were remotely paused from the remote device.	• No action required.
• Alarm volume changed	• MF	The network connection is lost, and the local alarm volume is increased.	• Readjust volume if needed.
• All monitors disconnected (Bed to Bed)	• MF	The monitor is disconnected from the network.	• Re-establish connection. • If the problem persists, contact authorized service personnel.
• Audio fail	• MF	The system can't communicate with audio chip hardware.	• Check patient status. • If the problem persists, contact authorized service personnel.
• Barcode scanned	• MF	All data has been successfully stored to the monitor.	• No action required.
• Barcode too long	• MF	The maximum length of the barcode has been exceeded.	• Verify the information read by the barcode reader and edit if necessary.
• Battery empty	• MF	The monitor is battery powered and less than 5 min of monitoring time is available with battery.	• Charge the battery by using the monitor on main power.
• Battery low	• MF	The monitor is battery powered and less than 20 min of monitoring time is available with battery.	• Charge the battery by using the monitor on main power.
• Battery temperature high	• MF	The battery's temperature is too high.	• If the problem persists, contact authorized service personnel.
• Call service UMBC error	• MF	UMBC communication error, and UMBC communication is disabled.	• Contact authorized service personnel.
• Certificate close to expiration	• MF	The CA and client certificate in system time is 0-14 days before expire time.	• Contact authorized service personnel to install another CA certificate.
• Certificate expired	• MF	CA and client certificate is expired.	• Contact authorized service personnel to install another CA certificate.
• Condition battery	• MF	Battery is not working properly.	• Connect AC main to condition battery. • If the problem persists, contact authorized service personnel.

Message	Location	Possible causes	Suggested actions
CS Gateway communication failure	MF	An error occurred when trying to search for patient on the CARE-SCAPE Gateway.	- Check the network connectivity. - Check whether the CARESCAPE Gateway is offline. - Retry loading from the network. - If the problem persists, contact authorized service personnel.
DEMO MODE	MF	DEMO mode has been enabled.	To exit the DEMO mode: Contact authorized service personnel.
E-Manual lost	MF	E-manual is not available.	Contact authorized service personnel.
Entering standby	MF	Activate standby has been selected.	No action required.
Frame temperature high	MF	The temperature inside the frame is over 70°C/158 °F.	- Turn off the monitor, wait for it cool down. - Make sure there is sufficient ventilation. - Check and clean monitor ventilation holes.
Identical IP address noticed	MF	Two or more monitors on the network have the same IP address.	Contact authorized service personnel.
Identical unit&bed name noticed	MF	Two or more monitors in the network have the same unit and bed name.	- Disconnect the patient monitor that has the identical unit and bed name. - Change the unit and bed name of the duplicate patient monitor unit and bed name.
Incorrect barcode value	MF	The barcode string differs from the defined values.	Contact authorized service personnel.
Invalid barcode configuration	MF	The barcode configuration is not correct.	Contact authorized service personnel.
License invalid	MF	License is invalid during start up.	Contact authorized service personnel.
Monitor disconnected (Bed to Bed)	MF	The monitor with alarm notification enabled is disconnected from the network.	Re-establish the connection.
Motion Sensor Start Failed (not for device with VSP 4.0 Upgrade Software)	MF	The motion sensor for alarm gesture start failed for 10 times continuously.	- Restart the monitor. - If the problem persists, contact authorized service personnel.
Network: HL7	MF	When network connection between HL7 TCP Client application and monitor is made.	No action required.
Network down: HL7	MF	No HL7 TCP Client is configured to connect to monitor on the network.	- Try to re-establish the connection. - If the problem persists, contact authorized service personnel.

Message	Location	Possible causes	Suggested actions
• Network down	• MF	CARESCAPE Network connection has failed.	- Try to re-establish the connection. - If the problem persists, contact authorized service personnel.
• Network made	• MF	When CARESCAPE network is connected.	No action required.
• No battery backup	• MF	Battery missing from the battery compartments.	Contact authorized service personnel.
• No patients found	• MF	No patients were found when searching on CARESCAPE gateway.	- Verify or change search criteria. - Manually enter patient information.
• No printer selected	• MF	There is no printer selected on the monitor.	Select a printer.
• Patient admitted	• MF	The current patient has been admitted.	No action required.
• Patient discharged	• MF	The patient has been discharged.	No action required.
• Printing	• MF	Printing is occurring.	Wait for the printing to finish.
• Printing Alarm	• MF	An alarm has triggered printing.	Wait for the printing to finish.
• Printer error	• MF	A printer is not present or the printer needs paper.	- Choose a different printer. - Add paper to the printer.
• Printing ready	• MF	Your printing request has been forwarded to the printer.	No action required.
• Recorder: cover open	• MF	The recorder cover is open.	Close the recorder cover.
• Recorder: input voltage high • Recorder: input voltage low	• MF	There are problems with the recorder input voltage.	Contact authorized service personnel.
• Recorder: out of paper	• MF	The recorder is out of paper.	Replace recorder paper.
• Recorder module removed	• MF	Recorder module has been removed.	Reconnect the recorder module if you need.
• Recorder system error	• MF	The local recorder is not working.	- Disconnect and reconnect the recorder cable. - If the problem persists, contact authorized service personnel.
• Recorder thermal array overheat	• MF	There are problems with the recorder temperature. Long time printing.	- Try stopping the recording. - If the problem persists, contact authorized service personnel.
• Replace battery	• MF	Battery is not working properly.	Replace the battery.
• Restart needed	• MF	The monitor should be restarted.	Restart the monitor.
• Saving	• MF	The printing device is not available, and the records are saved for later printing.	- Check the printing device. - Select a printing location.
• Saving PDF	• MF	The patient data are exporting to USB in PDF format	No action required.

Message	Location	Possible causes	Suggested actions
• Saving PDF failed	• MF	The patient data failed to export to USB in PDF format.	• Check whether the USB disk is in FAT32 format, or whether the USB disk's space is full. • Check whether the USB disk is inserted into the correct USB connector.
• Speaker failure	• MF	Speaker failure	• Check the patient status. • If the problem persists, contact authorized service personnel.

Abbreviations

List of abbreviations

The abbreviations that appear in the monitor software and manuals. Some abbreviations listed have multiple meanings but are differentiated by the context in which they appear.

/min	beats per minute, breaths per minute
°C	Celsius degree
°F	Fahrenheit degree
μ	micro
12RL	twelve reduced leads
12SL	twelve simultaneous leads
a	arterial
A	auricular alveolar
A Fib	atrial fibrillation
AA	anesthetic agent
AaDO ₂	alveoli-arterial oxygen difference
AAMI	Association for the Advancement of Medical Instrumentation
AC	alternating current
Accel. Ventric.	accelerated ventricular rhythm
AGSS	anesthetic gas scavenging system
AHA	American Heart Association
AirW	airway temperature
Alpha	alpha frequency band
Alpha%	alpha frequency band percentage
Amp	amplitude
ANATEL	Agência Nacional de Telecomunicações
ANSI	American National Standards Institute
Ant.	anterior
AoA	adequacy of anesthesia
APN	apnea
Arrh	arrhythmia
Art; ABP	arterial pressure
ASA	American Society of Anesthesiologists
ASB	assisted spontaneous breathing

ASY	asystole
ATMP	atmospheric pressure
ATPD	atmospheric/ambient temperature and pressure, dry gas
Auto	continuous NIBP measurement mode
aVF	left foot augmented lead
aVL	left arm augmented lead
AVOA	automatic view on alarm
aVR	right arm augmented lead
Axil	axillary temperature
BAEP	brainstem auditory evoked potential
BE	base excess
Beta	beta frequency band
Beta%	beta frequency band percentage
BIPAP	biphasic positive airway pressure
BIS	bispectral index
BISx	digital signal processing unit
Blad	bladder temperature
BNP	B-type natriuretic peptide
bpm	beats per minute
Brady	bradycardia
BSA	body surface area
BSR	burst suppression ratio
B-to-B	beat-to-beat
BTPS	body temperature and pressure, saturated gas
BUN	blood urea nitrogen
C	central
C (C1 - C6)	chest
C(a-v)O ₂	arteriovenous oxygen content difference
C.I.	cardiac index
C.O.	cardiac output
C1 to C6	ECG lead C1 to ECG lead C6
CaO ₂	arterial oxygen content
cc	cubic centimeter
CCI	continuous cardiac index
CCO	continuous cardiac output
CcO ₂	capillary oxygen content
CCU	cardiac (coronary) care unit
CFI	Cardiac function index

CIC	Clinical Information Center
Cicalc	cardiac index calculated by Fick equation
CISPR	International Special Committee on Radio Interference
CK-MB	cardiac muscle type creatine kinase
Cl	chlorine
cmH ₂ O	centimeter of water
CMRR	common mode rejection ratio
CNS	central nervous system
CO ₂	carbon dioxide
COcalc	cardiac output calculated by Fick equation
Compl	compliance
Core	core temperature
Count	count of responses
CPP	cerebral perfusion pressure
CPU	central processing unit
CSA	Canadian Standards Association compressed spectral array
CT	computed tomography
CvO ₂	venous oxygen content
CVP	central venous pressure
d	day
dB	decibel
DBS	double burst stimulation
DC	direct current
Delta	delta frequency band
Delta%	delta frequency band percentage
DEMO	demonstration (mode)
Des	desflurane
Dia; DIA	diastolic pressure
DO ₂	oxygen delivery
DO ₂ I	oxygen delivery index
dPmax	Index of left ventricular contractility
DS	dead space ventilation
DSC	digital signal converter
e	estimated
ECG	electrocardiogram
ECT	electroconvulsive therapy
ED	emergency department
EDV	end-diastolic volume

EEG	electroencephalogram
EMC	electromagnetic compatibility
EMG	electromyogram
EMI	electromagnetic interference
EMMV	extended mandatory minute ventilation
Enf	enflurane
EP	evoked potential
ESD	electrostatic discharge electrostatic sensitive devices
Eso	esophageal temperature
ESU	electrosurgical unit
ESV	end-systolic volume
ESVI	end-systolic volume index
ET	endotracheal
ET; Et	end-tidal concentration
EtAA	end-tidal anesthetic agent
EtBal	end-tidal balance gas
EtCO ₂	end-tidal carbon dioxide
EtN ₂ O	end-tidal nitrous oxide
EtO ₂	end-tidal oxygen
EVLW	Extravascular lung water
Exp; exp	expiratory
F	foot (describing location) frontal
feCO ₂	mixed expired carbon dioxide concentration
Fem	femoral
FEMG	frontal electromyogram
FemV	femoral venous
feO ₂	mixed expired oxygen concentration
FFT	fast Fourier transform
FI; Fi	fraction of inspired gas
FiAA	fraction of inspired anesthetic agent
Fib	fibrillation
FiCO ₂	fraction of inspired carbon dioxide
FiN ₂	fraction of inspired nitrogen
FiN ₂ O	fraction of inspired nitrous oxide
FiO ₂	fraction of inspired oxygen
Flow; F	flow

Flow-Vol Loop	flow volume loop
Fp	fronto-polar
Fr	French (unit of measure for a Catheter diameter scale)
ft	feet foot
g	gram
g/dl	grams per deciliter
g/l	grams per liter
GND	ground
h	hour
Hal	halothane
Hb	hemoglobin
HbO ₂	oxyhemoglobin
HCO ₃ ⁻	bicarbonate
Hct	hematocrit
Hemo	hemodynamic
HFV	high frequency ventilation
HME	heat and moisture exchanger
HMEF	heat and moisture exchanger with filter
hPa	hectopascal
HR	heart rate
HRdif	heart rate difference
Hz	hertz
I	lead I
I.U.	international unit
I:E	inspiratory-expiratory ratio
IABP	intra-aortic balloon pump
iCa	ionized Calcium
ICASA	Independent Communications Authority of South Africa
ICP	intracranial pressure
ICU	intensive care unit
ID	identification
IEC	International Electrotechnical Commission
II	lead II
III	lead III
IM	intramuscular
Imped	impedance
in	inch
Insp; insp	inspiratory

Intellirate	automatic heart rate source selection of PDM
IP	internet protocol invasive blood pressure
IPPV	intermittent positive pressure ventilation
IPPV/ASSIST	intermittent positive pressure ventilation & assisted
IrMod%	infrared modulation percentage
Iso	isoflurane
ISO	International Standards Organization
ITBI	Intrathoracic blood volume index
ITBV	Intrathoracic blood volume
ITTV	Intrathoracic thermal volume
IV	intravenous
J	joule
K	potassium
kcal	kilocalorie
KCC	Korea Communications Commission
kg	kilogram
kJ	kilojoule
kPa	kilopascal
l	liter
l/min	liters/minute
LA	left arm (describing location)
Lab	laboratory
LAN	local area network
LAP	left atrial pressure
lb	pound
LCD	liquid crystal display
LCW	left cardiac work
LCWI	left cardiac work index
LED	light emitting diode
LL	left leg (describing location)
MAC	minimum alveolar concentration
MACage	MAC compensated with patient age, patient temperature, and atmospheric pressure
Man	manual
Man/Spont	manual/spontaneous
MAP	mean arterial pressure
Max.	maximum
mbar	millibar

mcg/l	microgram per liter
mcmol/l	micromole per liter
Mean; M	mean blood pressure
mEq	milliequivalent
mEq/l	milliequivalent per liter
MetHb	methemoglobin
mg	milligram
mg/dl	milligram per deciliter
ml.U.	milli International Unit
min	minute
ml	milliliter
MLAEP	middle-latency auditory evoked potential
mm	millimeter
mmHg	millimeters of mercury
mmol	millimol
mmol/l	millimole per liter
MMV	mandatory minute ventilation
MMV/ASB	mandatory minute ventilation & assisted spontaneous breathing
mol	mole
MRI	magnetic resonance imaging
MRN	medical record number
ms	millisecond
MV	minute volume
MVexp	expired minute volume (l/min)
MVinsp	inspired minute volume (l/min)
MVspont	spontaneous minute volume
Myo	myocardial temperature
N	neutral
N/A	not applicable
N ₂	nitrogen
N ₂ O	nitrous oxide
Na	sodium
Naso	nasopharyngeal temperature
Neo	neonate
Neuro	neurological
ng/l	nanogram per liter
ng/ml	nanogram per milliliter
NIBP	non-invasive blood pressure

NICU	neonatal intensive care unit
NMBA	neuromuscular blocking agent
NMT	neuromuscular transmission
NTPD	normal temperature and pressure, dry gas
O	occipital
O ₂	oxygen
O ₂ ER	oxygen extraction ratio
OR	operating room
Oxy	oxygenation
P	pressure
Pa	Pascal
PA	pulmonary arterial pressure
Paced	paced beats
PaCO ₂	partial pressure of carbon dioxide in the arteries
PACU	post anesthesia care unit
PaO ₂	partial pressure of oxygen in the arteries
PAO ₂	partial pressure of oxygen in the alveoli
Paw	airway pressure
Paw-Vol Loop	pressure volume loop
PBSA	Predicted body surface area
PBW	Predicted body weight
pCO ₂ ; PCO ₂	carbon dioxide partial pressure
pcs	pieces
PCV	pressure controlled ventilation
PCV-A/C	pressure controlled ventilation & assisted control
PCV-CMV	pressure controlled ventilation – controlled mandatory ventilation
PCV-CPAP	pressure controlled ventilation & continuous positive airway pressure
PCWP	pulmonary capillary wedge pressure
PCV-SIMV	pressure controlled ventilation & synchronized intermittent mandatory ventilation
PDF	portable document format
PE	polyethylene
Peds	pediatrics
PEEP	positive end-expiratory pressure
PEEP _e	extrinsic positive end expiratory pressure (ICU, NICU, ED software packages)
PEEP _e +PEEP _i	total positive end expiratory pressure (ICU, NICU, ED software packages)
PEEP _i	intrinsic positive end expiratory pressure (ICU, NICU, ED software packages)
PEEP _{tot}	total positive end expiratory pressure (OR, PACU software packages)
pg/ml	picogram per milliliter

pH	potential of hydrogen
pHa	arterial pH
pHv	mixed venous pH venous pH
PIC	patient interface cable
Pinsp	inspiratory (target) pressure
Pleth	plethysmographic pulse waveform
Pmean	mean pressure
PN	part number
pO ₂ ; PO ₂	oxygen partial pressure
Ppeak	peak pressure
Pplat	plateau (pause) pressure
PPV	pulse pressure variation
PR	pulse rate
PT	prothrombin time
PTC	post tetanic count
PVC	polyvinyl chloride premature ventricular contraction
PvCO ₂	carbon dioxide partial pressure in mixed venous blood
PvO ₂	partial pressure of oxygen in (mixed) venous blood
PVPI	Pulmonary vascular permeability index
PVR	pulmonary vascular resistance
PVRI	pulmonary vascular resistance index
QRS	QRS complex
Qs/Qt	venous admixture
QT	Q-T interval
QTc	corrected value of the QT interval
R	right (describing location)
R on T	early PVC, close to the T wave of the preceding normal beat
RA	right arm (describing location)
RAP	right atrial pressure
Raw	airway resistance
RCW	right cardiac work
RCWI	right cardiac work index
RE	response Entropy
Rect	rectal temperature
REF	right ventricular ejection fraction
Resp Rate	respiration rate (total) (measured)
RF	radio frequency

RL	reduced leadset
RMS	average (root mean square) power
Room	room temperature
RQ	respiratory quotient
RR	respiration rate
RVP	right ventricular pressure
RVSW	right ventricular stroke work
RVSWI	right ventricular stroke work index
s	second
SaO2	arterial oxygen saturation
SB	spontaneous breathing
ScvO2	central venous oxygen saturation
SE	state Entropy
SEF	spectral edge frequency
Sev	sevoflurane
Skin	skin temperature
SL	simultaneous leads
SN	serial number
SO2	saturated oxygen
SPI	surgical pleth index
Spiro	Patient Spirometry
SpO2	oxygen saturation
Spont	spontaneous
SPV	systolic pressure variation
SQ	subcutaneous
SQI	signal quality index
SR	suppression ratio
ST	single twitch ST segment
Stat	five minute continuous NIBP measurement mode
STPD	standard temperature and pressure, dry gas
Supra	supramaximal
Surf	surface temperature
SV	stroke volume supraventricular
SW; sw	software
SVC	supra ventricular contraction
SVI	stroke volume index
SvO2	mixed venous oxygen saturation

SVR	systemic vascular resistance
SVRI	systemic vascular resistance index
SV Tachy	supra ventricular tachycardia
SVV	stroke volume variation
Sync MAS	Synchrom Master
Sync SLV	Synchrom Slave
Sys; SYS	systolic pressure
T	temperature temporal
T(BTPS)	temperature in BTPS conditions
T1	first twitch
T1%	first stimulus as percent of the reference value NMT
Tab	tabular
Tachy	tachycardia
Tblood	blood temperature
TC	transcutaneous
TcCO ₂	transcutaneous carbon dioxide
TcO ₂	transcutaneous oxygen
TCO ₂	total carbon dioxide
Tcorr	patient temperature used to correct pH, PCO ₂ , PO ₂
Temp	temperature
Texp	expiratory time
Theta	theta frequency band
Theta%	theta frequency band percentage
Tinj	injectate temperature
Tinsp	inspiratory time
TOF	train of four
TOF%	train of four percentage
Tpause	pause time
TTX	telemetry transmitter
TV	tidal volume
TVexp	expired tidal volume (ml)
TVinsp	inspired tidal volume (ml)
Tx-Ty	temperature difference
Tymp	tympanic temperature
UAC	umbilical arterial catheter
UI	user interface
UVC	umbilical venous catheter
V	ventricular

V; Vent	ventilation
V (V1-V6)	chest
V Brady	ventricular bradycardia
V Fib	ventricular fibrillation
V Tach	ventricular tachycardia
v	venous
VA	alveolar ventilation
VCO2	carbon dioxide production
Vd	dead space
Vd/Vt	dead space ventilation
Vent	ventilator
WLAN	wireless local area network
VO2	oxygen consumption
VO2calc	calculated oxygen consumption
VO2Icalc	calculated oxygen consumption index
VO2	oxygen consumption index
Vol; V	volume
Vol Assist	volume assisted
VT > 2	ventricular tachycardia with more than two beats
yrs	years



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Patient Monitor B155M-OR/B125M-OR/B105M-OR

Supplemental Information Manual

Software Version 4.0



5829101-EN
Revision 1
English

Notice

The information in this manual applies to the software version listed on the first page of the manual. Due to continuing product innovation, specifications in this manual are subject to change without notice.

Revision history

Revision	Date	Reason for change
1	2024-05-08	Initial release.

Contents

About this manual.....	8
Intended use of this manual.....	8
Intended audience of this manual	8
Manual conventions.....	8
Acquisition module naming conventions.....	8
Illustrations and names	9
Related documents.....	9
Ordering manuals	9
Accessing manuals online	9
Accessing manuals on monitor	9
Using E-manuals on monitor	10
Trademarks	10
Third party trademarks	10
Manufacturer responsibility	10
Product availability.....	11
Compatible devices	12
Compatibility.....	12
E-module compatibility	12
Frame compatibility.....	12
Input-output device compatibility	12
Printing device	12
Display device	13
Data collection device	13
Input device	13
Peripheral device	13
Network compatibility	13
Design, environmental and physical specifications	15
Design, environmental, and physical specifications.....	15
Monitor specifications	15
B1X5-F2 frame specifications	16
B1X5-REC recorder specifications.....	17
E-COP module specifications	17
E-sCAiO, E-sCO, and N-CAiO module specifications.....	17
E-miniC module specifications.....	17
E-ENTROPY module specifications	18
E-NMT module specifications.....	18

E-BIS module specifications.....	18
Battery specifications	19
WLAN specifications.....	19
Alarm specifications.....	21
Alarm standards compliance.....	21
Auditory alarm volume	21
Audio alarm sound tolerances	21
General alarm tone sound patterns.....	21
IEC alarm tone sound patterns	22
ISO alarm tone sound patterns	22
ISO2 alarm tone sound patterns	23
Auditory information signal characteristics	23
Visual information signals	23
Alarm broadcast mapping.....	23
Physiological alarm limits specifications	29
Alarm limits specifications for ECG alarms.....	29
Alarm limits specifications for impedance respiration alarms.....	30
Alarm limits specifications for SpO ₂ alarms.....	30
Alarm limits specifications for NIBP alarms	30
Alarm limits specifications for invasive pressures alarms	31
Alarm limits specifications for temperature alarms	32
Alarm limits specifications for airway gases alarms	32
Alarm limits specifications for spirometry alarms	33
Alarm limits specifications for Entropy alarms	33
Alarm limits specifications for NMT alarms.....	33
Alarm limits specifications for BIS alarms	34
Alarm delay specifications.....	34
Time to alarm for tachycardia	34
Alarm priorities and escalations	34
Alarm priorities and escalation times for ECG.....	34
Alarm priorities and escalation times for impedance respiration.....	37
Alarm priorities and escalation times for SpO ₂	37
Alarm priorities and escalation times for NIBP	39
Alarm priorities and escalation times for invasive pressures.....	40
Alarm priorities and escalation times for temperature	43
Alarm priorities and escalation times for cardiac output.....	43
Alarm priorities and escalation times for airway gases	43
Alarm priorities and escalation times for spirometry	45
Alarm priorities and escalation times for Entropy	46
Alarm priorities and escalation times for NMT	47
Alarm priorities and escalation times for BIS.....	48
Alarm priorities and escalation times for trends and snapshots	49
Alarm priorities and escalation times for various situations.....	49

Parameter specifications	52
ECG performance specifications	52
Impedance respiration performance specifications	53
SpO ₂ displayed saturation values	54
SpO ₂ summary of clinical studies used to establish accuracy claims	54
Accuracy of Nellcor Oximax technology with Oximax sensors	54
Accuracy of Masimo SET technology with Masimo sensors	54
Accuracy of GE technology with TruSignal sensors	55
SpO ₂ test methods used to establish accuracy claims during motion	55
SpO ₂ test methods used to establish accuracy claims during low perfusion	56
Low perfusion accuracy of Nellcor Oximax technology with Oximax sensors	56
Low perfusion accuracy of Masimo SET technology	56
Low perfusion accuracy of GE TruSignal technology with TruSignal sensors	56
SpO ₂ test methods used to establish pulse rate accuracy	56
Pulse rate accuracy of Nellcor Oximax technology with Oximax sensors	56
Pulse rate accuracy of Masimo SET technology with Masimo sensors	57
Pulse rate accuracy of GE TruSignal technology with TruSignal sensors	57
SpO ₂ performance specifications	57
SPI performance specifications	60
SPI calculations	60
NIBP performance specifications	60
Invasive pressure performance specifications	61
SPV and PPV calculations	62
Temperature performance specifications	62
Cardiac output (C.O.) performance specifications	62
Airway gases normal conditions	63
Airway gases performance specifications	64
Airway gases calculations	68
Airway gases CO ₂ unit conversions	68
Spirometry display specifications	69
Entropy performance specifications	70
Entropy calculations	70
NMT performance specifications	71
BIS performance specifications	71
BIS calculations	72
Default settings	73
Understanding your monitor configuration	73
User modes	73
User mode settings	73

Common settings for all modes	74
Basic default settings	78
Admit/Discharge settings	78
Trends settings	79
Brightness settings	81
Sound volume settings	81
Night mode settings	81
Screen setup settings	82
Layout 1	82
Layout 2	83
Layout 3	83
Layout 4	84
Alarm setup settings	84
Printing settings	86
Export patient data settings	86
OxyCRG settings	87
EWS settings	87
Other patients settings	88
Password settings	88
Installation default settings	89
Alarm options settings	89
Snapshot settings	91
Parameter settings	92
Roving settings	93
Gesture control settings	93
Save modes settings	94
Time and Date settings	94
Time zone settings	94
USB import and export settings	96
EWS settings	96
Printer settings	96
Parameter default settings	96
ECG default settings	96
ECG alarms default settings	98
Impedance respiration default settings	99
SpO ₂ default settings	100
NIBP default settings	101
Invasive pressure default settings	102
Temperature default settings	105
Cardiac output (C.O.) default settings	105
Airway gases default settings	106
CO ₂ default settings	106
O ₂ default settings	107
Anesthetic agent/N ₂ O default settings	107
Entropy default settings	108
NMT default settings	109

BIS default settings.....	109
Spirometry default settings	110
Electromagnetic compatibility	111
Standards compliance	111
Essential performance in EMC.....	111
Entropy accessories and electromagnetic compatibility.....	112
BIS accessories and electromagnetic compatibility	112
Electromagnetic emissions	113
Electromagnetic immunity.....	113
Electromagnetic immunity for RF	114
Recommended separation distances.....	116
Proximity field immunity compliance.....	116
Minimizing electromagnetic interference.....	118
SpO2 supplemental analysis graphs	119
Additional accuracy information for GE TruSignal sensors	119
Additional accuracy information for Masimo sensors	126
Additional accuracy information for Nellcor™ sensors.....	130

About this manual

Intended use of this manual

This manual must be used in conjunction with the user's manual for important safety information and detailed instructions for clinical use of these products. Devices and versions not specifically stated are not supported and should not be used.

As the monitor configuration may vary, some menus, displays and functions described may not be available in the monitor you are using.

See the user's manual for the instructions necessary to operate the device safely in accordance with its function and intended use.

Intended audience of this manual

This manual is intended for clinical professionals. Clinical professionals are expected to have a working knowledge of medical procedures, practices and terminology required to provide patient care. Using the device should never replace nor impede the human intervention and required patient care provided by clinical professionals. This manual is also intended for service representatives and technical personnel who install, maintain, troubleshoot, or repair this device.

Manual conventions

This manual uses the following styles to emphasize text or indicate action.

Item	Description
Courier	Indicates hardware terms.
bold	Indicates software terms.
<i>italic</i>	Indicates terms for emphasis.
select	The word select means choosing and confirming.
supplemental information	Indicates information that appears in the Supplemental Information Manual or supplements provided.
NOTE	Note statements provide application tips or other useful information.

Acquisition module naming conventions

In this manual, the following naming conventions are used to refer to different modules and module categories:

- E-miniC: Single-width airway module
- E-sCO, E-sCAiO: CARESCAPE respiratory modules
- N-CAiO: Airway Gas Option
- E-modules: All modules with the prefix E-

Illustrations and names

This manual uses illustrations as examples only. Illustrations in this manual may not necessarily reflect all system settings, features, configurations, or displayed data.

Names of persons, institutions, and places and related information are fictitious; any similarity to actual persons, entities, or places is purely coincidental.

Related documents

- B155M-OR/B125M-OR/B105M-OR Patient Monitor User's Manual
- B155M-OR/B125M-OR/B105M-OR Patient Monitor Technical Manual
- Supplies and accessories
- Service manuals for acquisition modules
- Patient Monitoring Network Configuration Guide
- CARESCAPE Central Station User's Manual
- HL7 Reference Manual
- Privacy and Security Manual

Ordering manuals

Paper copies of the medical device IFU will be provided within 7 days of receiving the request, at no additional cost. Contact your local GE representative and request the part number on the first page of the eIFU.

Accessing manuals online

To access manuals online,

1. Go to <https://www.gehealthcare.com/documentationlibrary>.
2. Enter **Customer Documentation Portal** site.
3. Select **Modality to Monitoring Solutions (MS)** and **Products** to related products you want to search. Launch the search.
4. Identify and download the IFUs.

The IFUs are in PDF format, make sure the device has software to open the PDF files (e.g. Adobe® Acrobat® Reader).

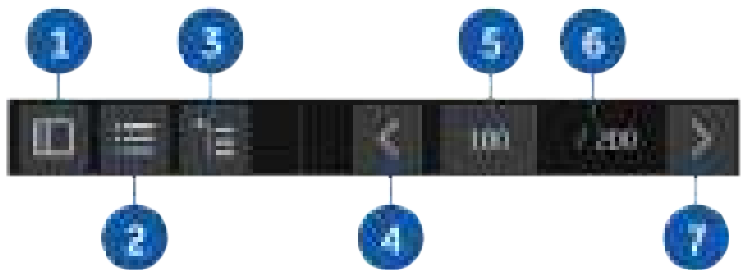
Accessing manuals on monitor

To access manuals on monitor:

1. Press the **On/Off** button (more than 3 seconds) to turn on the monitor.
2. Select  >  **E-Manual**.
3. Select related manuals.

Using E-manuals on monitor

The E-manual's navigation are on the top of the menu.



1.	Show/Hide bookmark view softkey	5.	Current page area
2.	Collapse bookmark view softkey	6.	Total page
3.	Expand bookmark view softkey	7.	Next page softkey
4.	Previous page softkey		

1. Swipe down and up to scroll the page.
2. Select < or > to turn pages.
3. Enter a page number to current page area can jump to this page.
4. Select  to display or hide the bookmark volume on the left.
5. Select  to collapse bookmark.
6. Select  to expand bookmark.

Trademarks

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Multi-Link is the trademark of CareFusion Corporation or one of its subsidiaries.

HL7 is a registered trademark of Health Level Seven (HL7), Inc.

All other third-party trademarks are the property of their respective owners.

Manufacturer responsibility

GE HealthCare is responsible for the effects on safety, reliability, and performance of the equipment only if:

- Assembly operations, extensions, readjustments, modifications, servicing, or repairs are carried out by authorized service personnel.
- The electrical installation of the relevant room complies with the requirements of the appropriate regulations.
- The equipment is used in accordance with the instructions for use.

Product availability

NOTE

Due to continual product innovation and design, specifications for these products are subject to change without notice.

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

Compatible devices

Compatibility

Devices and versions not specifically stated have not been verified and validated as comprising a conforming system with the monitor.

In the following sections, compatible devices refer to devices that have been verified to be compliant with the standard IEC 60601-1. Supported devices refer to devices that are compatible with the system, but have not been verified to meet the recent standard requirements.

Devices and versions listed as supported only: refer to their original user and technical documentation.

For the list of monitor-compatible supplies and accessories, refer to the Supplies and Accessories.

E-module compatibility

The monitor is compatible with the following module:

- E-COP-01
- E-sCAiO-00
- E-sCO-00
- N-CAiO-00
- E-miniC-00
- E-ENTROPY-01
- E-NMT-01
- E-BIS-01

Frame compatibility

The monitor is compatible with the B1X5-F2 Frame.

Input-output device compatibility

Printing device

The monitor is compatible with the following devices:

- B1X5-REC recorder in local
- Laser printer:
 - HP LaserJet Enterprise M507dn
 - HP M405dn

**NOTE**

You also can from CARESCAPE Central Station to do print, refer to CARESCAPE Central Station User's Manual for compatible devices.

Display device

The monitor is compatible with the external display with following resolutions:

- 1280*800
- 1366*768

Data collection device

The monitor supports the following device:

- iCollect V5

**NOTE**

The system supports two simultaneous Datex-Ohmeda S/5 Collect connections.

- USB storage device

Input device

The monitor is compatible with the following device:

- 5813075 USB barcode reader

Peripheral device

The monitor is compatible with the following devices:

- The anesthesia machine devices that support Datex-Ohmeda Com 1.2 serial protocol

Network compatibility

The monitor has been verified to be compatible with in CARESCAPE* Network environment.

The monitor is capable of EMR connectivity. The monitor HL7 (Health Level Seven) message is compliant with the IHE PCD-01 OBR/OBX format. There are two ways to acquire trended vital sign data from the monitor:

- HL7 directly from the monitor
- HL7 from the CARESCAPE Gateway

On the CARESCAPE network,

- The monitor is compatible with the following devices:
 - CARESCAPE Central Station v2.1, and v3.0
 - CARESCAPE Gateway v2
 - Mobile Care Server v6.3
 - CARESCAPE Bridge v2
- The monitor can communicate with the following bedside monitors:

- B155M/B125M/B125P/B105M/B105P VSP3.0 and 4.0
- The monitor supports maximum 2048 devices in MC network.
- The monitor can simultaneously respond with:
 - 10 views on the wireless network
 - 16 views on the wired network

**NOTE**

When the monitor **Radio Enable** in the service menu is set to **Disabled**, the monitor won't automatically allow 16 views. To switch to 16 views support, the WLAN license needs to be inactive.

Design, environmental and physical specifications

Design, environmental, and physical specifications

Operating/non-operating altitude: The system will meet specifications when subjected to altitudes corresponding to pressure readings from 700 hPa to 1060 hPa.



NOTE

An average pressure reading of 700 hPa corresponds to an altitude of 3000 m (10,000 ft) and 1060 hPa corresponds to an altitude of -400 m (-1000 ft).



NOTE

Operation of the monitor outside the environmental specifications may cause inaccurate results.

Monitor specifications

Size (H x W x D) Without module and recorder	B155M-OR: 305 mm x 405 mm x 175 mm B125M-OR: 280 mm x 312 mm x 175 mm B105M-OR: 275 mm x 265 mm x 175 mm
Weight With battery, without module and recorder	B155M-OR: ≤ 5.5 kg B125M-OR: ≤ 4.2 kg B105M-OR: ≤ 3.8 kg For device with VSP 4.0 Upgrade Software: B155M-OR: ≤ 5.2 kg
Monitor operating temperature range	5 to 40°C (41 to 104°F)
Battery charging temperature range	5 to 35°C (41 to 95°F)
Non-operating temperature range	-20 to 60°C (-4 to 140°F)
Operating humidity range	15 to 90% RH non-condensing
Non-operating humidity range	10 to 90% RH non-condensing
Operating altitude range	700 to 1060 hPa (525 to 795 mmHg)
Non-operating altitude range	700 to 1060 hPa (525 to 795 mmHg)
Degree of protection against harmful ingress of water	IP22
Power supply	Internal battery or AC power
Power requirements line voltage	100-240 VAC ±10%, 50/60 Hz
Power consumption	≤ 150 VA
Power cord type	IEC/EN 60320-1/C13 For USA, difference type of plugs should be used for connection to the alternate voltage 10 A 125 V.
Touchscreen	Capacitive
Alarm light	Illuminates red, yellow and cyan

Display size	B155M-OR: 15.6 in B125M-OR: 12.1 in B105M-OR: 10.1 in
Resolution	B155M-OR: 1366*768 B125M-OR/B105M-OR: 1280*800
Video connector	One HDMI connector for slave display
Ethernet port connector	One Ethernet interface (RJ45)
USB 2.0 port connector	Universal Serial Bus (USB type A connectors) compatible with the USB 2.0 standard 3 USB connectors. For device with VSP 4.0 Upgrade Software: 1 connector.
Recorder connector	One external thermal recorder interface
Nurse call connector	One nurse call connector
Serial port connector	One standard RS232 connector
Defibrillation synchronization connector	One defib marker out connector.
Sync pulse width	10 ms ($\pm 20\%$)
Sync output impedance	$110\ \Omega \pm 20\%$ @10 mA
Sync amplitude	CMOS compatible 3.5 V min. at 1 mA sourcing 0.5 V max. at 5 mA sinking
Sync delay	< 35 ms
Service life	10 years

B1X5-F2 frame specifications

Size (H x W x D)	160 mm x 266 mm x 132 mm
Weight	1.5 kg (3.3 lb)
Operating temperature range	5 to 40°C (41 to 104°F)
Non-operating temperature range	-20 to 60°C (-4 to 140°F)
Operating humidity range	20 to 90% RH non-condensing
Non-operating humidity range	10 to 90% RH non-condensing
Operating altitude range	700 to 1060 hPa (525 to 795 mmHg)
Non-operating altitude range	700 to 1060 hPa (525 to 795 mmHg)
Degree of protection against harmful ingress of water	IP21
Power requirements line voltage	100-240 VAC $\pm 10\%$, 50/60 Hz
Power consumption	≤ 50 VA
Service life	10 years

B1X5-REC recorder specifications

Recorder type	Thermal printer
Operating temperature range	5 to 40°C (41 to 104°F)
Non-operating temperature range	-20 to 60°C (-4 to 140°F)
Operating humidity range	20 to 90% RH non-condensing
Non-operating humidity range	10 to 90% RH non-condensing
Operating and non-operating altitude range	700 to 1060 hPa (525 to 795 mmHg)
Resolution	Horizontal: 24 dots/mm (600 dots/in) minimum in waveform mode Vertical: 8 dots/mm (200 dots/in) in non-waveform mode
Paper width	50 mm (2 in)
Power consumption	Printing: <=10 w
Service life	10 years

E-COP module specifications

Size (H x W x D)	112 x 37 x 187 mm (4.4 x 1.5 x 7.4 in)
Weight	0.35 kg (0.77 lb)
Power consumption	approximately <1.5 W
Operating temperature range	10 to 40°C (50 to 104°F)
Non-operating temperature range	-25 to 60°C (-13 to 140°F)
Operating humidity range	10 to 90% RH non-condensing
Non-operating humidity range	10 to 90% RH non-condensing

E-sCAiO, E-sCO, and N-CAiO module specifications

Size (H x W x D)	112 x 37 x 205 mm (4.4 x 1.5 x 8.1 in)
Weight	0.7 kg (1.5 lb)
Cooling	Forced air
Power consumption	3.9 W, 5.8 W momentary
Operating temperature range	10 to 40°C (50 to 104°F)
Non-operating temperature range	-25 to 60°C (-13 to 140°F)
Operating humidity range	10 to 98% RH non-condensing
Non-operating humidity range	10 to 90% RH non-condensing
Operating altitude range	660 to 1060 mbar

E-miniC module specifications

Size (H x W x D)	112 x 37 x 209 mm (4.4 x 1.5 x 8.2 in)

Weight	0.4 kg (0.88 lb)
Operating temperature range	10 to 40°C (50 to 104°F)
Non-operating temperature range	-25 to 70°C (-13 to 158°F)
Operating humidity range	10 to 95% RH non-condensing
Non-operating humidity range	10 to 95% RH non-condensing
Operating altitude range	666 to 1060 mbar

E-ENTROPY module specifications

Size (H x W x D)	112 x 37 x 180 mm (4.4 x 1.5 x 7.1 in)
Weight	0.35 kg (0.77 lb)
Power consumption	1.5 W
Operating temperature range	10 to 40°C (50 to 104°F)
Non-operating temperature range	-20 to 60°C (-4 to 140°F)
Operating humidity range	10 to 90% RH non-condensing
Non-operating humidity range	10 to 90% RH non-condensing

E-NMT module specifications

Size (H x W x D)	112 x 37 x 186 mm (4.4 x 1.5 x 7.3 in)
Weight	0.35 kg (0.77 lb)
Power consumption	3.3 W
Operating temperature range	10 to 40°C (50 to 104°F)
Non-operating temperature range	-20 to 60°C (-4 to 140°F)
Operating humidity range	10 to 90% RH non-condensing
Non-operating humidity range	10 to 90% RH non-condensing
Operating altitude range	700 to 1060 mbar

E-BIS module specifications

Size (H x W x D)	112 x 37 x 189 mm (4.4 x 1.5 x 7.4 in)
Weight	0.3 kg (0.66 lb)
Power consumption	2.2 W
Operating temperature range	10 to 40°C (50 to 104°F)
Non-operating temperature range	-25 to 70°C (-13 to 158°F)
Operating humidity range	10 to 95% RH non-condensing
Non-operating humidity range	10 to 95% RH non-condensing
Operating altitude range	700 to 1060 mbar

Battery specifications

	High capacity battery	Basic battery
Battery type	lithium-ion	
Battery model	FLEX-3S2P	03-57490-001
Battery voltage	10.8V±10%	10.95V±10%
Operation time	Under certain conditions* B105M-OR: 4.5 hours B155M-OR/B125M-OR: 4 hours	Under certain conditions* B105M-OR: 2.5 hours B155M-OR/B125M-OR: 2 hours
Charging time	< 4 hours to 90% capacity, under certain conditions*	
*Conditions: The new battery has been fully charged and discharged for three cycles. Typical monitor configuration: ECG, SPO ₂ , and 15 minutes interval NIBP measurement. Screen brightness is set to 70%.		

WLAN specifications

Type	B1x5-01
Bands	2.4 GHz: Note the available channels for 802.11 b/g operation in the US are Channels 1 to 11. The range of channels is limited by firmware. 5.0 GHz: The use in the UNII (Unlicensed National Information Infrastructure) band 1 5150-5250 MHz band is restricted to indoor use only to reduce potential for harmful interference to co-channel mobile satellite systems. Any other use will make the operation of this device illegal.
Protocols	Radio support 802.11 abgn
RF output power	2.4 GHz EIRP: up to +18.83dBm 5 GHz EIRP: up to +16.42dBm NOTE: May be further restricted on some channels according to regulatory domain.
Data speed	Up to MCS15 (144 Mbps)
Radio RF standards	- USA: FCC Part 15.247, 15.401-15.407 - European Union: EN300328, EN301893 - Australia: AS/NZS 4268
Minimum RSSI value and data rate, which must be maintained in the coverage area to support application performance	RSSI Value: -65dBm Data rate: 54 Mbps
Maximum packet delay value before degradation of application quality	250 ms
Maximum packet loss value before degradation of application quality	5 drops per 1 million packets

On average, a given monitor uses 150-300 kbps of network bandwidth (i.e. usage) with a maximum of 500 kbps (i.e. 50 kbps times 10 patient views) limited in software by the 10-patient view requirement plus an additional 720 bps for on-demand HL7 traffic. GE recommends the wireless network to be

designed in such – that the Access Point utilization does not exceed 50% of full capacity for all wireless clients.

The monitor can reliably deliver patient data and alarms to the central station through WLAN Network under maximum data latency: 250 ms, this latency specification is based on the worst-case configuration as follow:

Configuration	Maximum
Number of Monitors in the system	1024
Number of Beds in each Care Unit	300
Number of real time patient views	10
Number of Monitors with active alarm conditions	205
CARESCAPE Gateway trend data requests interval	1 min

Alarm specifications

Alarm standards compliance

The system complies with IEC 60601-1-8/YY0709.

Auditory alarm volume

Tested in accordance with IEC 60601-1-8 subclause 6.3.3.2 with alarm volume control set to maximum.

Alarm volume can be adjusted from 45 to 85 dB.

Alarm volume setting	Sound pressure level
10	High priority: 72.0 dB average Medium priority: 64.9 dB average Low priority: 54.5 dB average
1	High priority: 57.9 dB average Medium priority: 51.6 dB average Low priority: 40.6 dB average

Audio alarm sound tolerances

General alarm tone sound patterns

Priority	Corresponding sound pattern
High	• Beep (500 ms) Silence (500 ms) Frequency: 815 Hz
Medium	• Beep (500 ms) Silence (500 ms) • Beep (500 ms) Silence (5 s) Frequency: 815 Hz
Low	• Beep (500 ms) Silence (30 s) Frequency: 815 Hz

IEC alarm tone sound patterns

Priority	Corresponding sound pattern
High	• Beep “C” (373 Hz/80 ms) Silence (120 ms) • Beep “F” (498 Hz/80 ms) Silence (120 ms) • Beep “G” (560 Hz/80 ms) Silence (320 ms) • Beep “A” (628 Hz/80 ms) Silence (120 ms) • Beep “B” (705 Hz/80 ms) Silence (1020 ms) • Beep “C” (373 Hz/80 ms) Silence (120 ms) • Beep “F” (498 Hz/80 ms) Silence (120 ms) • Beep “G” (560 Hz/80 ms) Silence (320 ms) • Beep “A” (628 Hz/80 ms) Silence (120 ms) • Beep “B” (705 Hz/80 ms) Silence (5 s)
Medium	• Beep “C” (373 Hz/150 ms) Silence (250 ms) • Beep “G” (560 Hz/150 ms) Silence (250 ms) • Beep “B” (705 Hz/150 ms) Silence (19 s)
Low	• Beep “C” (373 Hz/150 ms) Silence (30 s)

ISO alarm tone sound patterns

Priority	Corresponding sound pattern
High	• Beep (100 ms) Silence (100 ms) • Beep (100 ms) Silence (100 ms) • Beep (100 ms) Silence (200 ms) • Beep (100 ms) Silence (100 ms) • Beep (100 ms) Silence (1 s) • Beep (100 ms) Silence (100 ms) • Beep (100 ms) Silence (100 ms) • Beep (100 ms) Silence (200 ms) • Beep (100 ms) Silence (100 ms) • Beep (100 ms) Silence (5 s) Frequency: 815 Hz
Medium	• Beep (200 ms) Silence (200 ms) • Beep (200 ms) Silence (200 ms) • Beep (200 ms) Silence (19 s) Frequency: 815 Hz
Low	• Beep (500 ms) Silence (30 s) Frequency: 815 Hz

ISO2 alarm tone sound patterns

Priority	Corresponding sound pattern
High	• Beep “C” (523 Hz/80 ms) Silence (120 ms) • Beep “F” (698 Hz/80 ms) Silence (120 ms) • Beep “G” (784 Hz/80 ms) Silence (220 ms) • Beep “A” (880 Hz/80 ms) Silence (120 ms) • Beep “B” (988 Hz/80 ms) Silence (1020 ms) • Beep “C” (523 Hz/80 ms) Silence (120 ms) • Beep “F” (698 Hz/80 ms) Silence (120 ms) • Beep “G” (784 Hz/80 ms) Silence (220 ms) • Beep “A” (880 Hz/80 ms) Silence (120 ms) • Beep “B” (988 Hz/80 ms) Silence (5 s)
Medium	• Beep “C” (523 Hz/115 ms) Silence (185 ms) • Beep “G” (784 Hz/115 ms) Silence (185 ms) • Beep “B” 988 Hz/115 ms) Silence (19.5 s)
Low	• Beep “C” (523 Hz/380 ms) Silence (30 s)

Auditory information signal characteristics

Measurement and start-up related information signals		
Signal	Frequency (Hz)	Duration (ms)
Start-up sound	523	1000
HR beat beep	815	10
Completed NIBP volume	250	500
Reminder tone	523	125

Visual information signals

For information regarding visual information signals, see the user’s manual.

Alarm broadcast mapping

Feature	Message on the bedside monitor	Message displayed on the central station/remote monitor
ECG	Tachy	TACHY
ECG	Brady	BRADY
ECG	ST Ant high	ST ANT HIGH
ECG	ST Ant low	ST ANT LOW
ECG	ST Inf high	ST INF HIGH
ECG	ST Inf low	ST INF LOW
ECG	ST Lat high	ST LAT HIGH

Feature	Message on the bedside monitor	Message displayed on the central station/remote monitor
ECG	ST Lat low	ST LAT LOW
ECG	Frequent PVCs	FREQUENT PVCS
ECG	Frequent SVCs	FREQUENT SVCS
ECG	Asystole	ASYSTOLE
ECG	V Fib / V Tach	V FIB/V TACH
ECG	V Tach	V TACH
ECG	ECG measurements removed	ECG REMOVED
ECG	Arrh Paused	ARRH PAUSED
ECG	Leads off	LEADS OFF
ECG	Lead off	LEAD OFF
ECG	ECG module error	ECG MOD ERROR
RESP	RR (Imped.) high	RR IMP. HIGH
RESP	RR (Imped.) low	RR IMP. LOW
RESP	Apnea (Imped.)	APNEA IMP.
RESP	Lead I failed	LD I FAIL
RESP	Lead II failed	LD II FAIL
RESP	Lead RL-LL failed	RL-LL FAIL
NIBP	NIBP DIA high NIBP SYS high NIBP MAP high	NIBP HIGH
NIBP	NIBP DIA low NIBP SYS low NIBP MAP low	NIBP LOW
NIBP	NIBP measurement removed	NIBP REMOVED
NIBP	Check NIBP	CHECK NIBP
NIBP	NIBP cuff occlusion	OCCCLUSION
NIBP	NIBP cuff loose	CUFF LOOSE
IBP	Art Sys high Art Dia high Art Mean high	ART HIGH
IBP	ABP Sys high ABP Dia high ABP Mean high	ABP HIGH
IBP	CVP Sys high CVP Dia high CVP Mean high	CVP HIGH
IBP	IBP1 Sys high IBP1 Dia high IBP1 Mean high	P1 HIGH

Feature	Message on the bedside monitor	Message displayed on the central station/remote monitor
IBP	IBP2 Sys high IBP2 Dia high IBP2 Mean high	P2 HIGH
IBP	IBP8 Sys high IBP8 Dia high IBP8 Mean high	P8 HIGH
IBP	ICP Sys high ICP Dia high ICP Mean high	ICP HIGH
IBP	LAP Sys high LAP Dia high LAP Mean high	LAP HIGH
IBP	PA Sys high PA Dia high PA Mean high	PA HIGH
IBP	RAP Sys high RAP Dia high RAP Mean high	RAP HIGH
IBP	RVP Sys high RVP Dia high RVP Mean high	RVP HIGH
IBP	UAC Sys high UAC Dia high UAC Mean high	UAC HIGH
IBP	UVC Sys high UVC Dia high UVC Mean high	UVC HIGH
IBP	Art Sys low Art Dia low Art Mean low	ART LOW
IBP	ABP Sys low ABP Dia low ABP Mean low	ABP LOW
IBP	CVP Sys low CVP Dia low CVP Mean low	CVP LOW
IBP	IBP1 Sys low IBP1 Dia low IBP1 Mean low	P1 LOW

Feature	Message on the bedside monitor	Message displayed on the central station/remote monitor
IBP	IBP2 Sys low IBP2 Dia low IBP2 Mean low	P2 LOW
IBP	IBP8 Sys low IBP8 Dia low IBP8 Mean low	P8 LOW
IBP	ICP Sys low ICP Dia low ICP Mean low	ICP LOW
IBP	LAP Sys low LAP Dia low LAP Mean low	LAP LOW
IBP	PA Sys low PA Dia low PA Mean low	PA LOW
IBP	RAP Sys low RAP Dia low RAP Mean low	RAP LOW
IBP	RVP Sys low RVP Dia low RVP Mean low	RVP LOW
IBP	UAC Sys low UAC Dia low UAC Mean low	UAC LOW
IBP	UVC Sys low UVC Dia low UVC Mean low	UVC LOW
IBP	No Px transducer	NO PX TRANSD
IBP	InvBP's not zeroed	IP NOT ZEROED
IBP	P1 over range	P1 OVER RNG
IBP	P2 over range	P2 OVER RNG
IBP	P8 over range	P8 OVER RNG
IBP	P1 under range	P1 UNDER RG
IBP	P2 under range	P2 UNDER RG
IBP	P8 under range	P8 UNDER RG
IBP, Temperature	STP measurements removed	STP REMOVED
IBP	Art disconnect	ART DISCONN
IBP	ABP disconnect	ABP DISCONN
IBP	UAC disconnect	UAC DISCONN
SpO ₂	SpO2 high	SPO2 HIGH

Feature	Message on the bedside monitor	Message displayed on the central station/remote monitor
SpO ₂	SpO2 low	SPO2 LOW
SpO ₂	No SpO2 pulse	NO SPO2 PULSE
SpO ₂	SpO2 probe off	SPO2 PROBE
SpO ₂	No SpO2 probe	NO SPO2 PROBE
SpO ₂	Check SpO2 probe SpO2 faulty probe	SPO2 FAULTY
SpO ₂	Incompatible SpO2 Probe	SPO2 INCOMPAT
SpO ₂	Identical SpO2 modules	SPO2 IDENT
SpO ₂	SpO2 measurement removed	SPO2 REMOVED
Temperature	T1 high	T1 HIGH
Temperature	T2 high	T2 HIGH
Temperature	T1 low	T1 LOW
Temperature	T2 low	T2 LOW
Temperature	Tblood high	TBLOOD HIGH
Temperature	Tblood low	TBLOOD LOW
Temperature	T1 temperature error T2 temperature error	TEMP ERROR
C.O.	C.O. measurement removed	CO REMOVED
C.O.	Identical C.O. modules	IDENTICAL CO
Gases	RR (CO2) high	RR CO2 HIGH
Gases	RR (CO2) low	RR CO2 LOW
Gases	Apnea (CO2)	APNEA CO2
Gases	Apnea (Anes CO2)	VENT CO2 APN
Gases	EtCO2 high	ETCO2 HIGH
Gases	EtCO2 low	ETCO2 LOW
Gases	FiCO2 high	FICO2 HIGH
Gases	FiCO2 low	FICO2 LOW
Gases	EtO2 high	ETO2 HIGH
Gases	EtO2 low	ETO2 LOW
Gases	FiO2 high	FIO2 HIGH
Gases	FiO2 low	FIO2 LOW
Gases	Etxxx high (xxx: Hal, Enf, Iso, Sev, Des)	ETAA HIGH
Gases	Etxxx low	ETAA LOW
Gases	Fixxxhigh	FIAA HIGH
Gases	Fixxxlow	FIAA LOW
Gases	FiN2O high	FIN2O HIGH
Gases	Agent Mixture	AGENT MIXTURE

Feature	Message on the bedside monitor	Message displayed on the central station/remote monitor
Gases	Identical gas modules	MODULE ERROR
Gases	Failure in Agent ID	CHECK GAS
Gases	Service gas module	SERVICE GAS
Gases	Multiple agents present	MULTI AGENTS
Gases	Sample line blocked	BLOCKED LINE
Gases	Check sample gas out	SAMPLE GAS
Gases	Check water trap	WATER TRAP?
Gases	Gas measurements removed	GAS REMOVED
Entropy	Entropy RE high	RE HIGH
Entropy	Entropy RE low	RE LOW
Entropy	Entropy SE high	SE HIGH
Entropy	Entropy SE low	SE LOW
Entropy	Identical Entropy modules	ENTROPY IDENT
Entropy	Entropy measurement removed	ENTROPY REMOV
NMT	NMT measurement removed	NMT REMOVED
NMT	Identical NMT modules	NMT IDENT
Monitor battery	Battery empty	BATT EMPTY
BIS	BIS high	BIS HIGH
BIS	BIS low	BIS LOW
BIS	BIS measurement removed	BIS REMOVED
BIS	Identical BIS modules	BIS IDENT
BIS	BIS module error	BIS MOD ERR
Monitor sound	Audio fail	AUDIO FAIL
Monitor speaker	Speaker failure	SPEAKER FAIL
Spirometry	TVexp low	TVEXP LOW
Spirometry	TVexp high	TVEXP HIGH
Spirometry	Ppeak low	PPEAK LOW
Spirometry	Ppeak high	PPEAK HIGH
Spirometry	MVexp low	MVEXP LOW
Spirometry	MVexp high	MVEXP HIGH
Spirometry	Anes: Apnea	VENT APNEA
ECG full arrhythmia	VT > 2	VT > 2
ECG full arrhythmia	R on T	R ON T
ECG full arrhythmia	V Brady	V BRADY
ECG full arrhythmia	Couplet	COUPLET
ECG full arrhythmia	Bigeminy	BIGEMINY

ECG full arrhythmia	Accel. Ventric.	ACC VENT
ECG full arrhythmia	Trigeminy	TRIGEMINY
ECG full arrhythmia	Multifocal PVCs	MULTIFOC PVCS
ECG full arrhythmia	A Fib	ATRIAL FIB
ECG full arrhythmia	Missing Beat	MISSING BEAT
ECG full arrhythmia	Pause	PAUSE
ECG full arrhythmia	SV Tachy	SV TACHY
ECG full arrhythmia	Irregular	IRREGULAR

Physiological alarm limits specifications

Alarm limits specifications for ECG alarms

The following table lists the alarm limits for physiological alarms related to the ECG measurement.

Alarm	Limit range	Limit increment
Asystole	NA	NA
Brady	20 to 295 bpm The Brady limit matches the low heart rate limit. If the low heart rate limit is changed, the Brady limit changes.	5 bpm
ST Ant high ST Inf high ST Lat high	-6.0 to +6.0 mm	0.1 mm
ST Ant low ST Inf low ST Lat low	-6.0 to +6.0 mm	0.1 mm
Tachy	25 to 300 bpm The Tachy limit matches the high heart rate limit. If the high heart rate limit is changed, the Tachy limit changes.	5 bpm
V Fib / V Tach	NA	NA
V Tach	NA	NA
A Fib	NA	NA
Accel. Ventric.	NA	NA
Bigeminy	NA	NA
Couplet	NA	NA
Frequent PVCs	1 to 100 per minute	1 per minute
Frequent SVCs	1 to 100 per minute	1 per minute

Irregular	NA	NA
Missing Beat	NA	NA
Multifocal PVCs	NA	NA
Pause	NA	NA
R on T	NA	NA
SV Tachy	4 to 10 beats	2 beats
Trigeminy	NA	NA
V Brady	NA	NA
VT > 2	NA	NA

Alarm limits specifications for impedance respiration alarms

The following table lists the alarm limits for physiological alarms related to the impedance respiration measurement.

Alarm	Limit range	Limit increment
Apnea Apnea (Imped.) APN	NA	NA
RR (Imped.) high	4 to 120 breaths per minute	1 breath per minute
RR (Imped.) low	4 to 120 breaths per minute	1 breath per minute

Alarm limits specifications for SpO₂ alarms

The following table lists the alarm limits for physiological alarms related to the SpO₂ measurement.

Alarm	Limit range	Limit increment
No pulse No SpO₂ pulse	NA	NA
SpO₂ high	51 to 100%	1%
SpO₂ low	50 to 100%	1%

Alarm limits specifications for NIBP alarms

The following table lists the alarm limits for physiological alarms related to the non-invasive blood pressure measurement.

Alarm	Limit range	Limit increment
NIBP SYS high NIBP SYS low	A/P: 30 to 290 mmHg NEO: 30 to 140 mmHg	5 mmHg
NIBP DIA high NIBP DIA low	A/P: 10 to 220 mmHg NEO: 10 to 110 mmHg	5 mmHg
NIBP MAP high NIBP MAP low	A/P: 20 to 260 mmHg NEO: 20 to 125 mmHg	5 mmHg

Alarm limits specifications for invasive pressures alarms

The following table lists the alarm limits for physiological alarms related to the invasive pressures measurement.

Alarm	Limit range	Limit increment
ABP Sys high / ABP Dia high / ABP Mean high Art Sys high / Art Dia high / Art Mean high CVP Sys high / CVP Dia high / CVP Mean high PA Sys high / PA Dia high / PA Mean high ICP Sys high / ICP Dia high / ICP Mean high LAP Sys high / LAP Dia high / LAP Mean high IBP1 Sys high / IBP1 Dia high / IBP1 Mean high IBP2 Sys high / IBP2 Dia high / IBP2 Mean high IBP8 Sys high / IBP8 Dia high / IBP8 Mean high RAP Sys high / RAP Dia high / RAP Mean high RVP Sys high / RVP Dia high / RVP Mean high UAC Sys high / UAC Dia high / UAC Mean high UVC Sys high / UVC Dia high / UVC Mean high	-40 to 320 mmHg (-5.3 to 42.7 kPa)	-40 to 39 mmHg (-5.3 to 5.2 kPa): 1 mmHg (0.13 kPa) 40 to 320 mmHg (5.3 to 42.7 kPa): 5 mmHg (0.67 kPa)

Alarm	Limit range	Limit increment
ABP Sys low / ABP Dia low / ABP Mean low Art Sys low / Art Dia low / Art Mean low CVP Sys low / CVP Dia low / CVP Mean low PA Sys low / PA Dia low / PA Mean low ICP Sys low / ICP Dia low / ICP Mean low LAP Sys low / LAP Dia low / LAP Mean low IBP1 Sys low / IBP1 Dia low / IBP1 Mean low IBP2 Sys low / IBP2 Dia low / IBP2 Mean low IBP8 Sys low / IBP8 Dia low / IBP8 Mean low RAP Sys low / RAP Dia low / RAP Mean low RVP Sys low / RVP Dia low / RVP Mean low UAC Sys low / UAC Dia low / UAC Mean low UVC Sys low / UVC Dia low / UVC Mean low		

Alarm limits specifications for temperature alarms

The following table lists the alarm limits for physiological alarms related to the temperature measurement.

Alarm	Limit range	Limit increment
T1 high T1 low T2 high T2 low	10 to 45°C (50 to 113°F)	0.1°C (0.18°F)
Tblood high Tblood low	17.5 to 43°C (63.5 to 109.4°F)	0.1°C (0.18°F)

Alarm limits specifications for airway gases alarms

The monitor only supports the adjustment of the airway gas alarm limit from the gas modules. The monitor does not support the adjustment of the airway gas alarm limit from the anesthesia machine. The airway gases alarm limits from anesthesia machine can only be displayed on the monitor screen.

Alarm	Limit range	Limit increment
Apnea (Imped.) / APN / Apnea (CO2)	NA	NA
EtCO2 high / EtCO2 low	0 to 13%	0.1%

Alarm	Limit range	Limit increment
FiCO2 high / FiCO2 low	0 to 3%	0.1%
EtO2 high / EtO2 low	10 to 100%	1%
FiO2 high / FiO2 low	18 to 100%	1%
Etxxx high (xxx: Hal, Enf, Iso, Sev, Des) / Et xxx low	AA, HAL, ENF, ISO: 0 to 6% SEV: 0 to 8% DES: 0 to 20%	AA, HAL, ENF, ISO, SEV: 0.1% DES: 0.5%
Fixxx high / Fixxx low	AA, HAL, ENF, ISO: 0 to 6% SEV: 0 to 8% DES: 0 to 20%	AA, HAL, ENF, ISO, SEV: 0.1% DES: 0.5%
FiN2O high	82%	NA
RR (CO2) high / RR (CO2) low	Adult/Pediatric: 4 to 60 breaths per minute Neonatal : 4 to 100 breaths per minute	1 breath per minute

Alarm limits specifications for spirometry alarms

This monitor does not support adjustment of spirometry alarms limit from anesthesia machine. The monitor can only display the spirometry alarms from the anesthesia machine.

Alarm	Limit range	Limit increment
Ppeak high / Ppeak low	-20 to 100 cmH2O -20 to 98 hPa -20 to 98 mbar -15 to 74 mmHg -2.0 to 9.8 kPa	1 cmH2O 1 hPa 1 mbar 1 mmHg 0.1 kPa
MVexp high / MVexp low	0 to 60 l/min	0.1 l/m
TVexp high / TVexp low	0 to 3200 ml	1 ml

Alarm limits specifications for Entropy alarms

The following table lists the alarm delays for physiological alarms related to the Entropy measurement.

Alarm	Limit range	Limit increment
Entropy RE high	0 to 100	1
Entropy RE low	0 to 100	1
Entropy SE high	0 to 91	1
Entropy SE low	0 to 91	1

Alarm limits specifications for NMT alarms

The following table lists the alarm limits for physiological alarms related to the NMT measurement.

Alarm	Limit range	Limit increment
Block recovery	• 1 to 4 count	• 1 count

Alarm limits specifications for BIS alarms

The following table lists the alarm limits for physiological alarms related to the BIS measurement.

Alarm	Limit range	Limit increment
BIS high	0 to 100	1
BIS low	0 to 100	1

Alarm delay specifications

The alarm system delay consists of two components:

- Alarm signal detection delay: <3 s
- Fixed delay of the algorithm and monitor software: see following list for alarm priorities and escalations

Possible interferences and poor quality signals in a clinical environment may extend the disclosed alarm system delays.

Local alarm condition delay to output port: <5 s

Time to alarm for tachycardia

When tested in accordance to YY1079 4.1.2.1g and IEC 60601-2-27 201.7.9.2.9.101b 6), the time to alarm for tachycardia is as follows:

Ventricular tachycardia (206 bpm); halved amplitude: 9.9 s (average) (5.8 to 11.5 s range)
Ventricular tachycardia (206 bpm); normal amplitude: 7.1 s (average) (4.5 to 9.2 s range)
Ventricular tachycardia (206 bpm); doubled amplitude: 4.4 s (average) (3.5 to 6.2 s range)
Ventricular tachycardia (195 bpm); halved amplitude: 7.0 s (average) (4.8 to 8.5 s range)
Ventricular tachycardia (195 bpm); normal amplitude: 5.8 s (average) (3.5 to 8.5 s range)
Ventricular tachycardia (195 bpm); doubled amplitude: 6.1 s (average) (3.5 to 8.5 s range)

Alarm priorities and escalations

Alarm priorities and escalation times for ECG

The following table shows related messages with their priorities and escalation times. In the table, the message location is indicated by the following: MF = message field; DF = digit field; WF = waveform field. For more information on alarm messages, refer to the user's manual.

MESSAGE	LOCATION	ALARM PRIORITY SETTING	PRIORITIES AND ESCALATION TIMES			
			info	low	medium	high
Alarm setup changed from Central	MF		0 s			
Arrhythmia Paused	WF	High, Medium, Low		0s, according to priority setting		
		Escalating			0 s	
Arrh Paused	MF	High, Medium, Low		0s, according to priority setting		
	MF	Escalating			0 s	40 s
Artifact	WF		0 s			
Asystole ASY	MF, WF DF					0 s
Brady	MF, WF	High, Medium, Low		0s, according to priority setting		
		Escalating			0 s	69 s
		Escalating (when HR <0.75 x low limit, and ECG as a primary source)				0 s
ECG module error	MF				0 s	
ECG measurements removed	MF		5 s		5 s	
Frequent PVCs	MF	High, Medium, Low, Info	2s, according to priority setting			
		Escalating			2 s	71 s
	WF		0 s			
Frequent SVCs	MF, WF	High, Medium, Low, Info	0s, according to priority setting			
		Escalating		0 s	13 s	
Incompatible ECG firmware	MF			3 s		
LA/L lead off LL/F lead off RA/R lead off V/C lead off V2/C2 lead off V3/C3 lead off V4/C4 lead off V5/C5 lead off V6/C6 lead off	WF		0 s			
RL/N lead off			0s, after Lead off disappears.			
Lead changed	WF		0 s			

MESSAGE	LOCATION	ALARM PRIORITY SETTING	PRIORITIES AND ESCALATION TIMES			
			info	low	medium	high
Lead off	MF	Low, Info	7 s, according to priority setting, (after "xxx lead off" message appears in WF)			
Leads off	MF	High, Medium, Low		3 s, according to priority setting		
		Escalating		3 s	12 s	60 s
	WF		0 s			
ST Ant high / ST Ant low ST Inf high / ST Inf low ST Lat high / ST Lat low	MF	High, Medium, Low, Info	60 s, according to priority setting			
Tachy	MF, WF	High, Medium, Low		0s, according to priority setting		
		Escalating			0 s	69 s
		Escalating (when HR >1.25 x high limit, and ECG as a primary source)				0 s
V Fib / V Tach	MF, WF					8 s
V Tach	MF, WF	High, Medium, Low, Info	0s, according to priority setting			
	DF	High, Medium			0s, according to priority setting	
		 NOTE The alarm priority is always high if the duration is over 30 s, the set HR high limit is exceeded, and the HR is over 180 in NEONATAL mode or over 150 in all other modes.				
A Fib	MF, WF		0s, according to priority setting			
Accelerated Ventricular	MF, WF		0s, according to priority setting			
Bigeminy	MF, WF		0s, according to priority setting			
Couplet	MF, WF		0s, according to priority setting			
Irregular	MF, WF		0s, according to priority setting			
Missing Beat	MF, WF		0s, according to priority setting			
Multifocal PVCs	MF, WF		0s, according to priority setting			
Pause	MF, WF		0s, according to priority setting			
R on T	MF, WF		0s, according to priority setting			
SV Tachy	MF, WF		0s, according to priority setting			
Trigeminy	MF, WF		0s, according to priority setting			

V Brady	MF, WF		0s, according to priority setting
VT > 2	MF, WF		0s, according to priority setting

Alarm priorities and escalation times for impedance respiration

The following table shows related messages with their priorities and escalation times. In the table, the message location is indicated by the following: MF = message field; DF = digit field; WF = waveform field. For more information on alarm messages, refer to the user's manual.

MESSAGE	LOCATION	PRIORITY SETTING	PRIORITIES AND ESCALATION TIMES			
			info	low	medium	high
Apnea Apnea (Imped.) APN	MF, WF, DF	Low, Medium, High		X s (X = adjustable limit), according to priority setting		
		Escalating		X s	X + 30 s	X + 60 s
Apnea deactivated	DF		0 s			
Check electrodes	WF, DF		5 s			
Lead I failed Lead II failed Lead RL-LL failed	WF, DF		2 s			
			2 s (If disconnect RL, 0s after Measurement off disappears)			
Learning	WF, DF		0 s			
Measurement off OFF	WF, DF DF		0 s			
Resp artifact	WF, DF		0 s			
RR (Imped.) high RR (Imped.) low	MF	Low, High, Medium		20 s, according to priority setting		
		Escalating		20 s	60 s	
Small resp curve	DF		0 s			

Alarm priorities and escalation times for SpO₂

The following table shows related messages with their priorities and escalation times. In the table, the message location is indicated by the following: MF = message field; DF = digit field; WF = waveform field. For more information on alarm messages, refer to the user's manual.

During the NIBP measurement, the new **SpO2 high**, **SpO2 low** alarms will de-escalate to the low priority.

MESSAGE	LOCATION	PRIORITY SETTING	PRIORITIES AND ESCALATION TIMES			
			info	low	medium	high
Check Device	DF		0 s			
Check Probe	DF		10 s	5 s	30 s	

MESSAGE	LOCATION	PRIORITY SETTING	PRIORITIES AND ESCALATION TIMES			
			info	low	medium	high
Check SpO2 probe	MF			5 s	30 s	
Faulty Probe	DF		5 s	5 s	30 s	
Identical SpO2 modules	MF				0 s	
Incompatible Probe	DF		0 s	5 s	30 s	
Incompatible SpO2 Probe	MF			5 s	30 s	
Interference	DF		0 s			
Low Perfusion	DF		0 s			
Low signal quality	DF		0 s			
No Probe	DF		5 s	5 s	30 s	
No SpO2 probe	MF			5 s	30 s	
No Pulse	DF		8 s	10 s	15 s, escalates to Medium only if HR source is AUTO or pleth	
No SpO2 pulse	MF			10 s	15 s, escalates to Medium only if HR source is AUTO or pleth	
Poor Signal	DF		0 s			
Probe Off	DF	High, Medium, Low		0 s, according to priority setting		
		Escalating	5 s	5 s	30 s	
Pulse Search	DF		0 s			
SpO2 faulty probe	MF			5 s	30 s	
SpO2 high	MF	High, Medium, Low		10 s, according to priority setting		
		Escalating		10 s, de-escalate to low when NIBP cuff pressure is over 30 mmHg	10 s	42 s
SpO2 low	MF	High, Medium, Low		10 s, according to priority setting For Masimo: Alarm delay time, or 0 s when SpO ₂ value below low limit more than 5%		

MESSAGE	LOCATION	PRIORITY SETTING	PRIORITIES AND ESCALATION TIMES			
			info	low	medium	high
		Escalating		10 s, de-escalate to low when NIBP cuff pressure is over 30 mmHg	10 s For Masimo: Alarm delay time, or 0 s when SpO ₂ value below low limit more than 5%	42 s For Masimo: Alarm delay time + 32 s, or 32 s when SpO ₂ value below low limit more than 5%
SpO₂ measurement removed	MF		5 s (patient discharged)		5 s (patient admitted)	
SpO₂ module error	MF				0 s	
STP module error	MF				0 s	
Incompatible Masimo	MF					0 s
Identical STP modules	MF				0 s	
SpO₂ probe off	MF	High, Medium, Low		5 s, according to priority setting		
		Escalating		5 s	30 s	

Alarm priorities and escalation times for NIBP

The following table shows related messages with their priorities and escalation times. In the table, the message location is indicated by the following: MF = message field; DF = digit field; WF = waveform field. For more information on alarm messages, refer to the user's manual.

MESSAGE	LOCATION	ALARM PRIORITY SETTING	PRIORITIES AND ESCALATION TIMES			
			info	low	medium	high
Call service: Error x where x = 0 - 18	DF				0 s	
Check NIBP	MF				If measurement finished, but value is missing: 0 s If measurement interrupted: 15 s	
Cuff loose	DF				< 30 s	
Cuff occlusion	DF				0 s	
Cuff overpressure displays for 10 s	DF				0 s	
Long measurement time displays for 10 s	MF, DF				0 s	

MESSAGE	LOCATION	ALARM PRIORITY SETTING	PRIORITIES AND ESCALATION TIMES			
			info	low	medium	high
NIBP call service error	MF				0 s	
NIBP cuff loose	MF				< 30 s	
NIBP cuff occlusion	MF				0 s	
NIBP cuff overpressure	MF				0 s	
NIBP manual	MF				0 s	
NIBP SYS high / NIBP SYS low NIBP MAP high / NIBP MAP low NIBP DIA high / NIBP DIA low	MF	High, Medium, Low		0 s, according to priority setting		
NIBP measurement removed	MF		5 s		5 s	
Select cuff size	MF		0 s			
Unstable zero pressure displays for 10 s	DF		0 s			
Weak pulsation	MF, DF				0 s	

Alarm priorities and escalation times for invasive pressures

The following table shows related messages with their priorities and escalation times. In the table, the message location is indicated by the following: MF = message field; DF = digit field; WF = waveform field. For more information on alarm messages, refer to the user's manual.

MESSAGE	LOCATION	ALARM PRIORITY SETTING	PRIORITIES AND ESCALATION TIMES			
			info	low	medium	high
ABP disconnect Art disconnect UAC disconnect	MF					5 s
ABP Sys high / ABP Sys low	MF	High, Medium, Low		0 s, according to priority setting		
ABP Mean high / ABP Mean low ABP Dia high / ABP Dia low		Escalating			0 s	0 s if Brady/Tachy alarm also present
Art Sys high / Art Sys low	MF	High, Medium, Low		0 s, according to priority setting		
Art Mean high / Art Mean low ArtDia high / Art Dia low		Escalating			0 s	0 s if Brady/Tachy alarm also present

MESSAGE	LOCATION	ALARM PRIORITY SETTING	PRIORITIES AND ESCALATION TIMES			
			info	low	medium	high
Calibrating Displays for 10 s	Menu		0 s			
Calibrated	Menu		0 s			
CVP Sys high / CVP Sys low	MF	High, Medium, Low		0 s, according to priority setting		
CVP Mean high / CVP Mean low		Escalating			0 s	0 s if Brady/Tachy alarm also present
CVP Dia high / CVP Dia low						
Failed	Menu		0 s			
Failed: P<100	Menu		0 s			
IBP1 Sys high / IBP1 Sys low to IBP8 Sys high / IBP8 Sys low	MF	High, Medium, Low		0 s, according to priority setting		
IBP1 Mean high / IBP1 Mean low to IBP8 Mean high / IBP8 Mean low		Escalating			0 s	0 s if Brady/Tachy alarm also present
IBP1 Dia high / IBP1 Dia low to IBP8 Dia high / IBP8 Dia low						
ICP Sys high / ICP Sys low	MF	High, Medium, Low		0 s, according to priority setting		
ICP Mean high / ICP Mean low		Escalating			0 s	0 s if Brady/Tachy alarm also present
ICP Dia high / ICP Dia low						
InvBP's not zeroed	MF		8 s	300 s		
LAP Sys high / LAP Sys low	MF	High, Medium, Low		0 s, according to priority setting		
LAP Mean high / LAP Mean low		Escalating			0 s	0 s if Brady/Tachy alarm also present
LAP Dia high / LAP Dia low						
No Px transducer	MF			3 s	30 s	
Not Zeroed	DF		8 s			
Over range > 320 mmHg or Over range > 43 kPa Under range < -40 mmHg or Under range < -5 kPa Under range < -30 mmHg or Under range < -4 kPa	DF		0 s			

MESSAGE	LOCATION	ALARM PRIORITY SETTING	PRIORITIES AND ESCALATION TIMES			
			info	low	medium	high
P1 over range / P2 over range / P8 over range P1 under range / P2 under range / P8 under range	MF				0 s	
PA Sys high / PA Sys low PA Mean high / PA Mean low PA Dia high / PA Dia low	MF	High, Medium, Low		0 s, according to priority setting		
		Escalating			0 s	0 s if Brady/Tachy alarm also present
RAP Sys high / RAP Sys low RAP Mean high / RAP Mean low RAP Dia high / RAP Dia low	MF	High, Medium, Low		0 s, according to priority setting		
		Escalating			0 s	10 s if Brady/Tachy alarm also present
RVP Sys high / RVP Sys low RVP Mean high / RVP Mean low RVP Dia high / RVP Dia low	MF	High, Medium, Low		0 s, according to priority setting		
		Escalating			0 s	0 s if Brady/Tachy alarm also present
STP measurements removed	MF		5 s		5 s	
UAC Sys high / UAC Sys low UAC Mean high / UAC Mean low UAC Dia high / UAC Dia low	MF	High, Medium, Low		0 s, according to priority setting		
		Escalating			0 s	0 s if Brady/Tachy alarm also present
UVC Sys high / UVC Sys low UVC Mean high / UVC Mean low UVC Dia high / UVC Dia low	MF	High, Medium, Low		0 s, according to priority setting		
		Escalating			0 s	0 s if Brady/Tachy alarm also present
Zero adj > 100 mmHg	DF		0 s			
Zero ICP separately	MF		0 s			
Zeroed	DF		0 s			
Zeroing	DF		0 s			
Zeroing failed	DF		0 s			
Out of range	DF		0 s			

Alarm priorities and escalation times for temperature

The following table shows related messages with their priorities and escalation times. In the table, the message location is indicated by the following: MF = message field; DF = digit field; WF = waveform field. For more information on alarm messages, refer to the user's manual.

MESSAGE	LOCATION	ALARM PRIORITY SETTING	PRIORITIES AND ESCALATION TIMES			
			info	low	medium	high
Performing temp test	DF		0 s			
STP measurements removed	MF		5 s		5 s	
T1 high / T1 low T2 high / T2 low Tblood high / Tblood low	MF	Medium, Low		60 s	120 s	
T1 temperature error T2 temperature error	MF				0 s	
Temperature error	DF		0 s			

Alarm priorities and escalation times for cardiac output

The following table shows related messages with their priorities and escalation times. In the table, the message location is indicated by the following: MF = message field; DF = digit field; WF = waveform field. For more information on alarm messages, refer to the user's manual.

MESSAGE	LOCATION	ALARM PRIORITY SETTING	PRIORITIES AND ESCALATION TIMES			
			info	low	medium	high
C.O. measurement removed	MF		5 s		5 s	
C.O. module error	MF				0 s	
Confirm C.O.	DF, MF		0 s			
Identical C.O. modules	MF				0 s	
Service C.O. module	MF			0 s		
Unstable Tblood	DF		0 s			

Alarm priorities and escalation times for airway gases

The following table shows related messages with their priorities and escalation times. In the table, the message location is indicated by the following: MF = message field; DF = digit field; WF = waveform field. For more information on alarm messages, refer to the user's manual.

MESSAGE	LOCATION	PRIORITY SETTING	PRIORITIES AND ESCALATION TIMES			
			info	low	medium	high
Apnea (CO2) Apnea APN	MF, DF, WF	High, Medium, Low		20 s, according to priority setting		
	MF	Escalating		20 s	50 s	80 s
	DF, WF			20 s		
Agent Mixture	MF			0 s, MAC/ MACage<3	0 s, MAC/ MACage>=3	
Agent inaccurate	MF			20 s		
Apnea deactivated	DF		0 s			
Calibrating gas sensor	WF		0 s			
Check water trap and sample gas out. Wait 30 sec and press Home to continue.	WF			40 s		
Check water trap	WF, DF		0 s			
	MF			40 s	60 s	
Check sample gas out	WF, DF		0 s			
	MF			40 s	60 s	
CO2 over scale	WF		0 s			
CO2 inaccurate	MF			20 s		
Continuous blockage. Check sample line and water trap.	WF			40 s		
Etxxx high (xxx: Hal, Enf, Iso, Sev, Des)	MF			20 s	90 s	183 s
Etxxx low	MF			20 s	90 s	
EtCO2 high EtCO2 low	MF	High, Medium			20 s, according to priority setting	
		Escalating		20 s	60 s	
EtO2 high	MF			20 s	20 s	
EtO2 low	MF			20 s	20 s	82 s or 20 s (when EtO ₂ <10%)
Failure in Agent ID	MF				0 s	
	DF		0 s			
Fixxx high	MF	High, Medium			20 s, according to priority setting	
		Escalating		20 s	180 s	273 s

MESSAGE	LOCATION	PRIORITY SETTING	PRIORITIES AND ESCALATION TIMES			
			info	low	medium	high
Fixxx low	MF	High, Medium			20 s, according to priority setting	
		Escalating		20 s	180 s	
FiCO₂ high FiCO₂ low	MF	High, Medium			20 s, according to priority setting	
		Escalating		20 s	60 s	
FiN₂O high	MF					20 s
FiO₂ high	MF			20 s	20 s	
FiO₂ low	MF			20 s	20 s	82 s or 20 s (when FiO ₂ <18%)
Gas measurements removed	MF		5 s, if patient discharged		5 s, if patient admitted	
Gas module standby	MF		0 s			
Standby	DF					
Gas module standby. Touch to activate. Gas module standby. Start from CO₂ menu.	WF					
Identical gas modules	MF				0 s	
Low gas sample flow	MF			10 s		
Multiple agents present	MF, DF, WF				0 s	
N₂O inaccurate	MF			20 s		
O₂ inaccurate	MF			20 s		
Replace water trap	MF			40 s		
RR (CO₂) high RR (CO₂) low	MF	High, Medium, low		20 s, according to priority setting		
		Escalating		20 s	60 s	
Sample line blocked	WF, DF		0 s	40 s		
	MF			40 s	60 s	
Service gas module	MF, WF				0 s	

Alarm priorities and escalation times for spirometry

The following table shows related messages with their priorities and escalation times. In the table, the message location is indicated by the following: MF = message field; DF = digit field; WF = waveform field. For more information on alarm messages, refer to the user's manual.

MESSAGE	LOCATION	PRIORITY SETTING	PRIORITIES AND ESCALATION TIMES			
			info	low	medium	high
Anes: Apnea	MF					0 s
Anesthesia interface removed	MF		5 s		5 s (When patient enters monitoring)	
Anesthesia incompatible device	MF				5 s	
MVexp high / MVexp low	MF			0 s	40 s	
Ppeak high	MF				0 s	40 s
Ppeak low	MF				0 s	
TVexp high / TVexp low	MF				0 s	

Alarm priorities and escalation times for Entropy

The following table shows related messages with their priorities and escalation times. In the table, the message location is indicated by the following: MF = message field; DF = digit field; WF = waveform field. For more information on alarm messages, refer to the user's manual.

MESSAGE	LOCATION	ALARM PRIORITY SETTING	PRIORITIES AND ESCALATION TIMES			
			info	low	medium	high
Artifacts	DF		0 s			
Automatic check off	DF		0 s			
Cable off	DF		0 s			
Checking sensor	DF, WF		0 s			
Confirm sensor electrode 1 Confirm sensor electrode 2 Confirm sensor electrode 3	DF		0 s			
Confirm sensor electrodes	DF		0 s			
Entropy cable off	MF			60 s		
Entropy measurement removed	MF		5s, if patient discharged		5s, if patient admitted	
Entropy RE high / Entropy RE low	MF			15 s		
Entropy SE high / Entropy SE low	MF			15 s		
Entropy sensor check failed	MF			0 s		

MESSAGE	LOCATION	ALARM PRI- ORITY SET- TING	PRIORITIES AND ESCALATION TIMES			
			info	low	medium	high
Entropy sensor off	MF			60 s		
Identical Entropy modules	MF				0 s	
Isoelectric EEG	DF, WF		0 s			
Low signal	DF		0 s			
No Entropy sensor	MF			60 s		
Noise	WF		0 s			
No sensor	DF		0 s			
Sensor check failed	DF		0 s			
Sensor off	DF		0 s			
Starting up	DF		0 s			

Alarm priorities and escalation times for NMT

The following table shows related messages with their priorities and escalation times. In the table, the message location is indicated by the following: MF = message field; DF = digit field; WF = waveform field. For more information on alarm messages, refer to the user's manual.

MESSAGE	LOCATION	ALARM PRI- ORITY SET- TING	PRIORITIES AND ESCALATION TIMES			
			info	low	medium	high
Block recovery	MF		0 s			
Check electrodes	DF		0 s			
Identical NMT modules	MF				0 s	
Measurement off	DF		0 s			
NMT cable removed	MF		0 s, patient in discharged	0 s, patient in admitted		
NMT measurement removed	MF		5 s, patient in discharged	5 s, patient in admitted		
Reference not stable	DF		0 s			
Reference set	DF		0 s			
Response too weak	DF		0 s			
Sensor off	DF		0 s			
Setting reference	DF		0 s			
Start measurement	DF		0 s			
Supramax not found	DF		0 s			
Supramax search	DF		0 s			

MESSAGE	LOCATION	ALARM PRIORITY SETTING	PRIORITIES AND ESCALATION TIMES			
			info	low	medium	high
Wait to continue	DF		0 s			

Alarm priorities and escalation times for BIS

The following table shows related messages with their priorities and escalation times. In the table, the message location is indicated by the following: MF = message field; DF = digit field; WF = waveform field. For more information on alarm messages, refer to the user's manual.

MESSAGE	LOCATION	PRIORITY SETTING	PRIORITIES AND ESCALATION TIMES			
			info	low	medium	high
Apply sensor	DF		0 s			
BIS Apply sensor	MF					
Artifact	DF, WF		30 s			
Automatic check off	DF		0 s			
BIS high /BIS low	MF			15 s		
BIS measurement removed	MF		5 s if no patient admitted		5 s if no patient admitted	
Checking sensor	DF, WF		0 s			
Demo data	DF, WF		0 s			
DSC error	DF, WF		0 s			
BIS DSC error	MF					
High BIS impedance	MF			0 s		
Identical BIS modules	MF				0 s	
Incompatible sensor	DF, WF		0 s			
Module error	DF, WF		0 s		0 s	
BIS module error	MF					
No sensor	DF, WF		0 s	60 s		
No BIS sensor	MF					
Poor signal	DF, WF		30 s			
Replace sensor	DF		0 s	0 s		
BIS sensor expired	MF					
Sensor check failed	DF, WF		0 s	0 s		
BIS sensor check failed	MF					
Testing DSC	DF, WF		0 s			

Alarm priorities and escalation times for trends and snapshots

The following table shows related messages with their priorities and escalation times. In the table, the message location is indicated by the following: MF = message field; DF = digit field; WF = waveform field. For more information on alarm messages, refer to the user's manual.

MESSAGE	LOCATION	PRIORITIES AND ESCALATION TIMES			
		info	low	medium	high
Check OxyCRG	MF	0 s			
Creating OxyCRG snapshot	MF	0 s			
End of 20 min trend data	MF	0 s			
No more space Full disclosure disabled	MF			0 s	
No storage Full disclosure disabled	MF			0 s	
Mark X where xxx = snapshot sequence number Displays for 5 seconds	MF	0 s			
Snapshot created	MF	0 s			
Snapshot memory full. Oldest snapshot erased.	MF	0 s			
Storage fail Full disclosure failure	MF		0 s		

Alarm priorities and escalation times for various situations

The following table shows related messages with their priorities and escalation times. In the table, the message location is indicated by the following: MF = message field; DF = digit field; WF = waveform field. For more information on alarm messages, refer to the user's manual.

MESSAGE	LOCATION	PRIORITIES AND ESCALATION TIMES			
		info	low	medium	high
Alarm setup changed from Central	MF	0 s			
Alarms reset remotely	MF	0 s			
Alarm volume changed	MF		0 s		
All monitors disconnected	MF		0 s		
Audio fail	MF			0 s	
Barcode scanned	MF	0 s			
Barcode too long	MF	0 s			

MESSAGE	LOCATION	PRIORITIES AND ESCALATION TIMES			
		info	low	medium	high
Battery empty	MF			0 s	
Battery low	MF		0 s		
Battery temperature high	MF			0 s	
Call service UMBC error	MF				0 s
Certificate close to expiration	MF		0 s		
Certificate expired	MF		0 s		
Condition battery	MF			0 s	
CS Gateway communication failure	MF	0 s			
DEMO MODE	MF				0 s
E-Manual lost	MF				0 s
Entering standby	MF	0 s			
Frame temperature high	MF			0 s	
Identical IP address noticed	MF			max. 40 s	
Identical unit&bed name noticed	MF			max. 40 s	
Incorrect barcode value	MF	0 s			
Invalid barcode configuration	MF	0 s			
License invalid	MF	0 s			
Monitor disconnected	MF		0 s		
Motion Sensor Start Failed (not for device with VSP 4.0 Upgrade Software)	MF		0 s		
Network: HL7	MF		max. 40 s		
Network down: HL7	MF		max. 40 s		
Network down	MF		max. 40 s		
Network made	MF		max. 40 s		
No battery backup	MF			0 s	
No patients found	MF	0 s			
No printer selected	MF	0 s			
Patient admitted	MF	0 s			
Patient discharged	MF	0 s			
Printing	MF	3 s			

MESSAGE	LOCATION	PRIORITIES AND ESCALATION TIMES			
		info	low	medium	high
Printing Alarm	MF	3 s			
Printer error	MF	0 s			
Printing ready	MF	0 s			
Recorder: cover open	MF	0 s			
Recorder: input voltage high	MF	0 s			
Recorder: input voltage low					
Recorder: out of paper	MF	0 s			
Recorder module removed	MF	0 s			
Recorder system error	MF	0 s			
Recorder thermal array overheat	MF	0 s			
Replace battery	MF			0 s	
Restart needed	MF				0 s
Saving	MF	3 s			
Saving PDF	MF	0 s			
Saving PDF failed	MF	0 s			
Speaker failure	MF			0 s	

Parameter specifications

ECG performance specifications

ECG heart rate range	20 to 300 bpm
ECG heart rate accuracy	±1% or ±1 bpm, whichever is greater.
ECG heart rate resolution	1 bpm
ECG heart rate response time	Indicate a new heart rate for a step increase of 80 to 120 bpm and a step decrease of 80 to 40 bpm in < 10 s
Heart rate accuracy and response to irregular rhythm	Heart rate calculation operates with irregular rhythms of IEC 60601-2-27 201.7.9.2.9.101 b 4) and YY1079 4.1.2.1e as follows: Ventricular bigeminy: 80 bpm Slow alternating ventricular bigeminy: 30 bpm (normal), 60 bpm (narrow) Rapid alternating ventricular bigeminy: 120-128 bpm Bidirectional systoles: 60 bpm
ECG heart rate averaging computation	Average of 12 second median values
ECG QRS detection range	±0.5 to ±5 mV
ECG QRS detection width (Q to S)	40 to 120 ms
PVC rate range	0 to 300 PVCs per minute
PVC rate resolution	1 PVC per minute
SVC rate range	0 to 300 SVCs per minute
SVC rate resolution	1 SVC per minute
ST numeric range	-20 to +20 mm (-2 to +2 mV)
ST numeric resolution	0.1 mm
ST numeric accuracy	±0.2 mm or ±10%, whichever is greater (within the measurement range of -8 to +8 mm)
ECG display bandwidth	With 50/60 Hz powerline frequency: - Monitoring: 0.5 to 40 Hz (-3 dB) - ST: 0.05 to 40 Hz (-3 dB) - Diagnostic: 0.05 to 145 Hz (-3 dB) - Moderate: 0.5 to 20 Hz (-3 dB)
ECG differential offset voltage (allowable offset)	±0.9V dc ±10%
ECG input impedance	- Common mode: > 10 MΩ @ 50/60 Hz - Differential: > 2.5 MΩ from 0.67 to 40 Hz
ECG common mode rejection ratio	90 dB minimum at 50/60 Hz
Maximum tall T-wave rejection capability (with a 1 mV QRS test signal)	< 1.4 mV

ECG sweep speed options	12.5, 25, and 50 mm/s
ECG leads available	I, II, III, V1 to V6, aVR, aVL, and aVF
ECG leadsets supported	3-, 5-, or 10-leadwire ECG
Pacemaker pulse display capability	Voltage range: ± 2 to ± 700 mV Pulse width: 0.5 to 2 ms
Pacemaker pulse rejection capability	Voltage range: ± 2 to ± 700 mV Pulse width: 0.1 to 2 ms Overshoot according to Method A (IEC 60601-2-27 201.12.1.101.13 and YY1079 4.1.4.2) with amplitude max 2 mV  NOTE According to IEC 60601-2-27 201.12.1.101.13 a) b) c) and YY1079 4.1.4.2 a) b) c) an atrial pace pulse with identical amplitude and duration precedes ventricular pace pulse by 150 ms to 250 ms.
Pacer pulse rejection of fast ECG signals (according to the test defined in IEC 60601-2-27 201.12.1.101.12 and YY1079 4.1.4.3)	5.0 V/s
ECG leads disconnection (direct current for leads-off) detection	- Active patient electrode: < 30 nA each - Reference electrode: < 300 nA
Defibrillation protection	5000 V, 360 J
Defibrillation recovery time	< 5 s
Sync signal	Pulse width: 10 ms ($\pm 20\%$) Output impedance: $110 \Omega \pm 20\%$ @10 mA
Defibrillator sync delay	< 35 ms
GE recommends every year to verify the total sensitivity by using a standard electrocardiogram testing signal. (according to YY0782 51.103.2).	

Impedance respiration performance specifications

Impedance respiration measurement range	Adult/pediatric: 0 to 120 breaths per minute Neonatal: 0 to 200 breaths per minute
Impedance respiration measurement accuracy	0 to 120 breaths per minute: ± 1 breath per minute 121 to 200 breaths per minute: ± 3 breaths per minute
Impedance respiration gain range	0.1 to 5 cm/ Ω
Impedance respiration waveform sweep speed options	0.625 mm/s, 6.25 mm/s, 12.5 mm/s, 25 mm/s and 50 mm/s
Impedance respiration normalized respiration sensing current	$\leq 30 \mu\text{A}$
Impedance respiration carrier frequency	55.555KHz

SpO₂ displayed saturation values

GE TruSignal, Masimo SET and Nellcor OxiMax pulse oximetry are calibrated to display functional saturation.

NOTE

You can verify the functionality of pulse oximeter sensor and monitor with a functional SpO₂ tester but you cannot evaluate their accuracy with such a device. For more information, refer to the standard ISO 80601-2-61 Annex FF (Simulators, calibrators and functional testers for pulse oximeter equipment).

SpO₂ summary of clinical studies used to establish accuracy claims

Accuracy of Nellcor Oximax technology with Oximax sensors

The Nellcor Oximax Technology with Oximax sensors have been validated for no motion accuracy in controlled hypoxia studies with healthy non-smoking adult volunteers over the specified saturation SpO₂ range(s). Pulse oximeter SpO₂ readings were compared to SaO₂ values of drawn blood samples measured by hemoximetry. Subjects used to validate SpO₂ measurement accuracies were healthy and recruited from the local population. Subjects comprised both adult men and women and spanned a range of skin pigmentations. Because scatter and bias of pulse oximeter SpO₂ and blood SaO₂ comparisons commonly increase as the saturation decreases, and accuracy specifications are calculated from data spanning the stated range, different accuracy values may result when describing partially overlapping ranges. When sensors are used on neonatal subjects as recommended, the specified accuracy range is increased by ± 1 digit, as compared to adult usage, to account for the theoretical effect on oximeter measurements of fetal hemoglobin in neonatal blood.

Neonate specifications are shown for OxiMax MAXN sensors with the pulse oximeter.

Clinical functionality has been demonstrated on a population of hospitalized neonate patients. The observed SpO₂ accuracy was 2.5% in a study of 42 patients with ages of 1 to 23 days, weight from 750 to 4,100 grams, and 61 observations made spanning a range of 77% to 98% SaO₂.

Accuracy of Masimo SET technology with Masimo sensors

Masimo SET Technology with Masimo sensors has been validated for no motion accuracy in human blood studies on healthy adult male and female volunteers with light to dark skin pigmentation in induced hypoxia studies in the range of 70-100% SpO₂ against a laboratory co-oximeter and ECG monitor. This variation equals ± 1 standard deviation. Plus or minus one standard deviation encompasses 68% of the population.

For detailed information, refer to the supplemental analysis graphs in the appendix (Bland and Altman. Agreement between methods of measurement with multiple observations per individual. Journal of Biopharmaceutical Statistics (2007) vol. 17 pp. 571-582).

Accuracy of GE technology with TruSignal sensors

GE Technology with TruSignal sensors has been validated for no motion accuracy in controlled hypoxia studies with healthy non-smoking adult volunteers over the specified saturation SpO₂ range(s). Pulse oximeter SpO₂ readings were compared to SaO₂ values of drawn blood samples measured by a laboratory co-oximeter. Subjects comprised both healthy adult men and women and spanned a range of ages and skin pigmentations.

GE Oxy-AF and GE Oxy-SE sensors have been validated for neonatal accuracy. The subject demographics included 28 neonates and 1 infant (15 females and 14 males). The subjects ranged in age from newborn to 37 days old. The weights ranged from 560 to 3060 g. The skin tones included in the study were light to dark. For the neonatal study, the Arms of the collected convenience samples were 2.7, the Oxy-AF sensor in the SaO₂ range of 87-100% collected 52 data points, and the Oxy-SE sensor in the SaO₂ range of 81-100% collected 53 data points.

For more detailed information, refer to the supplemental analysis graphs in the appendix (Bland and Altman. Agreement between methods of measurement with multiple observations per individual. Journal of Biopharmaceutical Statistics (2007) vol. 17 pp. 571-582).

SpO₂ test methods used to establish accuracy claims during motion

Nellcor™ sensors' accuracy specifications were validated using measurements of healthy non-smoking adult volunteers during controlled hypoxia studies spanning the specified saturation ranges. Subjects were recruited from the local population and comprised both men and women ranging in age from 18-50 years old, and spanned a range of skin pigmentations. Pulse oximeter SpO₂ readings were compared to SaO₂ values of drawn blood samples measured by hemoximetry. All accuracies are expressed as ± 1 SD. Because pulse oximeter equipment measurements are statistically distributed, about two-thirds of the measurements can be expected to fall in this accuracy (A_{RMS}) range.

Nellcor sensors' motion performance was validated during a controlled hypoxia blood study over an SaO₂ span of 70% to 98.9% and a convenience-sample heart range of 41-105 bpm. Subjects performed rubbing and tapping movements 1-2 cm in amplitude with aperiodic intervals (randomly changing) with a random variation in frequency between 1-4 Hz. The average percent range was validated using synthetic signals from a patient simulator that comprised representative cardiac and signal artifact components. Applicability: OxiMax MAXA, MAXAL, MAXP, MAXI, and MAXN sensors.

Masimo SET Technology with Masimo sensors has been validated for motion accuracy in human blood studies on healthy adult volunteers in induced hypoxia studies while performing rubbing and tapping motions at 2 to 4 Hz at an amplitude of 1 to 2 cm and non-repetitive motion between 1 to 5 Hz at an amplitude of 2 to 3 cm in the range of 70% to 100% SpO₂ compared against a laboratory CO-oximeter and ECG monitor. The variation equals ± 1 standard deviation, which encompasses 68% of the population.



NOTE

Accuracy during motion has not been specified for Masimo SET sensors TC-I, TF-I, DBI, Blue, and E-1.

GE Technology with TS-AF and TS-AP sensors has been validated for motion accuracy in controlled hypoxia studies with healthy non-smoking adult volunteers over the specified saturation SpO₂ range(s). The following motion types were used: mechanically induced 3 Hz tapping motion at

an amplitude of 1-2 cm, patient induced non-repetitive rubbing motion, and patient induced non-repetitive hand motion in supine position. Pulse oximeter SpO₂ readings were compared to SaO₂ values of drawn blood samples measured by CO-oximetry. Subjects comprised both adult men and women and spanned a range of skin pigmentations.

SpO₂ test methods used to establish accuracy claims during low perfusion

Low perfusion accuracy of Nellcor Oximax technology with Oximax sensors

Nellcor Oximax technology with Oximax sensors has been validated for SpO₂ low perfusion accuracy in bench top testing using Nellcor's PS II simulator with signal strength setting of 0.03% modulation and oxygen saturation levels of 70 to 100% at a pulse rate of 90 BPM. Nellcor Oximax Technology with Oximax sensors has been validated for low perfusion pulse rate accuracy in bench top testing using Nellcor's PS II simulator at a simulated low perfusion level of 0.10% modulation in the pulse rate range of 40 to 250 beats per minute (BPM) at an SpO₂ of 95%.

Low perfusion accuracy of Masimo SET technology

Masimo SET technology has been validated for low perfusion accuracy in bench top testing against Biotek Index 2™ Simulator and Masimo's simulator with signal strength setting of greater than 0.02% and transmission of greater than 5% for saturation ranging from 70 to 100%. This variation equals ±1 standard deviation. ±1 standard deviation encompasses 68% of the population.

Low perfusion accuracy of GE TruSignal technology with TruSignal sensors

GE TruSignal technology with TruSignal sensors has been validated for low perfusion accuracy in a simulator test for saturation ranging from 70% to 100%. The test was conducted using a Fluke ProSim 8 simulator using 0.03% pulse amplitude and the Thin Finger transmission setting.

SpO₂ test methods used to establish pulse rate accuracy

Pulse rate accuracy of Nellcor Oximax technology with Oximax sensors

Accuracy specifications were validated using measurements of healthy non-smoking adult volunteers during controlled hypoxia studies spanning the specified saturation ranges. Subjects were recruited from the local population and comprised both men and women ranging in age from 18-50 years old, and spanned a range of skin pigmentations. Pulse oximeter SpO₂ readings were compared to SaO₂ values of drawn blood samples measured by hemoximetry. All accuracies are expressed as ±1 SD.

Because pulse oximeter equipment measurements are statistically distributed, about two-thirds of the measurements can be expected to fall in this accuracy (A_{RMS}) range.

Adult specifications are shown for OxiMax MAXA and MAXN sensors with the pulse oximeter.

Neonate specifications are shown for OxiMax MAXN sensors with the pulse oximeter.

Clinical functionality has been demonstrated on a population of hospitalized neonate patients. The observed SpO₂ accuracy was 2.5% in a study of 42 patients with ages of 1 to 23 days, weight from 750 to 4,100 grams, and 61 observations made spanning a range of 77% to 98% SaO₂.

The specification applies to monitoring cable performance. Reading accuracy in the presence of low perfusion (detected IR pulse modulation amplitude 0.03% - 1.5%) was validated using signals supplied by a patient simulator. SpO₂ and pulse rate values were varied across the monitoring range over a range of weak signal conditions and compared to the known true saturation and pulse rate of the input signals.

Nellcor™ sensors' motion performance was validated during a controlled hypoxia blood study over an SaO₂ span of 70% to 98.9% and a convenience-sample heart range of 41-105 bpm. Subjects performed rubbing and tapping movements 1-2 cm in amplitude with aperiodic intervals (randomly changing) with a random variation in frequency between 1-4 Hz. The average percent range was validated using synthetic signals from a patient simulator that comprised representative cardiac and signal artifact components. Applicability: OxiMax MAXA, MAXAL, MAXP, MAXI, and MAXN sensors.

Pulse rate accuracy of Masimo SET technology with Masimo sensors

Masimo SET Technology with Masimo sensors has been validated for pulse rate accuracy for the range of 25-240 bpm in bench top testing against a Biotek Index 2 simulator. The variation equals plus or minus one standard deviation, which encompasses 68% of the population.

Pulse rate accuracy of GE TruSignal technology with TruSignal sensors

GE TruSignal technology with TruSignal sensors has been validated for pulse rate accuracy over the specified range in bench top testing against a patient simulator.

SpO₂ performance specifications

The following specifications apply to all compatible modules unless otherwise indicated.

Pulse oximetry saturation measurement value and display range	1 to 100%
Pulse oximetry saturation measurement value accuracy	The specified accuracy for each module is the root-mean-square (RMS) difference between the measured values and the reference values. Because pulse oximetry equipment measurements are statistically distributed, only about two-thirds of the pulse oximetry equipment measurements can be expected to fall within the $\pm 1 A_{RMS}$ of the value measured by a CO-oximeter. Actual accuracy depends on sensor. Please refer to the sensor instructions for use for more detailed information.

	GE TruSignal: - Adult/Pediatric (70 to 100%): - Without motion: ± 2 - With motion: ± 3 - Low perfusion: ± 3 - Neonatal (70 to 100%): - Without/with motion: ± 3 - SpO₂ (< 70%): Unspecified Nellcor: - Adult/Pediatric (70 to 100%): ± 2 - Neonatal (70 to 100%): ± 3 - Low perfusion: ± 2 - SpO₂ (<70%): Unspecified Masimo: - Without motion: - Adult/Pediatric (70 to 100%): ± 2 - Neonatal (70 to 100%): ± 3 - With motion: Adult/Pediatric/Neonatal (70 to 100%): ± 3 - Low perfusion: ± 2 - SpO₂ (<70%): Unspecified
Pulse oximetry saturation display resolution	1 digit (% of SpO ₂)
Pulse oximetry peripheral pulse rate range	GE TruSignal: 30 to 250 bpm Nellcor: 20 to 250 bpm Masimo: 25 to 240 bpm
Pulse oximetry peripheral pulse rate accuracy	The specified accuracy for each module is the root-mean-square (RMS) difference between the measured values and the reference values. Actual accuracy depends on sensor. Please refer to the sensor instructions for use for more detailed information. GE TruSignal: - Without motion: ± 2 bpm - With motion: ± 3 bpm - Low perfusion: ± 5 bpm Nellcor: ± 3 bpm Masimo: - Without motion: ± 3 bpm - With motion: ± 5 bpm
Pulse oximetry peripheral pulse rate display resolution	1 bpm

Pulse oximetry saturation and pulse rate averaging time	The GE TruSignal configuration provides averaging time options of 3, and 12 seconds. When using the default averaging time, the overall alarm generation delay of SpO₂ is typically less than 28 seconds from the actual SpO₂ value for the patient. This delay is due to the SpO₂ averaging, signal processing and data transmission delays. The delay consists of the alarm condition and alarm generation delay, being typically <10 seconds and <18 seconds, respectively. For pulse rate, the alarm generation delay is typically less than 11 seconds, in which the alarm signal delay is less than a second. The SpO₂ and Pulse Rate data is updated every second. The Nellcor OXIMAX algorithm used in the device automatically extends the amount of data required for measuring SpO₂ and pulse rate depending on the measurement conditions. There are various matrices within the saturation pulse rate detection algorithm. Some of these are used to assess the severity of conditions presented to the measuring of SpO₂ and pulse rate on a patient. These individual matrices or combinations of these matrices are used to determine the quality of the received SpO₂ signal. The advanced signal processing in the algorithms automatically extends the amount of data required for measuring SpO₂ and pulse rate depending on the measuring conditions. During normal measurement conditions, the averaging time is approximately three seconds. The overall alarm generation delay of SpO₂ is typically less than 28 seconds from the actual SpO₂ value in the patient. This delay is due to SpO₂ averaging, signal processing and data transmission delays. The delay consists of the alarm condition and alarm generation delay, which are typically <10 seconds and <18 seconds, respectively. For pulse rate, the alarm generation delay is typically less than 11 seconds, in which the alarm signal delay is less than a second. The SpO₂ and Pulse Rate data is updated every second. The Masimo configuration provides averaging time options of 2, 4, 8, 10, 12, 14, and 16 seconds. When using the default averaging time, the overall alarm generation delay of SpO₂ is typically less than 28 seconds from the actual SpO₂ value in the patient. This delay is due to SpO₂ averaging, signal processing and data transmission delays. The delay consists of the alarm condition and alarm generation delay, which are typically <10 seconds and <18 seconds, respectively. For pulse rate, the alarm generation delay is typically less than 11 seconds, in which the alarm signal delay is less than a second. The SpO₂ and Pulse Rate data is updated every second.
Pulse oximetry waveform scale options	GE TruSignal: 2, 5, 10, 20, and 50 mod%, and auto Nellcor: 1x, 2x, 4x, and 8x Masmio: 1x, 2x, 4x, and 8x
Wavelength of SpO ₂ probe LEDs	Information on the peak wavelengths and maximum output power can be especially useful to clinicians performing photodynamic therapy. GE TruSignal: • Infrared LED: 940 nm • Red: 660 nm Nellcor: • Infrared LED: 900 nm • Red: 660 nm

	Masimo: • Infrared LED: 905 nm • Red: 660 nm
Maximum energy of SpO ₂ probe LEDs	Information on the peak wavelengths and maximum output power can be especially useful to clinicians performing photodynamic therapy. GE TruSignal: • Infrared: 42 µJ/pulse • Red: 62 µJ/pulse Nellcor: • ≤ 15 mW Masimo: • Infrared: ≤ 22.5 mW • Red: ≤ 27.5 mW

SPI performance specifications

SPI microtrend length is user-selectable.	
Measurement method	The SPI measurement is derived from the plethysmographic pulse amplitude and pulse interval from the Pleth waveform signal.
Performance	SPI has no measurement unit. Measurement range: 0 to 100
Display resolution	1 digit

SPI calculations

Adaptive histogram transformation (scale of 0 to 100) from the pulse interval and plethysmogram's pulse amplitude (PGA) =

$$100 - 0.3 * \text{Pulse interval (with normalization)} - 0.7 * \text{PGA (with normalization)} = \text{SPI}$$

The SPI algorithm is published: Huiku M, Uutela K, van Gils M, Korhonen I, Kymäläinen M, Meriläinen P, Paloheimo M, Rantanen M, Takala P, Viertiö-Oja H, Yli-Hankala A. Assessment of surgical stress during general anaesthesia. (Br J Anaesth 2007; 98: 447-55).

NIBP performance specifications

NIBP measurement technique	Oscillometric
NIBP measurement supported modes	Manual, Auto, and Stat
NIBP measurement time	Adult/child inflate duration time: less than 120 s Neonate inflate duration time: less than 85 s

NIBP measurement range	• Systolic: ◦ Adult/Pediatric: 30 to 290 mmHg ◦ Neonate: 30 to 140 mmHg • MAP: ◦ Adult/Pediatric: 20 to 260 mmHg ◦ Neonate: 20 to 125 mmHg • Diastolic: ◦ Adult/Pediatric: 10 to 220 mmHg ◦ Neonate: 10 to 110 mmHg
NIBP measurement accuracy	No more than 8 mmHg (1.1 kPa) standard deviation
NIBP pulse rate measurement range	30 to 250 bpm
NIBP pulse rate measurement accuracy	±5% or ±5 bpm, whichever is greater
NIBP measurement default initial inflation pressure	• Adult/Pediatric: 135 ±15 mmHg • Neonate: 100 ±15 mmHg
Maximum cuff measurement pressure (overpressure limit) allowed by independent safety controller	• Adult/Pediatric: 300 ±6 to 330 mmHg • Neonate: 150 ±3 to 165 mmHg
NIBP measurement available automatic cycle times	Custom, 1 min, 2 min, 3 min, 4 min, 5 min, 10 min, 15 min, 20 min, 30 min, 1 h, 1.5 h, and 2 h

Invasive pressure performance specifications



NOTE

E-module used for this measurement are not suitable for use with neonatal patients.

Invasive pressure measurement range	Monitor: -40 to 320 mmHg (-5.3 to 42.7 kPa) E-COP: -30 to 320 mmHg (-4.0 to 42.7 kPa)
Invasive pressure measurement accuracy	Monitor: ±4% or ±2 mmHg, whichever is greater E-COP: ±4% or ±4 mmHg, whichever is greater
Invasive pressure pulse rate range	30 to 250 bpm
Invasive pressure pulse rate accuracy	±2% or ±2 bpm, whichever is greater
Invasive pressure pulse rate display resolution	1 bpm
Invasive pressure zero adjustment range	±150 mmHg (±20.0 kPa)
Invasive pressure frequency response (waveform filter)	4 Hz, 5 Hz, 6 Hz, 7 Hz, 8 Hz, 9 Hz, 11 Hz, 14 Hz, 17 Hz, or 22 Hz (-3 dB)
Invasive pressure waveform display scale selections	10 to 300 mmHg, with a step size of 10 mmHg (2 to 40 kPa, with a step size of 2 kPa).
Invasive pressure waveform display range	-40 to 320 mmHg (-5.3 to 42.7 kPa)
Invasive pressure sweep speed options	12.5, 25, and 50 mm/s
Invasive pressure transducer sensitivity	5 µV/V/mmHg

SPV and PPV calculations

The algorithm uses the arterial blood pressure monitoring information and looks for respiratory changes in the signal. Respiratory information is derived from the invasive blood pressure data, and the values are calculated over one respiratory cycle.

The unit for SPV is mmHg and the value is calculated as follows:

$$SPV = SBP_{\max} - SBP_{\min}$$

where $SBP_{\max}$ and $SBP_{\min}$ represent the maximum and minimum values of a systolic blood pressure.

The unit for PPV is % and the value is calculated as follows:

$$PPV = (PP_{\max} - PP_{\min}) / [(PP_{\max} + PP_{\min}) / 2] * 100$$

where $PP_{\max}$ and $PP_{\min}$ represent the maximum and minimum pulse pressure.

Temperature performance specifications

Temperature measurement range	10 to 45°C (50 to 113°F)
Temperature measurement accuracy	±0.1°C without temperature sensor ±0.2 °C including sensor from 25 to 45 °C ±0.3 °C including sensor from 10 to 25 °C (not include 25 °C)
Temperature measurement display resolution	±0.1°C (±0.1°F)
Temperature measurement units	°C or °F
Temperature probe types supported	YSI 400 Series
Temperature probe types time response	- Reusable skin temperature probe: 45 s - Reusable adult R/E temperature probe: 20 s - Reusable pediatric R/E temperature probe: 25 s - Reusable temperature probes by Shenzhen Launch: 150 s - Disposable skin temperature probe: 35 s - Disposable central temperature probe, 9F: 30 s - Disposable central temperature probe, 12F: 35 s - Thermodilution catheter for Tblood: 10 s
Temperature test measurement cycle	At measurement start-up and then every 10 minutes
Temperature probe maximum energy dissipation	Transducer dissipation constant is 8 mW/°C in Well-stieer oil bath

Cardiac output (C.O.) performance specifications



NOTE

E-module used for this measurement are not suitable for use with neonatal patients.

C.O. measurement technique	Thermodilution
C.O. blood temperature range	17.5 to 43°C (63.5 to 109.4°F)

C.O. blood temperature accuracy	17.5 to 33.9°C (63.5 to 93.0°F): $\pm 0.4^{\circ}\text{C}$ (0.8°F) 34.0 to 42.0°C (93.2 to 107.6°F): $\pm 0.3^{\circ}\text{C}$ (0.5°F) 42.1 to 43.0°C (107.7 to 109.4°F): $\pm 0.4^{\circ}\text{C}$ (0.8°F)
C.O. blood temperature display resolution	0.1°C (0.1°F)
C.O. injectate temperature range	0 to 27°C (32.0 to 80.6°F)
C.O. injectate temperature accuracy	0 to 25.4°C (32 to 77.7°F): $\pm 0.3^{\circ}\text{C}$ (0.5°F) 25.5 to 27°C (77.9 to 80.6°F): $\pm 0.5^{\circ}\text{C}$ (0.9°F)
C.O. injectate temperature display resolution	0.1°C (0.1°F)
C.O. measurement range	0.5 to 20 l/min
C.O. display resolution	0.01 l/min < 10 l/min, 0.1 l/min $\geq$ 10 l/min
Right ventricular ejection fraction measurement method	Ejection fraction is determined using an exponential technique by synchronizing sensed R-waves with points of temperature changes on the time temperature (thermodilution curve). Once ejection fraction, cardiac output and heart rate are known, right ventricular volumes may be calculated.
Right ventricular ejection fraction measurement range	1 to 85%
Right ventricular ejection fraction measurement resolution	1%

Airway gases normal conditions

NOTE

E-miniC is not suitable for use with patients weighing less than 5 kg (11 lbs).

Accuracy specifications applied in normal conditions:

- Ambient temperature:
 - E-miniC: normal conditions after a 30 minute warm-up period: 18 to 28°C, within $\pm 5^{\circ}\text{C}$ of calibration
 - E-sCAiO, E-sCO, N-CAiO: normal conditions after a 20 minute warm-up period: 18 to 28°C, within $\pm 5^{\circ}\text{C}$ of calibration
- Ambient pressure:
 - E-miniC:
 - normal conditions after a 30 minute warm-up period: 500 to 800 mmHg, within ± 50 mmHg of calibration
 - E-sCAiO, E-sCO, N-CAiO: normal conditions after a 20 minute warm-up period: 660 mbar to 1060 mbar, ± 67 mbar of calibration
- Ambient humidity:
 - E-miniC: normal conditions after a 30 minute warm-up period: 20 to 80% RH, within $\pm 20\%$ RH of calibration
 - E-sCAiO, E-sCO, N-CAiO: normal conditions after a 20 minute warm-up period: 20 to 80% RH, non-condensing, within $\pm 20\%$ RH of calibration

Airway gases performance specifications

CO ₂ measurement range	E-miniC: 0 to 20% or 0 to 150 mmHg (0 to 20 kPa) E-sCAiO, E-sCO, N-CAiO: 0 to 15 vol% or 0 to 113 mmHg (0 to 15 kPa)
CO ₂ measurement accuracy	E-miniC: 0 to 15% vol: $\pm(0.2 \text{ vol\%} + 2\% \text{ of reading})$ 15 to 20% vol: $\pm(0.7 \text{ vol\%} + 2\% \text{ of reading})$ E-sCAiO, E-sCO, N-CAiO: $\pm(0.2 \text{ vol\%} + 2\% \text{ of reading})$
CO ₂ measurement display resolution	0.1% or 1 mmHg (0.1 kPa)
CO ₂ rise time	E-miniC: < 300 ms E-sCAiO, E-sCO, N-CAiO: < 260 ms with 2 and 3 m sampling line lengths < 310 ms with 6 m sampling line length
CO ₂ drift	< 0.1 vol%
Gas cross effects to CO ₂ by O ₂ , N ₂ O, and anesthetic agents	E-sCAiO, E-sCO, N-CAiO: < 0.2 vol%
Total system response time	E-miniC: 2.4 s typical with a 3 m sampling line E-sCAiO, E-sCO, N-CAiO: < 3.0 s with 2 or 3 m sampling line
Respiration rate range	E-miniC: 4 to 80 breaths per minute E-sCAiO, E-sCO, N-CAiO: 4 to 100 breaths per minute
Respiration rate accuracy	E-miniC: 4 to 20 breaths per minute: ± 1 breath per minute 20 to 80 breaths per minute: $\pm 5\%$ E-sCAiO, E-sCO, N-CAiO: 4 to 20 breaths per minute: ± 1 breath per minute 20 to 100 breaths per minute: $\pm 5\%$
Respiration rate display resolution	1 breath per minute
Respiration rate breath detection	1 vol% change in CO ₂ level

Respiration rate verification method

The rated respiration rate range and the corresponding end-tidal gas reading accuracy were tested with reference gases of known concentrations. The test gases were fed to the gas sampling system of the module through an electrically actuated valve with very low internal volume. Depending on its actuation status, the valve directed either room air or a test gas to the gas sampling line. The desired respiration rates were set by the electrical actuating times of the valve.

The measurement accuracy of the end-tidal gas readings was tested using 3-meter gas sampling lines connected to the gas sample port of the water trap. The gas sampled to the sampling line was switched from room air to the test gases using electrically actuated valve with low internal dead space to generate step changes in the gas concentrations. The electrical actuating signal of the valve was generated using a highly accurate signal generator to accurately control the simulated respiration rate.

Expiration time and end-tidal readings

E-miniC: The length of expiration time has impact on the accuracy of the gas-specific end-tidal readings. The longer the expiration time, the better the module achieves the correct end-tidal reading. With I:E 2:1, the gas specific end-tidal values are within specifications up to respiration rate 45 /min. With other I:E values, the end-tidal readings are within specifications.

E-sCAiO, E-sCO, N-CAiO: The length of expiration time has impact on the accuracy of the gas-specific end-tidal readings. The longer the expiration time, the better the module achieves the correct end-tidal reading. With I:E 2:1, the gas specific end-tidal values are within specifications up to respiration rate 45 /min except with halothane (32 /min with halothane). With other I:E values, the end-tidal readings are within specifications.

O ₂ measurement range	E-sCAiO, E-sCO, N-CAiO: 0 to 100 vol%
O ₂ measurement accuracy	E-sCAiO, E-sCO, N-CAiO: $\pm(1 \text{ vol\%} + 2\% \text{ of reading})$
O ₂ measurement display resolution	E-sCAiO, E-sCO, N-CAiO: 1%
O ₂ rise time	E-sCAiO, E-sCO, N-CAiO: • $\leq 260 \text{ ms}$ with 2 and 3 m sampling line lengths • $\leq 310 \text{ ms}$ with 6 m sampling line length
O ₂ drift	E-sCAiO, E-sCO, N-CAiO: $< 0.3 \text{ vol\%}$
Gas cross effects to O ₂ by anesthetic agents	E-sCAiO, E-sCO, N-CAiO: $< 1 \text{ vol\%}$
Gas cross effects to O ₂ by N ₂ O	E-sCAiO, E-sCO, N-CAiO: $< 2 \text{ vol\%}$
N ₂ O measurement range	E-sCAiO, N-CAiO: 0 to 100 vol%
N ₂ O measurement accuracy	E-sCAiO, N-CAiO: • 0 to 84 vol%: $\pm(2 \text{ vol\%} + 2\% \text{ of reading})$ • 85 to 100 vol%: $\pm(2 \text{ vol\%} + 8\% \text{ of reading})$
N ₂ O measurement display resolution	E-sCAiO, N-CAiO: 1%
N ₂ O rise time	E-sCAiO, N-CAiO: • $\leq 320 \text{ ms}$ with 2 and 3 m sampling line lengths • $\leq 360 \text{ ms}$ with 6 m sampling line length
N ₂ O drift	E-sCAiO, N-CAiO: $< 0.3 \text{ vol\%}$
Gas cross effects to N ₂ O by anesthetic agents	E-sCAiO, N-CAiO: $< 2 \text{ vol\%}$
Anesthetic agents measurement range	E-sCAiO, N-CAiO: • Hal, Enf, Iso: 0 to 6 vol% • Sev: 0 to 8 vol% • Des: 0 to 20 vol%
Anesthetic agents measurement accuracy	E-sCAiO, N-CAiO: $\pm(0.15 \text{ vol\%} + 5\% \text{ of reading})$

Anesthetic agents display resolution	E-sCAiO, N-CAiO: - Resolution is 0.01% when the AA concentration between 0 to 1% - Resolution is 0.1% when the AA concentration $\geq 1\%$ - In the presence of agent mixture, values between 0 and 9.9%: 0.1% - In the presence of agent mixture, values $\geq 10\%$: 1%
Anesthetic agents rise time	E-sCAiO, N-CAiO: < 420 ms (< 800 ms for Halothane) with 2 and 3 m sampling line lengths < 700 ms (< 1800 ms for Halothane) with 6 m sampling line length
Hal, Enf, Iso, and Sev drift	E-sCAiO, N-CAiO: < 0.1 vol%
Des drift	E-sCAiO, N-CAiO: < 0.3 vol%
Gas cross effects to anesthetic agents by N ₂ O	E-sCAiO, N-CAiO: 0.15 vol%
Anesthetic agents total system response time	E-sCAiO, N-CAiO: < 3.5 s (< 3.8 s for Halothane) with 2 and 3 m sampling line lengths < 5.4 s (< 6.5 s for Halothane) with 6 m sampling line length
Anesthetic agents identification	E-sCAiO, N-CAiO: - The module automatically identifies the anesthetic agent present in the sampled gas and measures the concentration of the identified agent. - Identification threshold is 0.15 vol% - Identification time is < 20 s - The module automatically identifies mixtures of two anesthetic agents present in the sampled gas and measures the concentrations of the two identified agents. - Identification threshold for the second agent at 1 MAC of the first agent: 0.2 vol% + 10% of the concentration of the first agent
Effects of interfering gases and vapors	E-miniC: - Effect of Helium (50 vol%): Decreases CO₂ readings < 0.5 vol% - Effect of Xenon (80 vol%): Decreases CO₂ readings < 0.5 vol% - Effect of Halothane (4%): Increases CO₂ readings < 0.3 vol% - Effect of Isoflurane (5%): Increases CO₂ readings < 0.4 vol% - Effect of Desflurane (15%): Increases CO₂ readings < 0.8 vol% - Effect of Sevoflurane (5%): Increases CO₂ readings < 0.4 vol% - Effect of Enflurane (5%): Increase CO₂ readings < 0.4 vol% - Effect of N₂O (40%): Increases CO₂ readings < 0.4 vol% - Effect of O₂ (40% to 95%): - If compensation is not activated: decreases CO₂ readings < 0.3 vol% - If compensation is activated: error < 0.15 vol% - Effect of N₂O (40% to 80%): - If compensation is not activated: increases CO₂ readings < 0.8 vol% - If compensation is activated: error < 0.3 vol%

	E-sCAiO, E-sCO, N-CAiO: - Effect of Helium (50 vol%): - Decreases CO₂ readings < 0.5 vol% at 5 vol% of CO₂ - Decreases O₂ readings < 2 vol% at 50 vol% of O₂ - Effect of Xenon (80 vol%): - Decreases CO₂ readings < 0.5 vol% at 5 vol% of CO₂ - Decreases O₂ readings < 1.5 vol% at 14 vol% of O₂
Effects of non-interfering gases and vapors	E-miniC: - Ethanol C₂H₅OH (< 0.3%) - Acetone (< 0.2%) - Isopropanol (< 0.48%) - Methane CH₄ (< 0.3%) - Nitrogen N₂ - Freon R134A (< 1%) - Water vapor E-sCAiO, E-sCO, N-CAiO: - Ethanol C₂H₅OH (< 0.036%) - Acetone (< 0.2%) - Isopropanol (< 0.48%) - Methane CH₄ (< 0.3%) - Nitrogen N₂ - Carbon Monoxide CO (< 100 ppm) - Nitrous Oxide NO (< 200 ppm) - Freon R134A (< 1%) (for CO₂, O₂ and N₂O) - Water vapor
Effects of non-interfering gases to the measured gas concentrations	E-miniC: - CO₂: < 0.2 vol% E-sCAiO, E-sCO, N-CAiO: - CO₂: < 0.2 vol% - O₂, N₂O: < 2 vol% - Anesthetic agents: < 0.15 vol%
O ₂ compensation	E-miniC: Configured from 21 to 40% or 40 to 100% E-sCAiO, E-sCO, N-CAiO: The system automatically compensates for O₂.
N ₂ O compensation	E-miniC: Configured from 0 to 40% or 40 to 80% E-sCAiO, E-sCO, N-CAiO: The system automatically compensates for N₂O.
Warm-up time	E-miniC: 1 min for operation, 30 min for full specifications E-sCAiO, N-CAiO: 60±5 s for operation with CO₂, O₂ and N₂O 5 min for operation of anesthetic agents 20 min for full specifications E-sCO: 60±5 s for operation with CO₂, O₂ 20 min for full specifications

Flow rate (diverting sampling)	E-miniC: 150 ml/min ± 25 ml/min E-sCAiO, E-sCO, N-CAiO: 120 ml/min ± 20 ml/min

Airway gases calculations

MAC	$MAC = (EtAA_1 (\%) / x(AA_1)) + (EtAA_2 (\%) / x(AA_2)) + (EtN_2O (\%) / 100)$	where AA_1 = primary agent, AA_2 = secondary agent, $x(AA)$ is Hal=0.75%, Enf=1.7%, Iso=1.15%, Sev=2.05%, Des=6.0% and N_2O =100%
MACage	$MACage \text{ (volatile agent)} = [(100 \times ATMP) / ((5 \times T - 85) \times 760 \text{ mmHg})] \times (EtAA (\%) / AAage)$ $MACage (N_2O) = [(100 \times ATMP) / ((5 \times 37 - 85) \times 760 \text{ mmHg})] \times (EtN_2O (\%) / (N_2Oage \times 100))$	where ATMP = atmospheric pressure in mmHg, T = temperature of the patient in Celsius, AAage = agent and age specific constant. AAage ranges: • Hal: 0.99 – 0.49 • Enf: 2.25 – 1.12 • Iso: 1.52 – 0.76 • Des: 7.93 – 3.95 • Sev: 2.71 – 1.35 N_2O age is a specific constant in the range of 1.38 – 0.62. Shown MACage is the sum of MACage of the primary agent, secondary agent, and N_2O .
Balance gas (EtBal)	$EtBal = 100 - EtCO_2 - EtO_2 - EtN_2O - EtAA_{(pri)} - EtAA_{(sec)}$	where $EtAA_{(pri)}$ and $EtAA_{(sec)}$ are the primary and secondary end tidal values for the measured anesthetic agent

References for anesthetic agent MAC values:

- Mapleson W.W.: Effect of age on MAC in humans: a meta-analysis. Br. J. of Anaesthesia 1996; 76: 179-185
- Rampil I.J.; Zwass M.; Lockhart S.; Eger E.I. II; Johnson B.H.; Yasuda N.; Weiskopf R.B.: MAC of I653 in surgical patients, Anesthesiology. Tram-Rac71 (3A):A269, September 1989
- Scheller M.S., Partridge B.L., Saidman L.J.: MAC of sevoflurane in humans and the New Zealand white rabbit. Anesthesiology 1987; 67: A373
- ISO21647:2004 + C1:2005, Medical electrical equipment - Particular requirements for the basic safety and essential performance of respiratory gas monitors.

References for MACage calculations:

- Eger, E.I. II.: Age, minimum alveolar anesthetic concentration, and minimum alveolar anesthetic concentration-awake. Anesth. Analg. 2001; 93:947-953
- Rampil I.J.; Zwass M.; Lockhart S.; Eger E.I. II; Johnson B.H.; Yasuda N.; Weiskopf R.B.: MAC of I653 in surgical patients, Anesthesiology. 71 (3A):A269, September 1989

Airway gases CO₂ unit conversions



NOTE

47 mmHg is the partial pressure of the saturated water vapor at 37°C.

The following table lists the relationship between gas concentration and its partial pressure.

Reading in mmHg (dry gas)	$(\text{ambient pressure in mmHg} * \text{gas concentration in \%})/100$
Reading in mmHg (water vapor saturated gas)	$((\text{ambient pressure in mmHg} - 47 \text{ mmHg}) * \text{gas concentration in \%})/100$
Reading in kPa (dry gas)	$(\text{ambient pressure in mmHg} * \text{gas concentration in \%})/750$
Reading in kPa (water vapor saturated gas)	$((\text{ambient pressure in mmHg} - 47 \text{ mmHg}) * \text{gas concentration in \%})/750$

Spirometry display specifications

Ppeak, Pmean, PEEP display range	-20 to 100 cmH ₂ O -20 to 98 hPa -20 to 98 mbar -15 to 74 mmHg -2.0 to 9.8 kPa
Pplat display range	0 to 100 cmH ₂ O 0 to 98 hPa 0 to 98 mbar 0 to 74 mmHg 0 to 9.8 kPa
Ppeak, Pmean, PEEP, Pplat display resolution	cmH ₂ O, hPa, mbar, mmHg, kPa: 1 kPa: 0.1
TVexp, TVinsp display range	0 to 2000 ml
TVexp, TVinsp display resolution	1 with interfaced device
MVexp, MVinsp display range	0 to 60 l/min
MVexp, MVinsp display resolution	0.1 with interfaced device
Compl display range	0 to 500 ml/cmH ₂ O 0 to 510 ml/hPa 0 to 510 ml/mbar 0 to 680 ml/mmHg 0 to 5099 ml/kPa
Compl display resolution	with interfaced device 10 to 500 ml/cmH ₂ O: 1 0 to 9.9 ml/cmH ₂ O: 0.1 10 to 510 ml/hPa: 1 0 to 9.9 ml/hPa: 0.1 10 to 510 ml/mbar: 1 0 to 9.9 ml/mbar: 0.1 10 to 680 ml/mmHg: 1 0 to 9.9 ml/mmHg: 0.1 10 to 5099 ml/kPa: 1 0 to 9.9 ml/kPa: 0.1
Raw display range	0 to 100 cmH ₂ O/l/s

Raw display resolution	with interfaced device 1 cmH ₂ O/l/s 1 hPa/l/s 1 mbar/l/s 1 mmHg/l/s 0.1 kPa/l/s

Entropy performance specifications



NOTE

The Entropy measurement is not indicated for pediatric patients younger than two years old.

Entropy amplifier input dynamic range	±500 µV
Entropy amplifier input offset range	±300 mV
Entropy amplifier frequency range	0.5 to >100 Hz
Entropy amplifier noise level	< 0.5 µV RMS, <6 µV peak-to-peak
Entropy amplifier input impedance	> 400 kOhm @ 10 Hz
Entropy amplifier common mode rejection ratio (CMRR)	> 90 dB @ 50 Hz
Entropy amplifier defibrillation protection	3000 V
Entropy waveform display range	1000 µVpp
Entropy waveform display scales	±25, ±50, ±100, ±250, ±400, and ±500 µV
Entropy waveform display sweep speeds	12.5, 25, and 50 mm/s
Entropy numeric display range	- RE: 0 - 100 - SE: 0 - 91 - BSR: 0 - 100%
Entropy numeric display resolution	1 digit
Entropy numeric display update interval	1 s
Electrode impedance measurement range	1 to 20 kOhm
Electrode impedance measurement accuracy	±1 kOhm or ±10%
Electrode impedance measurement start	Manual or automatic
Defibrillation recovery time	< 10 s

Entropy calculations

Entropy measurement is based on acquisition and processing of raw EEG and FEMG signals by using the Entropy algorithm, a GE application of Spectral Entropy.

The algorithm is published: Viertiö-Oja H, Maja V, Särkelä M, Talja P, Tenkanen N, Tolvanen-Laakso H, Paloheimo M, Vakkuri A, Yli-Hankala A, Meriläinen P. Description of the Entropy algorithm as applied in the Datex-Ohmeda S/5 Entropy Module. (Acta Anaesthesiologica Scandinavica 2004; Volume 48: Issue 2:154-161, 2004).

NMT performance specifications



NOTE

NMT measurement is not indicated for pediatric patients weighing less than 5 kg (11 lbs).

NMT measurement stimulation modes	• Train of four (TOF) • Double burst (3.3) (DBS) • Single twitch (ST) • 50 Hz tetanic
NMT measurement intervals	• TOF/DBS modes: Manual, 10 s, 12 s, 15 s, 20 s, 1 min, 5 min, 15 min, 30 min, 60 min, and 120 min • ST mode: Manual, 1 s, 10 s, and 20 s
NMT measurement stimulus pulse	A square wave with constant current
NMT measurement pulse width	100, 200, or 300 μ s
NMT measurement tetanic stimulation duration	5 s
NMT measurement stimulus current range	• Supramax: 1 to 70 mA • Manual: 1 to 70 mA, in 1 mA steps
NMT measurement range of load impedance and maximum load	Range of load 0.5 to 3 kOhm, max load 3 kOhm (The impedance over this range does not have an effect on the stimulus parameters.)
NMT measurement maximum voltage	300 V peak

BIS performance specifications

Bispectral Index (BIS) display range	0 to 100
EMG display range	0 to 100 dB
SQI display range	0 to 100%
SR display range	0 to 100%
EEG scales supported	± 25 to ± 500 μ V (input dynamic range)
Frequency range	0.25 to 100 Hz
EEG measurement input offset	± 300 mV
EEG measurement input noise level	< 6 μ V peak-to-peak
EEG measurement signal reproduction accuracy	$\leq \pm 20\%$ or ± 10 μ V, whichever is greater
EEG sweep speeds supported	12.5, 25, and 50 mm/s
Artifact rejection	Automatic
Common mode rejection	110 dB @ 50/60 Hz
Filters supported	• ON: 2 to 70 Hz with notch • OFF: 0.25 to 100 Hz
Smoothing rate	15 or 30 s

Radiated immunity level	1 V/m

BIS calculations

The BIS is computed in real time using three steps:

- 1. The raw EEG signal is broken down second by second, and the segments that have artifact are identified and removed.
- 2. The BIS is calculated by combining EEG features associated with anesthetic effect.
- 3. The index is modified to reflect the amount of suppressed EEG signal in the raw waveform.

Default settings

Understanding your monitor configuration

The monitor's configuration is dependent on the equipment used, the software license, and the settings that define how the software application behaves.

User modes

The monitor can have up to seven user modes, but only one can be enabled at a time. User modes pre-configure the monitor's behavior and appearance for a specific clinical environment. There are:

- STEP-DOWN: intermediated care
- ED: Emergency Department (also called Emergency Care)
- PACU: Post Anesthesia Care Unit (also called Post Anesthesia Care)
- ICU: Intensive Care Unit
- OR: Operating Room (also called Anesthesia Care)
- PEDIATRIC: Pediatric Care
- NEONATAL: Neonatal Care

Each mode is a group of unique settings suited to a particular care unit or patient demographic. (e.g., alarm limits, screen layouts, trends and snapshot settings). STEP-DOWN is the factory default user mode. The mode's settings can be customized.

User mode settings

User mode settings are password protected. They are established during installation/configuration of the monitor. The mode setting's factory default values are also provided.

The mode settings have three values:

- Current values: Values displayed on the monitor for the current patient.
- Saved values: Values selected and saved during configuration/installation of the monitor to meet the needs of a particular clinical environment.
- Factory default values: Permanent values used in case of failure that allow the software application recover from failure by reverting to these values for system operation.

Mode settings generally share the same reset behavior. There are three types of reset:

- Patient discharge: Patient is discharged from the monitor. The setting will be changed to saved values (default mode).
- Cold start: The setting will be changed to saved values (default mode).

The following condition will target cold start:

- Start-up after an abrupt crash.
- Start-up after some service settings update, such as language, license, etc.

- Warm start: The settings will still use the current value. Normal restart is regarded as warm start.

Common settings for all modes

When you change the saved values of following settings, will affect all modes.

Settings	How to get there
Patient information • First Name • Last Name • MRN • Second ID • Patient Type • Demographics ◦ Day ◦ Month ◦ Year ◦ Gender ◦ Age ◦ Age Unit ◦ Height ◦ Weight ◦ BSA	Information area
Screen • Screen Brightness • Brightness Type (not for device with VSP 4.0 Upgrade Software)	 >  Screen Brightness
Alarm • High & Medium Alarm Volume • Low Alarm Volume	 >  Alarms Setup > Audio tab
(not for device with VSP 4.0 Upgrade Software) • Alarm Light Type • Alarm Light	Visual tab (not for device with VSP 4.0 Upgrade Software)
Sound Volumes • Alarm Volume • High & Medium Alarm Volume • Low Alarm Volume • Beat Volume • Completed NIBP Volume	 >  Sound Volumes

Settings	How to get there
Export Patient Data • Graphic Trend • Numeric Trend • Snapshot • Export Latest Data • All ECG Waveforms • Alarm History • Set Key for Patient Data Export	 >  Export Patient Data
Trends • Trends Printing	 >  (shift to numerical trends if necessary) > 
Night Mode • Beat Volume • Screen Brightness • Alarm Volume • High & Medium Alarm Volume • Low Alarm Volume • Completed NIBP Volume • Alarm Light (not for device with VSP 4.0 Upgrade Software)	 >  Night Mode > Setup tab
• Scheduled • Scheduled from/to hour • Scheduled from/to minute	Enter tab
Other Patients • Unit • Show	 >  Other Patients
• Change All Notifications • Change All Priorities • Alarm Notification • Alarm Priorities	Receive Alarms tab
ECG • Size • Set ISO point, Set J point	HR digit field > Size HR digit field > ST tab > Set ISO point or Set J point
Impedance respiration • Measurement Source • Resp Averaging Time	Resp digit field > Measurement Source Resp digit field > Resp Averaging Time
IBP • SPV Source	IBP digit field > Advanced tab > SPV Source
Temperature • Unit	Temperature digit field > Unit
C.O. • Scale	C.O. digit field > Scale

Settings	How to get there
CO ₂ • Unit	CO ₂ digit field > Unit
Entropy • Check Sensor	Entropy digit field > Check Sensor
NMT • Current mA • Start-up Settings • Use Supramax	NMT digit field > Current mA NMT digit field > Start-up Settings, Use Supramax
BIS • Sensor Check	BIS digit field > Sensor Check check box
Password • Password Policy	 >  Service > enter Username and Password
Alarm Options - Local Alarms tab • Audio of Alarms ◦ Audio Off Allowed ◦ Reminder Volume ◦ Alarm Tones ◦ Low Priority Alarm Tone ◦ Alarm Volume Control ◦ Minimum Alarm Volume Settings • High & Medium Alarm Volume • Low Alarm Volume	 >  Service > Alarm Options > Audio of Alarms
• Allowed Alarm Priorities ◦ Tachy ◦ V Tach ◦ Brady ◦ ST Segment high/low ◦ Arrhythmia paused ◦ ECG lead off ◦ ECG leads off ◦ SpO2 low ◦ SpO2 probe off ◦ IBP high/low ◦ NIBP high/low ◦ RR (Imped.) high/low ◦ CO2 high/low ◦ Temp high/low ◦ Apnea (Imped.) ◦ FiAA high/low	 >  Service > Alarm Options > Allowed Alarm Priorities
• Latching Alarms • Nurse Call • Alarm Light OFF Allowed (not for device with VSP 4.0 Upgrade Software)	 >  Service > Alarm Options

Settings	How to get there
Alarm Options - Remote Alarms tab • From Remote Location • For Remote Bed • Allow Remote Pausing of • Remote Alarm Light • Show Remote Patient Name • Remote Alarm Tone • Remote Bed Selections	 >  Service > Alarm Options > Remote Alarms tab
Save Modes • Default Mode	 >  Service > Save Modes > Default Mode
Time and Date • Time Format	 >  Service > Time and Date > Time Format
Time Zone • Daylight Savings tab ◦ Daylight Savings ◦ Daylight Savings Offset (HH:MM) • DST Adjustment tab ◦ Begins ◦ Ends • Time Source tab ◦ Time Source • NTP Config tab ◦ Difference from GMT (HH:MM) + If Later ◦ Primary NTP Server ◦ NTS ◦ Select Certificate ◦ Secondary NTP Server ◦ NTS ◦ Select Certificate	 >  Service > Time Zone
Parameter Settings • Units ◦ Blood Pressure ◦ Height ◦ Weight ◦ Paw ◦ I:E • Others ◦ CO2 Numbers ◦ MAC Type	 >  Service > Parameter Settings
Roving • Monitor Roving • Roving Between Units • Manual Bed Entry	 >  Service > Roving

Settings	How to get there
Gesture Control (not for device with VSP 4.0 Upgrade Software) • Gesture Control • Time Period 1 • Time Period 2 • from/to hour • from/to minute	 >  Service > Gesture Control (not for device with VSP 4.0 Upgrade Software)
EWS • Protocol Type	 >  Service > EWS

Basic default settings

Admit/Discharge settings

Select patient information area to adjust the admit/discharge patient settings.

Setting	Default value
Select Patient tab	
First Name	NA
Last Name	NA
MRN	NA
Second ID	Disabled
Patient Type	Adult/Pediatric
Select Demographics	
Day	NA
Month	NA
Year	NA
Age	NA
Age Unit	Years NEONATAL mode: Days
Gender	NA
Height	NA
Weight	NA
BSA	NA
Select Load Patient tab > Find Patients	
MRN	NA
Last Name	NA
First Name	NA
Select Select Mode tab	

Setting	Default value
Select Mode	STEP-DOWN When Patient Type set to Neonatal , this mode option is fixed to NEONATAL .
Select Unit & Bed tab	
Unit Name	Current unit
Bed Name	Current bed
Select New Unit & Bed	
Unit Name	NA
Bed Name	NA
Select Printing	
Printout	Waveforms
Care Unit	NA
Location	Local selected
Remote Device	NA

Trends settings

Graphic Trends

Select  > **Trends** tab >  (shift to graphic trends if necessary) >  on the bottom right corner > **Scales** tab to setup the graphic trends scale.

Setting	Default value
General vertical tab	
Time Scale	2 h
SpO2	80–100 %
HR	0–240 /min
ST	-5..+5 mm
C.O.	0–9 l/min
C.I.	0–10 l/min/m2
PVC	0–24 /min
Press. vertical tab	
PCWP	0–30 mmHg
CPP	0–200 mmHg
Temp vertical tab	
Tblood	20–40 °C
T1	20–40 °C
T2	20–40 °C

Select the **Pages** tab to setup the graphic trends pages.

Setting	Description	Default value		
		STEP-DOWN, PE-DIATRIC, NEONATAL	ED, PACU, OR	ICU
Page 1: Select the Page 1 vertical tab				
Field 1	Select what displays in the first field.	HR		
Field 2	Select what displays in the second field.	SpO2		
Field 3	Select what displays in the third field.	RR (Imped.)		ST
Field 4	Select what displays in the fourth field.	NIBP		
Page 2: Select the Page 2 vertical tab				
Field 1	Select what displays in the first field.	ST		PVC
Field 2	Select what displays in the second field.	PVC		RR (Imped.)
Field 3	Select what displays in the third field.	T1	CO2	T1
Field 4	Select what displays in the fourth field.	T2	IBP1	T2
Page 3: Select the Page 3 vertical tab				
Field 1	Select what displays in the first field.	IBP1	IBP2	CO2
Field 2	Select what displays in the second field.	IBP2	CPP	IBP1
Field 3	Select what displays in the third field.	CPP	T1	IBP2
Field 4	Select what displays in the fourth field.	CO2	T2	CPP
Page 4: Select the Page 4 vertical tab				
Field 1	Select what displays in the first field.	C.O.		
Field 2	Select what displays in the second field.	C.I.		
Field 3	Select what displays in the third field.	PI OR mode: NMT T1 & Ratio		
Field 4	Select what displays in the fourth field.	OFF OR mode: NMT PTC & Count		

Numerical Trends

Back to the Trends menu, select  >  on the bottom right corner to setup the numerical trends.

Setting	Default value
Trends Interval	5 min
Trends Printing	Screen Data

Full Disclosure

Back to the Trends menu, select **Full Disclosure** tab, Select  on the bottom right corner to setup the full disclosure.

Setting	Default value
Hemodynamics Sweep Speed	12.5 mm/s

Brightness settings

Select the  >  **Screen Brightness** to adjust the display brightness.

Setting	Default value
Brightness Type (not for device with VSP 4.0 Upgrade Software)	Manual
Screen Brightness	70%

Sound volume settings

Select the  >  **Sound Volumes** to adjust the sound volume settings.

Setting	Default value
High & Medium Alarm Volume	5
Low Alarm Volume	5
Beat Volume	0 OR mode: 3
Completed NIBP Volume	3

Night mode settings

Select the  >  **Night Mode** to adjust the night mode settings.

Setting	Default value
Select Enter tab	
Scheduled	Not selected
From	21 : 00
To	07 : 00
Select Setup tab	
High & Medium Alarm Volume	5
Low Alarm Volume	5

Setting	Default value
Beat Volume	0
Screen Brightness	10%
Alarm Light (not for device with VSP 4.0 Upgrade Software)	40%
Completed NIBP Volume	0
Silence ALL	Disabled

Screen setup settings

Select the  **Screen Setup** to adjust the screen settings.

Layout 1

Select the **Layout 1** tab.

Setting	Default value						
	STEP-DOWN	ED	PACU	ICU	OR	PEDIATRIC	NEONATAL
Waveform 1	ECG1						
Waveform 2	ECG2						
Waveform 3	Pleth(SpO2)			ECG3	Pleth(SpO2)		
Waveform 4	Resp		CO2	Pleth(SpO2)	CO2	Resp	
Waveform 5	IBP1	CO2	IBP1	Resp	IBP1		CO2
Waveform 6	CO2	IBP1	IBP2	IBP1	IBP2	CO2	IBP1
Waveform 7	OFF		O2	IBP2	IBP8	OFF	
Waveform 8	OFF		Resp	IBP8	NMT	OFF	
Waveform 9	OFF			NMT	Entropy	OFF	
Waveform 10	OFF						
Waveform 11	OFF						
Waveform 12 (need to turn off the lower digital field)	OFF						
Combine Pressures	Not selected						
Select Lower Area vertical tab							
Lower Area	ON						
Lower Field 1	Temp						
Lower Field 2	EWS			PCWP	MAC	OFF	
Lower Field 3	NIBP						
Lower Field 4	OFF			C.O.	Gases	OFF	

Setting	Default value						
	STEP-DOWN	ED	PACU	ICU	OR	PEDIATRIC	NEONATAL
Select Split Screen vertical tab							
Show	None						

Layout 2

Select the **Layout 2** tab.

Setting	Default value						
	STEP-DOWN	ED	PACU	ICU	OR	PEDIATRIC	NEONATAL
Waveform 1	ECG1						
Waveform 2	ECG2					Pleth(SpO2)	
Waveform 3	Pleth(SpO2)			ECG3	Pleth(SpO2)	Resp	
Waveform 4	Resp		CO2	IBP1	CO2	IBP1	CO2
Waveform 5	IBP1	CO2	Resp	IBP2	IBP1	CO2	IBP1
Waveform 6	NIBP	IBP1		IBP8	IBP2		
Waveform 7	CO2	NIBP	NMT	Pleth(SpO2)	IBP8	OFF	
Waveform 8	OFF	NMT	OFF	CO2	Resp	OFF	
Waveform 9	OFF			Resp	Entropy	OFF	
Waveform 10	OFF				NMT	OFF	
Waveform 11	OFF						
Waveform 12 (need to turn off the lower digital field)	OFF						
Combine Pressures	Not selected						
Select Lower Area vertical tab							
Lower Area	ON						
Lower Field 1	Temp			NIBP	Temp		
Lower Field 2	EWS			PCWP	MAC	EWS	
Lower Field 3	OFF		NIBP	C.O.	NIBP		
Lower Field 4	OFF			NMT	EWS	OFF	
Select Split Screen vertical tab							
Show	None						

Layout 3

Select the **Layout 3** horizontal tab.

Setting	Default value
Field 1	HR
Field 2	SpO2
Field 3	Resp
Field 4	NIBP

Layout 4

Select the **Layout 4** horizontal tab.

Setting	Default value
Field 1	HR
Field 2	IBP1
Field 3	SpO2
Field 4	Resp
Field 5	CO2
Field 6	NIBP

Alarm setup settings

Select the  >  to setup alarm settings.

Setting	Description	Default value
Select Alarm Limits tab.		
 NOTE The alarm limits default value is the same as parameter menu, refer to “Parameter default settings” for more details.		
Default Limits	Return to default alarm limits.	NA
Auto Limits	Setup to auto alarm limits.	NA
Cancel	Select to cancel the changes.	NA
Apply	Select to apply the changes.	NA
Select Audio tab.		
High & Medium Alarm Volume	Select the volume for High & Medium priority alarms.	5
Low Alarm Volume	Select the volume for Low priority alarms.	5
Activate All Audible Alarms	Activate all audio off alarms.	NA
None	No alarms are audio off.	Selected
Silence Apnea	Audio off apnea, EtCO ₂ , FiCO ₂ , RR limit alarms.	No selected
Silence ECG	Audio off HR source limit and arrhythmia alarms.	No selected

Setting	Description	Default value
Silence Apn&ECG	Audio off HR source limit, arrhythmia, apnea, EtCO ₂ , FiCO ₂ , RR limit alarms	No selected
Silence ALL	Audio off all alarms except the break-through alarms.	No selected

Select **Priorities** to adjust the alarm priority settings.

Setting	Default value
Select ECG vertical tab.	
Tachy	Medium
Brady	Medium PEDIATRIC and NEONATAL mode: High
ST Segment high/low	Medium NEONATAL mode: Low
Arrhythmia paused	Escalating
ECG lead off	Low
ECG leads off	Escalating
Frequent PVCs	Low OR mode: Escalating
Frequent SVCs	Low
Select Lethal vertical tab. The same contents as in ECG alarms default settings.	
Select Ventri cular vertical tab. The same contents as in ECG alarms default settings.	
Select Atrial vertical tab. The same contents as in ECG alarms default settings.	
Select IBP vertical tab.	
Art & ABP high/low	Medium
CVP high/low	Medium
PA high/low	Medium
RAP high/low	Medium
RVP high/low	Medium
LAP high/low	Medium
ICP high/low	Medium
UAC high/low	Medium
UVC high/low	Medium
IBP1 high/low	Medium
IBP2 high/low	Medium
IBP8 high/low	Medium
Select Others vertical tab.	
SpO2 high	Escalating
SpO2 low	Escalating
SpO2 probe off	Escalating

Setting	Default value
NIBP high/low	Medium
RR (Imped.) high/low	Escalating
Apnea (Imped.)	Escalating
CO2 high/low	Medium
FiAA high/low	Medium
Apnea (CO2)	Escalating
Temp high/low	Escalating
RR (CO2) high/low	Escalating

Select **Visual** to adjust the alarm light settings. (not for device with VSP 4.0 Upgrade Software)

Setting	Default value
Alarm Light Type	Auto
Alarm Light	100%

Printing settings

Select the  >  **Printing Setup** to setup the printing settings.

Setting	Default value
Select the Waveforms tab.	
Waveform 1	II
Waveform 2	OFF
Waveform 3	OFF
Start On Alarms	No
Delay	10 s
Paper Speed	25 mm/s
Length	30 s
Select the Devices tab.	
Printout	Waveforms
Care Unit	NA
Location	Local selected
Remote Device	NA

Export patient data settings

Select the  >  **Export Patient Data** to setup settings.

Setting	Default value
Graphic Trend	Not selected

Setting	Default value
Numeric Trend	Selected
Snapshot	Not selected
Export Latest Data	2 h
All ECG Waveforms	Not selected
Alarm History	Selected

OxyCRG settings

Make sure already selected the NEONATAL mode. Select the  >  **OxyCRG** > **OxyCRG Setup** tab to setup OxyCRG.

Setting	Default value
SpO2 High Limit	OFF
SpO2 Low Limit	88
Short Apnea	20
HR High Limit	200
HR Low Limit	90

EWS settings

Select the  >  **EWS**.

Table 1 For National Early Warning Score 2:

Setting	Default value
Select Calculation tab	
HR, SpO2, RR, SYS, Temp values are the real time value	
Hypercapnic Respiratory Failure	not selected
Air or oxygen?	Blank
Consciousness	Blank

Table 2 For Modified Early Warning Score:

Setting	Default value
Select Calculation tab	
SYS, Pulse (ECG), Temp, RR (CO2) values are the real time value	
Consciousness	Blank
Hourly Urine for 2 hours	Blank

Other patients settings

Select the  >  **Other Patients** to adjust the remote alarm settings for each individual remote bed or for all remote beds in the selected Unit.

For more information, see the user's manual.

The Receive Alarms tab is only visible when the automatic view on alarm (AVOA) functionality is enabled.

Setting	Description	Default value
View Patients tab		
Unit	Select the care unit.	Current unit
Show	Select which patient beds are shown in the list.	All Patients
Receive Alarms		
Change All Notifications	Select the type of alarm notification(s) that will display on this monitor for the selected unit.	Off
Change All Priorities	Select the alarm priority level that will display on this monitor for the selected bed.	High, Medium
Alarm Notification	Select the type of alarm notification(s) that will display on this monitor for the selected Unit.	Off
Alarm Priorities	Select the alarm priority level that will display on this monitor for the selected bed unless the Alarm Notification setting is Off .	High, Medium

Password settings

Select the  >  **Service** to setup password settings.

Setting	Default value
Username	NA
Password	NA
Select Reset Password	
Expiration Date (YYYYMMDD)	NA
Activation Code	NA
Select Change Password	
clinical	Not selected
service	Not selected
New Password	NA
Confirm New Password	NA
Select Password Policy > Basic Policy tab	

Setting	Default value
Password Minimum Length	8
Uppercase characters Minimum number	0
Lowercase characters Minimum number	0
Digit Minimum number (need check)	0
Special characters Minimum number	0
Select Password Policy > Advanced Policy tab	
Maximum repeating character length	Not selected , value is 3
Maximum monotonic sequence length	Not selected , value is 3
Password history	Not selected , value is 10
Maximum error attempts	Not selected, value is 3
Password expired duration(month)	Not selected, value is 3

Installation default settings

The **Clinical** setup menus include the advanced configuration settings which need password to enter in. We recommend you contact the responsible organization to setup.

To access and customize the installation settings:

1. Select the  >  **Service**.
2. Enter the **Username** and **Password**.
3. Select **Login**.



NOTE

Username and password are case sensitive.

Alarm options settings

Select the  >  **Service** > **Alarm Options** to setup.

Select **Audio of Alarms** to setup.

Setting	Description	Default value
Audio Off Allowed	Select if enable alarm audio off feature.	NO
Reminder Volume	Select the reminder beep volume. ^{*1}	5
Alarm Tones	Select the alarm tone patterns.	ISO2
Low Priority Alarm Tone	Select the audible alarm tone sound for low priority alarms.	Single
Alarm Volume Control	Select whether the alarm volume adjusts Common for All , or Separate for Low).	Common for All

Setting	Description	Default value
High & Medium Alarm Volume	Select the minimum audible alarm volume for high and medium priority alarms.	5
Low Alarm Volume	Select the minimum audible alarm volume for low priority alarms.	5
*1 Make sure the reminder beep volume is suit for your care environment to avoid missing silenced alarms.		

Select the **Allowed Alarm Priorities** to setup priority options.

Setting	Default value
ECG tab	
Tachy	Escalating High Medium
Brady	Escalating High Medium
V Tach	High
ST Segment high/low	High Medium Low
ECG lead off	Low
ECG leads off	Escalating High
Arrhythmia paused	Escalating High
SpO2 tab	
SpO2 low	Escalating High Medium
SpO2 probe off	Escalating High
BP tab	
IBP high/low	High Medium
NIBP high/low	High Medium
Others tab	
RR (Imped.) high/low	Escalating High Medium Low
Apnea (Imped.)	Escalating High Medium Low
CO2 high/low	High Medium
FiAA high/low	High Medium
Temp high/low	Escalating Medium Low

Select the **Alarm Delays** to setup.

Setting	Default value
V Tach Event Duration Criteria	not selected

Setting	Description	Default value
Latching Alarms	Select if keep alarm messages on screen even if initial alarm condition goes away.	NO

Setting	Description	Default value
Breakthrough Alarm	Select to allow some alarms to break through (interrupt) an audio off or audio pause condition. The choices are: • Off: close breakthrough feature. • Peds: turn on breakthrough feature for new fatal alarms, including Brady. • Adult: turn on breakthrough feature for new fatal alarms, excluding Brady.	Adult PEDIATRIC and NEONATAL mode: Peds
Nurse Call	Select the nurse call system electrical level in the hospital. The choices are: • Normal Open: high electrical level export from the nurse call connector when there is medium or high priority alarm. • Normal Close: low electrical level export from the nurse call connector when there is medium or high priority alarm.	Normal Open
Alarm Light (not for device with VSP 4.0 Upgrade Software)	Enable the alarm light to be turned off 0%(OFF) Allowed .	Disabled

Select the **Remote Alarms** tab to setup.

Setting	Description	Default value
For Remote Bed	Enable Audio pause for a remote bed from this monitor.	No
From Remote Location	Select which remote devices on the network can pause alarms for this monitor.	Not Allowed
Allow Remote Pausing of	Select the alarm priority levels that can be remotely paused.	Low Alarms
Show Remote Patient Name	Enable the patient's name to display when using the AVOA feature.	Disabled
Remote Alarm Light	Enable the alarm light for remote events.	On
Remote Alarm Tone	Select the audible alarm tone for remote alarms.	Local
Restore after Discharge	Select to restore the list of selected remote beds after a discharge.	Enabled

Snapshot settings

Select the  >  **Service > Snapshot**.

Setting	Description	Default value
Field 1	Select the parameter to display in snapshots.	ECG1
Field 2	Select the parameter to display in snapshots.	IBP1 ED mode: CO2 ICU mode: ECG2
Field 3	Select the parameter to display in snapshots.	Pleth ICU mode: IBP1 OR mode: CO2
Create on Alarms	Select if snapshot create on alarms.	YES

Parameter settings

Select the  **Service** > **Parameter Settings**.

Setting	Default value
Units tab	
Blood Pressure	mmHg
Height	cm
Weight	kg
Paw	cmH2O
I:E	[-]
Colors tab > IBP Page1 vertical tab	
Art	Red
RAP	White
ABP	Red
RVP	White
CVP	Blue
LAP	White
PA	Yellow
ICP	White
Colors tab > IBP Page2 vertical tab	
UAC	Red
UVC	White
IBP1	Red
IBP2	Blue
IBP8	Yellow
Colors tab > Common vertical tab	
ECG	Green
CO2	White
SpO2	Yellow

Setting	Default value
O2	White
NIBP	Red
N2O	Blue
Resp	White
Temp	White
Colors tab > Specific vertical tab	
BIS	Blue
Entropy	White
C.O.	White
NMT	Violet
Paw	Yellow
Flow	Green
SPI	Violet
Others tab	
CO2 Numbers	Dry
MAC Type	MAC
ECG Printout Format	4 x 2.5 - 1 Rhythm

Roving settings

Select the  >  **Service > Roving.**

Setting	Description	Default value
Monitor Roving	Select if monitor roving is allowed.	Not Allowed
Roving Between Units	Select if roving between units is allowed.	Not Allowed
Manual Bed Entry	Select if bed names can be entered manually.	Not Allowed

Gesture control settings

(not for device with VSP 4.0 Upgrade Software).

Select the  >  **Service > Gesture Control.**

Setting	Description	Default value
Gesture Control	Select to enable or disable gesture control feature.	Disabled
Time Period 1	Select to enable the first time period to disable gesture control feature.	Not selected
From To	Set the time period to disable gesture control.	00:00 - 00:00

Setting	Description	Default value
Time Period 2	Select to enable the second time period to disable gesture control feature.	Not selected
From To	Set the time period to disable gesture control.	00:00 - 00:00

Save modes settings

Select the  >  **Service > Save Modes.**

Setting	Description	Default value
Select Save Modes tab.		
Target Mode	Select the target mode to save current or factory settings.	STEP-DOWN
Save current settings to Target Mode	Save current settings to target mode	NA
Revert Target Mode to factory default	Revert target mode to factory default settings.	NA
Select Default Mode tab.		
Default Mode	Select the default mode.	STEP-DOWN

Time and Date settings



NOTE

The monitor can't be the TIME MASTER in network. If the monitor is connected to the network, it follows the central station's time settings and the **Time and Date** is gray.



NOTE

You can't change the time and date settings when the patient has been admitted.

Select the  >  **Service > Time and Date.**

Setting	Description	Default value
Time and Date	Select to view and adjust current time and date.	Keep the current time and date as default.
Select the Time Format tab		
Time Format	Select to adjust the time format.	24 h

Time zone settings

The **Time Zone** menu is enable only when the monitor is disconnect to the network and patient is discharged.

Select the  >  **Service > Time Zone.**

Setting	Description	Default value
Daylight Savings	Select to turn on/off, or set auto to adjust daylight savings time (DST).	ON
Daylight Savings Offset (HH:MM)	Select to set the hours : minutes off-set for daylight savings.	01 : 00
Select DST Adjustment tab ^{*1}		
Begins	Select to set daylight savings begin time.	• Month: Mar • Week (1st...): 2nd • Day of Week: Sun • Time 24h Clock: 02:00
Ends	Select to set daylight savings end time.	• Month: Nov • Week (1st...): 1st • Day of Week: Sun • Time 24h Clock: 02:00
Select the Time Source tab ^{*2}		
Time Source	Select to set time sync source. • Unity: Time sync to CARESCAPE network. • NTP: Time sync to NTP server.	Unity
Select the NTP Config tab ^{*3}		
Difference from GMT (HH:MM) + If Later	Select to set offset hours : minutes from GMT.	+01: 00
Primary NTP Server	Enter the primary NTP server IP address.	Blank
NTS	Select checkbox to enable Network Time Security (NTS) feature for Primary NTP Server , provides cryptographic security for the client-server mode of the Network Time Protocol (NTP).	Not selected
Select Certificate	Select the NTS certificate which have been imported by service or hospital IT.	Disable (select NTS to enable)
Secondary NTP Server	Enter the secondary NTP server IP address.	Blank
NTS	Select checkbox to enable Network Time Security (NTS) feature for Secondary NTP Server , provides cryptographic security for the client-server mode of the Network Time Protocol (NTP).	Not selected
Select Certificate	Select the NTS certificate which have been imported by service or hospital IT.	Disable (select NTS to enable)
^{*1} The settings are enable only when Daylight Savings is set to AUTO ^{*2} The tab is shown only when monitor has the UNITY and HL7 license. ^{*3} The tab is shown only when monitor has the HL7 license.		

USB import and export settings

Select the  >  **Service** > **USB Import/Export**.

Setting	Description	Default value
Export settings to USB Disk	Export all modes' settings to the USB storage device.	NA
Import settings from USB Disk	Import all modes' settings from the USB storage device. Restart needed.	NA
Set Key for Patient Data Export	Set key for patient data export to USB disk in PDF format.	NA
Export trends to USB Disk	Export the trends to the USB storage device	NA
Export logs to USB Disk	Export the logs to the USB storage device	NA

EWS settings

Select the  >  **Service** > **EWS**.

Setting	Description	Default value
Protocol Type	Select the protocol type to be NEWS2 or MEWS .	NEWS2

Printer settings

Select the  >  **Service** > **Page 2** vertical tab > **Printer**.

Setting	Description	Default value
Paper Size	Select the paper size for network printer.	A4
ECG Printout Format	Select the all ECG waveform printout format.	4 x 2.5 - 1 Rhythm
Print Patient Name	Include the patient name in printout.	Not selected.

Parameter default settings

ECG default settings

Select the HR digit field > **Setup** tab.

Setting	Description	Default value
ECG1 Lead	Select the ECG 1 lead for 3-,5-, 10-lead.	II
ECG2 Lead	Select the ECG 2 lead for 3-,5-, 10-lead.	3-lead mode: Cascade 5-, 10-lead mode: V1
ECG3 Lead	Select the ECG 3 lead for 3-,5-, 10-lead.	3-lead mode: Cascade 5-, 10-lead mode: aVL
V Lead	Select the V-lead label for 5-, 10-lead.	V1
Size	Select the waveform size.	1x
Hemodynamics Sweep Speed	Select the hemodynamic waveform speed.	25 mm/s
Beat Volume	Select the audible QRS beep tone volume.	0 OR mode: 3 .
Update Lead Set	Select to update lead set.	NA

Select the **Advanced** tab.

Setting	Description	Default value
Pacemaker Detection	Enable the pacemaker detection program.	Show OR mode: Hide .
Waveform Filter	Select the filter for waveform display and printed strips.	Monitoring OR mode: Moderate
QRS Width	Select the level of QRS detection enhancement.	Normal NEONATAL mode: Narrow .
Primary HR Source	Select the parameter to calculate HR.	AUTO
Display with Primary HR	Display a second HR value in the ECG digit field.	None
ECG Grid	Display a grid on waveforms.	Disabled
Relearn	Select to relearn the QRS pattern.	NA

Select the **ST** tab.

Setting	Description	Default value
Select the Adjust ST vertical tab		
Set ISO point	Select to enable ISO point set.	NA
Set J point	Select to enable J point set.	NA
ST point	Select the ST point	J+80
Select the ST Alarm vertical tab		
Lateral alarm limits	Select the high/low alarm limits.	2.0/-2.0
Lateral alarms on/off	Enable alarm when limits are violated.	OFF
Inferior alarm limits	Select the high/low alarm limits.	2.0/-2.0
Inferior alarms on/off	Enable alarm when limits are violated.	OFF

Setting	Description	Default value
Anterior alarm limits	Select the high/low alarm limits.	2.0/-2.0
Anterior alarms on/off	Enable alarm when limits are violated.	OFF

ECG alarms default settings

Select the **Alarms** tab > **HR** vertical tab.

Setting	Description	Default value
HR alarm limits	Select the high/low alarm limits.	160/40 PEDIATRIC mode: 160/70 NEONATAL mode: 200/90
HR alarms on/off	Enable alarm when limits are violated.	ON

Select the **Lethal** vertical tab.

Alarms	Alarm priority settings	Create Snapshot
Asystole	Fixed	ON
V Fib / V Tach	Fixed	ON
V Tach	High	ON

Setting	Description	Default value
Minimum HR/min	Select the minimum HR value to trigger the V Tach alarm.	100 NEONATAL mode: 160
Event Duration	Select how long time is needed to trigger the V Tach alarm.	3 s

Select the **Ventricular** vertical tab.

Alarms	Alarm priority settings	Create Snapshot
VT > 2	Medium	ON
R on T	Medium	OFF
V Brady	Medium OR mode: High	ON
Couplet	Low	ON
Bigeminy	Low	ON
Accelerated Ventricular	Low	OFF NEONATAL mode: ON
Trigeminy	Low	OFF OR and NEONATAL mode: ON
Multifocal PVCs	Off	OFF

Select the **Atrial** vertical tab.

Alarms	Alarm priority settings	Create Snapshot
A Fib	Off OR mode: Low	OFF
Irregular (NEONATAL mode only)	Low	ON
SV Tachy	Off	OFF
Missing Beat	Off OR mode: Low	OFF
Pause	Low	OFF OR mode: ON

Setting	Description	Default value
Pause Interval	Select the time interval between two adjacent beats before Pause alarm sounds.	3 s NEONATAL mode: 5 s
SVT Length	Define the number of beats before the SVT alarm sounds.	6 Beats
HR for SVT /min	Select the HR value to target SVT alarm.	120 NEONATAL mode: 180

Select the **PVC** vertical tab

Setting	Description	Default value
PVC alarm	Select the high alarm limit.	20 OR mode: 6
PVC alarm on/off	Enable alarm when limits are violated.	OFF

Select the **SVC** vertical tab

Setting	Description	Default value
SVC alarm	Select the high alarm limit.	10
SVC alarm on/off	Enable alarm when limits are violated.	OFF

Impedance respiration default settings

Select impedance respiration digit field.

Setting	Description	Default value
Size	Select the waveform display size.	0.8 NEONATAL mode: 1.0 .
Measurement	Display respiration measurement.	OFF
Measurement Source	Select the lead to measure respiration.	II

Setting	Description	Default value
Sweep Speed	Select the waveform display sweep speed.	6.25 mm/s NEONATAL mode: 0.625 mm/s .
Resp Averaging Time	Select the respiration average time.	10

Select the **Alarms** tab.

Setting	Description	Default value
Respiration Rate alarm limits	Select the high/low alarm limits.	60/4 OR mode: 60/OFF NEONATAL mode: 50/20
Respiration Rate alarm on	Enable alarm when limits are violated.	ON OR mode: OFF
Apnea Limit Seconds	Select Apnea alarm delay time.	20 NEONATAL mode: 15

SpO₂ default settings

Select the SpO₂ digit field to setup.

Setting	Description	Default value
Pleth Scale	Select the waveform display scale.	- GE SpO₂: AUTO OR mode: 20 - Nellcor/Masimo SpO₂: 1x
SpO₂ Response (GE SpO ₂ only.)	Select the averaging time.	Normal
Averaging (Masimo SpO ₂ only.)	Select the averaging time.	8s NEONATAL mode: 12s
Sensitivity (Masimo SpO ₂ only.)	Select the SpO ₂ sensor sensitivity level.	Normal
Beat Volume	Select the volume of the pulse rate beat tone.	0 OR mode: 3
Primary HR Source	Select the parameter to calculate HR.	AUTO
Show PI (GE and Masimo SpO ₂ only.)	Select to show/hide PI.	ON

Select the SpO₂ digit field > **Alarms** tab to setup.

Setting	Description	Default value
SpO ₂ alarm limits	Select the high/low alarm limits.	OFF /90 PEDIATRIC mode: OFF/94 NEONATAL mode: OFF/88
SpO ₂ alarms on	Enable alarm when limits are violated.	ON

Setting	Description	Default value
Alarm Delay (Masimo SpO ₂ only.)	Select the SpO2 low alarm delay time.	5s

NIBP default settings

Select the NIBP digit field > **Setup** tab.

Setting	Description	Default value
Cuff Size	Select the NIBP cuff size.	(Not Selected) NEONATAL mode: Neonatal
NIBP Manual	Start/stop once NIBP measurement.	NA
NIBP Auto	Start/stop auto NIBP measurement.	NA
Start STAT	Start/stop STAT NIBP measurement.	NA
Cycle Time	Select the amount of time between automatic measurements.	5 min PACU mode: 15 min. NEONATAL mode: 10 min.
Completed NIBP Volume	Select the tone volume that sounds when an NIBP measurement is complete.	3
Use Default Inflation Pressure	Enable automatic selection of initial cuff inflation pressure.	Enabled
Infl. Press.mmHg	Select the cuff initial inflation pressure.	- When Cuff Size is Adult/Child: 135 - PEDIATRIC mode: 125 - When Cuff Size is Neonatal: 100

Select the **Custom Series** tab.

Setting	Description	Default value
X BP Series	Select the first BP series measurement time.	q5min
repeat	Select the BP series measurement repeat time.	X4
X BP Series	Select the second BP series measurement time.	q15min
repeat	Select the BP series measurement repeat time.	X4
X BP Series	Select the third BP series measurement time.	q30min
repeat	Select the BP series measurement repeat time.	X2
X BP Series	Select the fourth BP series measurement time.	q60min
repeat	Select the BP series measurement repeat time.	X1

Select the **Venous Stasis** tab.

Setting	Description	Default value
Cuff Size	Select the type of cuff size.	Adult/Child
Stasis Press.	Select the stasis pressure.	80
Start Stasis	Start or stop the venous stasis measurement.	NA

Select the **Alarms** tab.

Setting	Description	Default value
Systolic alarm limits	Select the high/low adult and pediatric alarm limits. (When cuff size is Adult/Child)	150/70 OR mode: 180/80
	Select the high/low neonatal alarm limits. (When cuff size is Neonatal)	100/40 OR mode: 120/50
Systolic alarm on	Enable alarm when limits are violated.	ON
Mean alarm limits	Select the high/low adult and pediatric alarm limits. (When cuff size is Adult/Child)	100/40 OR mode: 140/60
	Select the high/low neonatal alarm limits. (When cuff size is Neonatal)	70/30 OR mode: 80/40
Mean alarm on	Enable alarm when limits are violated.	ON
Diastolic alarm limits	Select the high/low adult and pediatric alarm limits. (When cuff size is Adult/Child)	90/30 OR mode: 100/40
	Select the high/low neonatal alarm limits. (When cuff size is Neonatal)	60/20 OR mode: 70/30
Diastolic alarm on	Enable alarm when limits are violated.	ON

Invasive pressure default settings

The default **IBP1** pressure site for STEP-DOWN, ED, PACU, ICU, OR, and PEDIATRIC mode is **Art**, for NEONATAL mode is **UAC**.

The default **IBP2** pressure site for STEP-DOWN, ED, PACU, ICU, OR, and PEDIATRIC mode is **CVP**, for NEONATAL mode is **UVC**.

The default **IBP8** pressure site is **PA**, for NEONATAL mode is NA.

Setting	Description	Default value												
		IBP1	IBP2	IBP8	Art	CVP	PA	RAP	RVP	LAP	ICP	ABP	UAC	UVC
Select the IBP digit field > Setup tab.														
Label	Select the pressure site label.	IBP1	IBP2	IBP8	Art	CVP	PA	RAP	RVP	LAP	ICP	ABP	UAC	UVC
Scale mmHg	Select the trend scale.	0-200	0-20	0-60	0-200	0-20	0-60	0-20	0-60	0-20	0-20	0-200	0-100	0-10
Digit Format	Select the pressure values display format.	S/D	Mean	S/D	S/D	Mean	S/D	Mean	S/D	Mean	CPP	S/D	S/D	Mean
Hemodynamics Sweep Speed	Select the waveform display sweep speed.	25 mm/s												
HR Source	Select the parameter to calculate HR.	AUTO												
Select the Advanced tab.														
Response	Select the IBP averaging time.	Normal												
Filter Frequency Hz	Select the waveform filter.	22	9	9	22	9	9	9	9	9	9	22	14	14
Ventilation Mode	Select the mode for ventilation	Contrl, NEONATAL mode: Spont												
SPV Source	Select the source for SPV.				Off							Off		
Select the Alarms tab.														
Systolic alarm limits	Select the low/high alarm limits.	80/180	5/20	10/40	80/180	5/20	10/40	5/20	10/40	5/30	0/20	80/180	40/90	5/15, OR mode:0/20

Setting	Description	Default value												
		IBP1	IBP2	IBP8	Art	CVP	PA	RAP	RVP	LAP	ICP	ABP	UAC	UVC
Systolic alarms on	Enable alarm when limits are violated.	ON, OR mode: OFF	OFF	OFF	ON	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON, OR mode: OFF	OFF, OR mode: ON
Mean alarm limits	Select the low/high alarm limits.	60/140	-5/15, OR mode:0/15	5/30	60/140	-5/15, OR mode:0/15	5/30	0/15	5/35	5/20	0/15	60/140	30/60, OR mode: 30/70	-5/15, OR mode: 0/15, NEO mode: 0/5
Mean alarms on	Enable alarm when limits are violated.	OFF, OR mode: ON	ON	OFF	OFF	ON	OFF, OR mode: ON	OFF	OFF, OR mode: ON	OFF, OR mode: ON		OFF	ON	ON, OR mode: OFF
Diastolic alarm limits	Select the low/high alarm limits.	40/100	-5/10	5/20	40/100	-5/10	5/20	0/10	0/20	0/20	0/10	40/100	20/50	0/5, OR mode: -5/10
Diastolic alarms on	Enable alarm when limits are violated.	OFF	OFF	OFF	OFF	OFF	OFF, PACU, OR mode: ON	OFF	OFF	OFF	OFF	OFF	ON, OR mode: OFF	OFF

Temperature default settings

Select the temperature digit field to setup.

Setting	Description	Default value
T1 Label	Select the temperature site label.	T1
T2 Label	Select the temperature site label.	T2
Unit	Select the temperature unit.	°C

Select the **Alarms** tab.

Setting	Description	Default value
T1 alarm limits	Select the high/low alarm limits.	38.0/34.0 OR mode: 38.5/34.0 PEDIATRIC mode: 38.0/35.5 NEONATAL mode: 37.5/36.0
T1 alarms on/off	Enable alarm when limits are violated.	OFF OR mode: ON
T2 alarm limits	Select the high/low alarm limits.	38.0/15.0 OR mode: 38.5/15.0 NEONATAL mode: 37.5/36.0
T2 alarms on/off	Enable alarm when limits are violated.	OFF OR mode: ON
Tblood alarm limits	Select the high/low alarm limits.	38.5/34.0 PEDIATRIC mode: 38.0/35.5
Tblood alarms on/off	Enable alarm when limits are violated	OFF OR mode: ON

Cardiac output (C.O.) default settings

Select the C.O. digit field to setup.



NOTE

C.O. feature is not available for NEONATAL mode.

Select the **Setup** tab.

Setting	Description	Default value
Catheter Type	Select the catheter type.	777F8
Measurement Type	Select the measurement detection type.	Auto
REF Measurement	Enable REF measurement.	Disable
Injectate Volume	Select the initial injectate volume.	10 ml
Computation Constant	Select the computation constant value.	0.542

Setting	Description	Default value
Scale	Select the waveform scale.	1.0
Show With C.O./C.I.	Select what to show.	NONE

Select the **Alarms** tab.

Setting	Description	Default value
Tblood alarm limits	Select the high/low alarm limits.	38.5/34.0 PEDIATRIC mode: 38.0/35.5
Tblood alarms on/off	Enable alarm when limits are violated	OFF OR mode: ON

Airway gases default settings

CO₂ default settings

Select the CO₂ digit field.

Setting	Description	Default value
Scale	Select the CO ₂ scale.	6%
FiO₂ Level	Select the level of FiO ₂ used to make compensation to measured CO ₂ values.	21-40%
CO₂ Sweep Speed	Select the CO ₂ sweep speed.	6.25 mm/s
Unit	Select the CO ₂ unit	%
N₂O Level	Select the level of N ₂ O used to make compensation to measured CO ₂ values.	0-40%
Measurement	Display the CO ₂ measurement.	ON
Measurement Source	Select the gases measurement source: auto, gas module, or anesthesia	Automatic (A)

Select the **Alarms** tab.

Setting	Description	Default value
EtCO ₂ alarm limits	Select the high/low alarm limits (%).	8.0/3.0 NEONATAL mode: 6.0/3.0
EtCO ₂ alarms on/off	Enable alarm when limits are violated.	ON
FiCO ₂ alarm limits	Select the high/low alarm limits (%).	3.0/OFF
FiCO ₂ alarms on/off	Enable alarm when limits are violated.	ON

Setting	Description	Default value
RR (CO ₂) alarm limits	Select the high/low alarm limits (min).	60/4 NEONATAL mode: 75/20 OR mode: 60/OFF
RR (CO ₂) alarms on/off	Enable alarm when limits are violated.	ON OR mode: OFF

O₂ default settings

Select the O₂ digit field.

Setting	Description	Default value
Scale	Select the O ₂ scale.	DIFF6
Measurement	Display the CO ₂ measurement.	ON
O2 Sweep Speed	Select the O ₂ sweep speed.	6.25 mm/s

Select the **Alarms** tab.

Setting	Description	Default value
EtO ₂ alarm limits	Select the high/low alarm limits (%).	OFF/10
EtO ₂ alarms on/off	Enable alarm when limits are violated.	OFF
FiO ₂ alarm limits	Select the high/low alarm limits (%).	OFF/18
FiO ₂ alarms on/off	Enable alarm when limits are violated.	ON

Anesthetic agent/N₂O default settings

Select the AA digit field.

Setting	Description	Default value
Agent Scale	Select the agent scale.	AA, Hal: 1.2 Enf, Iso: 2.5 Des: 10 Sev: 5
Agent Measurement	Display the agent measurement.	ON
Agent Sweep Speed	Select the agent sweep speed.	6.25 mm/s
N2O Measurement	Display the N ₂ O measurement.	ON

Select the **Alarms** tab.

Setting	Description	Default value
EtHal alarm limits	Select the high/low alarm limits (%).	1.5/OFF OR and NEONATAL mode: 1.3/OFF

Setting	Description	Default value
EtEnf alarm limits		3.4/OFF OR and NEONATAL mode: 2.9/OFF
EtIso alarm limits		2.3/OFF OR and NEONATAL mode: 2.0/OFF
EtDes alarm limits		8.0/OFF OR and NEONATAL mode: 10.0/OFF
EtSev alarm limits		3.4/OFF
EtAA alarms on/off	Enable alarm when limits are violated.	OFF
FiHal alarm limits	Select the high/low alarm limits (%).	2.2/OFF
FiEnf alarm limits		5.1/OFF
FiIso alarm limits		3.4/OFF
FiDes alarm limits		12.0/OFF
FiSev alarm limits		5.1/OFF OR and NEONATAL mode: 6.0/OFF
FiAA alarms on/off	Enable alarm when limits are violated.	ON

Entropy default settings

Select the Entropy digit field.



NOTE

The Entropy is available in OR mode only.

Setting	Description	Default value
Entr. EEG Scale	Select the EEG waveform scale.	250
EEG Sweep Speed	Select the EEG sweep speed.	25 mm/s
Display Format	Select the value display format.	RE+SE
Entropy/SPI Trend Length	Select the trend length.	5 min
Check Sensor Automatic	Enable automatic sensor check.	Enabled

Select the **Alarms** tab.

Setting	Description	Default value
RE alarm limits	Select the high/low alarm limits (%).	OFF
RE alarms on/off	Enable alarm when limits are violated.	OFF
SE alarm limits	Select the high/low alarm limits (%).	OFF
SE alarms on/off	Enable alarm when limits are violated.	OFF

NMT default settings

Select the NMT digit field.



NOTE

The NMT feature not available for NEONATAL mode.

Setting	Description	Default value
Start-up Settings	Select when a new measurement starts.	AUTO
Use Supramax	Enable the search for the supramaximal stimulus current search.	Enabled
Current mA	Select the simulation current value for TOF, DBS and ST stimulation modes.	S (70 mA)
Cycle Time	Select the TOF/DBS stimulation mode cycle time.	20 s
	Select the ST stimulation mode cycle time.	1 s

Select the **Advanced** tab.

Setting	Description	Default value
Stimulus Mode	Select the stimulus mode.	TOF
Stimulation Type	Select the stimulation pulse width.	Adult
Recovery Note	Enable a recovery note to display.	OFF
Stimulus Beep Volume	Select the volume of the audible stimulus beep tone.	0
Show Ratio Microtrend	Select whether microtrend is shown.	Enabled

BIS default settings

Select the BIS digit field to setup.

NOTE

This measurement is not available in the Neonatal mode.

Setting	Description	Default value
BIS EEG Scale μV	Select the waveform scale.	100
EEG Sweep Speed	Select the waveform sweep speed.	25 mm/s
Smoothing Rate	Select the amount of data used to calculate the BIS value.	30 s OR, PACU mode: 15 s
Filters	Enable the EEG high and low pass filter frequencies.	Enabled

Setting	Description	Default value
Sensor Check Automatic	Enable automatic combined sensor impedance check and ground impedance check.	Enabled

Select the **Alarms** tab.

Setting	Description	Default value
BIS alarm limits	Select the high/low alarm limits.	OFF
BIS alarms on/off	Enable alarm when limits are violated.	OFF

Spirometry default settings

Select the Spirometry digit field.

Setting	Description	Default value
Paw Scale	Select the scale for PAW waveform.	60
Flow Scale	Select the scale for Flow waveform.	40
Paw Sweep Speed	Select the sweeping speed for Paw waveform.	6.25 mm/s
Flow Sweep Speed	Select the sweeping speed for Flow waveform.	6.25 mm/s
Show Volume	Select the volume.	TV

Select the **Alarms** tab.

Setting	Description	Default value
Ppeak	Enable alarm when limits are violated.	OFF
MVexp	Enable alarm when limits are violated.	OFF
TVexp	Enable alarm when limits are violated.	OFF
Apnea (Ane. Machine)	Enable alarm when limits are violated.	OFF

Electromagnetic compatibility

Standards compliance

In addition to the standards listed in the user documentation, the system is also compatible with the following Electromagnetic disturbances – Requirements and tests standard:

- IEC 60601-1-2/ EN 60601-1-2

Compliance with the standard IEC 60601-1-2 / EN 60601-1-2 applies only to those products that are currently being manufactured and shipped. It does not apply to older devices or devices that have their software upgraded.

Essential performance in EMC

Parameter	Essential performance
General	• No loss of or change to user settings, stored data or operating mode. • No permanent loss of display or unrecoverable loss of function due to equipment damage. • No loss of patient data, mode of operation, or stored data during loss of AC mains or battery power > 10 s. • Ability to generate a technical alarm during abnormal operation. • Resumption of normal operation without data loss within 10 seconds following exposure to electrosurgery.
ECG heart rate accuracy	• $\pm 1\%$ or ± 1 bpm, whichever is greater.
Impedance respiration rate accuracy	• 0 to 120 breaths per minute: ± 1 bpm
SpO ₂ saturation measurement value accuracy	GE TruSignal, Nellcor, Masimo: • Adult/Pediatric (70 to 100%): ± 2 • Neonatal (70 to 100%): ± 3
NIBP measurement accuracy	• The measurement of the cuff pressure reading ≤ 2 mmHg, and ≤ 8 mmHg (1.1 kPa) standard deviation
Invasive pressure measurement accuracy	• Monitor: $\pm 4\%$ or ± 2 mmHg, whichever is greater • E-COP: $\pm 4\%$ or ± 4 mmHg, whichever is greater
Temperature measurement accuracy	• $\pm 0.3^\circ\text{C}$ including sensor
C.O. blood temperature measurement accuracy	• 17.5 to 33.9°C (63.5 to 93.0°F): $\pm 0.4^\circ\text{C}$ (0.8°F) • 34.0 to 42.0°C (93.2 to 107.6°F): $\pm 0.3^\circ\text{C}$ (0.5°F) • 42.1 to 43.0°C (107.7 to 109.4°F): $\pm 0.4^\circ\text{C}$ (0.8°F)
CO ₂ measurement accuracy	• E-sCAiO, E-sCO, N-CAiO: $\pm(0.2 \text{ vol}\% + 2\% \text{ of reading})$ • E-miniC: 0 to 15% vol: $\pm(0.2 \text{ vol}\% + 2\% \text{ of reading})$, 15 to 20% vol: $\pm(0.7 \text{ vol}\% + 2\% \text{ of reading})$
O ₂ measurement accuracy	• $\pm(1 \text{ vol}\% + 2\% \text{ of reading})$

Parameter	Essential performance
N ₂ O measurement accuracy	0 to 84 vol%: $\pm(2 \text{ vol\%} + 2\% \text{ of reading})$ 85 to 100 vol%: $\pm(2 \text{ vol\%} + 8\% \text{ of reading})$
AA (Desflurane) measurement accuracy	$\pm(0.15 \text{ vol\%} + 5\% \text{ of reading})$
Entropy total noise level	$\leq \pm 20\%$ of the nominal output value or $\pm 10 \mu\text{V}$, whichever is greater.
BIS total noise level	$\leq \pm 20\%$ of the nominal output value or $\pm 10 \mu\text{V}$, whichever is greater.

Entropy accessories and electromagnetic compatibility

The Entropy accessories meet the IEC 60601-1-2 standard requirements for immunity with the following exceptions:

- The radiated Proximity RF fields immunity compliance level of the Entropy measurement is 10 V/m at 450 MHz. Higher levels may cause disturbance to the Entropy curve and numerical values.

Based on the standard, these degradations of the Entropy measurement are acceptable as they do not cause an unacceptable risk to the user or patient.

The user can easily notice the electromagnetic disturbance because there are changes in the Entropy values or the appearance of the Entropy curve (for example, excessive noise or a sine wave). If you suspect electromagnetic disturbance to the Entropy measurement, it is recommended that you select the Entropy curve to be shown on the screen.

If there is a disturbance on the Entropy curve and/or values, increase the distance between Entropy accessories and portable RF communications equipment.

BIS accessories and electromagnetic compatibility

The BIS accessories meet the IEC 60601-1-2 standard requirements for immunity with the following exceptions:

- The radiated RF immunity compliance level of the BIS measurement is 1 V/m with some frequencies. Higher levels may cause disturbance to the BIS curve and numerical values.
- When the BIS sensor is connected to the PIC+ cable, the maximum compliance level for the electrostatic air discharge of the BIS sensor connector is $\pm 8 \text{ kV}$. Higher levels may cause loss of BIS measurement.

Based on the standard, these degradations of the BIS measurement are acceptable as they do not cause an unacceptable risk to the user or patient.

The user can easily notice the electromagnetic disturbance because BIS measurement is lost or there are changes in the BIS values or the appearance of the BIS curve (for example, excessive noise or a sine wave). If you suspect electromagnetic disturbance to the BIS measurement, it is recommended that you select the BIS curve to be shown on the screen.

Depending on the error that the system detects if exposed to a significant electromagnetic interference, different actions may be required from the user. For example, the user may need to disconnect the BIS interface cable from the E-BIS module and immediately reconnect it back to the E-BIS module. If there is a disturbance on the BIS curve and/or values, increase the distance between BIS accessories and portable RF communications equipment.

Electromagnetic emissions

Guidance and manufacturer's declaration — electromagnetic emissions		
The device is intended for use in the electromagnetic environment specified below. The customer or the user of the device should assure that it is used in such an environment.		
Emissions test	Compliance	Electromagnetic environment - guidance
RF emissions CISPR 11*	Group 1	The monitors use RF energy only for their internal function. Therefore, RF emissions are very low and are not likely to cause any interference in nearby electronic equipment.
RF emissions CISPR 11*	Class A	
Harmonic emissions IEC 61000-3-2	Class A	
Voltage fluctuations/flicker emissions IEC 61000-3-3	Complies	
* Deviation from IEC 60601-1-2: tested with the test setup defined in IEC 60601-2-49.		



NOTE

The emissions characteristics of this equipment make it suitable for use in industrial areas and hospitals (CISPR 11 class A). If it is used in a residential environment (for which CISPR 11 class B is normally required), this equipment might not offer adequate protection to radio-frequency communication services. The user might need to take mitigation measures, such as relocating or re-orienting the equipment.

Electromagnetic immunity

Guidance and manufacturer's declaration — electromagnetic immunity			
This device is intended for use in the electromagnetic environment specified below. It is the responsibility of the hospital to assure that the device is used in such an environment.			
Immunity test	IEC 60601 test level	Compliance level	Electromagnetic environment — guidance
Electrostatic Discharge (ESD) IEC 61000-4-2	± 8 kV contact ± 2 kV, ± 4 kV, ± 8 kV, ± 15 kV air	± 8 kV contact ± 2 kV, ± 4 kV, ± 8 kV, ± 15 kV air	Floors should be wood, concrete or ceramic tile. If floors are covered with synthetic material, the relative humidity should be at least 30%. Mains power quality should be that of a typical commercial or hospital environment.
Electrical Fast Transient/Burst IEC 61000-4-4	± 2 kV for power supply lines ± 1 kV for input/output lines	± 2 kV for power supply lines ± 1 kV for input/output lines	
Surge IEC 61000-4-5	± 0.5 kV, ± 1 kV differential mode ± 0.5 kV, ± 1 kV, ± 2 kV common mode	± 0.5 kV, ± 1 kV differential mode ± 0.5 kV, ± 1 kV, ± 2 kV common mode	

Guidance and manufacturer's declaration — electromagnetic immunity This device is intended for use in the electromagnetic environment specified below. It is the responsibility of the hospital to assure that the device is used in such an environment.			
Immunity test	IEC 60601 test level	Compliance level	Electromagnetic environment — guidance
Voltage dips IEC 61000-4-11	$U_t = 0\%$, 0.5 cycle (0, 45, 90, 135, 180, 225, 270, and 315 degrees) $U_t = 0\%$, 1 cycle $U_t = 70\%$, 25/30 cycles (0 degrees)	$U_t = 0\%$, 0.5 cycle (0, 45, 90, 135, 180, 225, 270, and 315 degrees) $U_t = 0\%$, 1 cycle $U_t = 70\%$, 25/30 cycles (0 degrees)	Mains power quality should be that of a typical commercial or hospital environment. If the user of the equipment requires continued operation during power mains interruptions, it is recommended that the equipment be powered from an uninterruptible power supply or a battery.
Short interruptions and voltage variations on power supply input lines IEC 61000-4-11	$U_t = 0\%$, 250/300 cycles	$U_t = 0\%$, 250/300 cycles	Mains power quality should be that of a typical commercial or hospital environment. If the user of the equipment requires continued operation during power mains interruptions, it is recommended that the equipment be powered from an uninterruptible power supply or a battery.
Power Frequency Magnetic Field IEC 61000-4-8	30 A/m 50 Hz or 60 Hz	30 A/m 50 Hz and 60 Hz	Power frequency magnetic fields should be at levels characteristic of a typical location in a typical commercial or hospital environment.
 NOTE U_t is the AC mains voltage prior to application of the test level.			

Electromagnetic immunity for RF

Guidance and manufacturer's declaration — electromagnetic immunity This device is intended for use in the electromagnetic environment specified below. It is the responsibility of the hospital to assure that the device is used in such an environment.			
Immunity test	IEC 60601 test level	Compliance level	Electromagnetic environment - guidance
Conducted RF IEC 61000-4-6	3 Vrms 150 kHz to 80 MHz 6 Vrms 150 kHz to 80 MHz ^{*1}		Portable and mobile RF communications equipment should not be used closer to any part of the equipment, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter. Recommended separation distance for 1 W: $d = 1.2 \sqrt{P}$ 150 kHz to 80 MHz

Guidance and manufacturer's declaration — electromagnetic immunity This device is intended for use in the electromagnetic environment specified below. It is the responsibility of the hospital to assure that the device is used in such an environment.			
Immunity test	IEC 60601 test level	Compliance level	Electromagnetic environment - guidance
Radiated RF IEC 61000-4-3 ^{*2}	3 V/m^{*3} 80 MHz to 2.7 GHz	3 V/m 80 MHz to 2.7 GHz	$d = 1.2 \sqrt{P}$ 80 MHz to 800 MHz. $d = 2.3 \sqrt{P}$ 800 MHz to 2.7 GHz where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer, and d is the recommended separation distance in meters (m). Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey^{*4} should be less than the compliance level in each frequency range^{*5}. Interference may occur in the vicinity of equipment marked with the following symbol: 
 NOTE At 80 MHz and 800 MHz, the higher frequency range applies.  NOTE These guidelines may not apply in all situations. Electromagnetic propagation is affected by reflection from structures, objects, and people.			
^{*1} The ISM (industrial, scientific and medical) bands between 0.15 MHz and 80 MHz are 6.765 MHz to 6.795 MHz; 13.553 MHz to 13.567 MHz; 26.957 MHz to 27.283 MHz; and 40.66 MHz to 40.70 MHz. ^{*2} Over the frequency range 150 KHz to 80 MHz, field strengths should be less than 3 V/m. ^{*3} For more information, see section Proximity field immunity compliance. ^{*4} Field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile 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 re-orienting or relocating the equipment. ^{*5} 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 device.

This device is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The customer or the user of the device can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the device as recommended below, according to the maximum output power of the communications equipment.

Rated maximum output power of transmitter in watts (W)	Separation distance in meters (m) according to frequency of transmitter		
	150 kHz to 80 MHz	80 MHz to 800 MHz	800 MHz to 2.7 GHz
	$d = 1.2 \sqrt{P}$	$d = 1.2 \sqrt{P}$	$d = 2.3 \sqrt{P}$
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

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.



NOTE

At 80 MHz and 800 MHz, the separation distance for the higher frequency range applies.



NOTE

These guidelines may not apply in all instances. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.

Proximity field immunity compliance

Guidance and manufacturer's declaration — electromagnetic immunity (IEC/EN 60601-1-2)							
Test frequency (MHz)	Band (MHz)	Service	Modulation	Maximum power (W)	Distance (m)	Immunity compliance level (V/m)	Immunity test level (V/m)
385	380 to 390	TETRA 400	Pulse Modulation 18 Hz	1.8	0.3	27	27
450	430 to 470	GMRS 460, FRS 460	FM $\pm$ 5kHz deviation 1 kHz sine	2	0.3	28	28
710	704 to 787	LTE Band 13, 17	Pulse Modulation 217 Hz	0.2	0.3	9	9
745							
780							
810	800 to 960	GSM 800/900, TETRA 800, iDEN 820, CDMA 850, LTE Band 5	Pulse Modulation 18 Hz	2	0.3	28	28
870							

Guidance and manufacturer's declaration — electromagnetic immunity (IEC/EN 60601-1-2)							
Test frequency (MHz)	Band (MHz)	Service	Modulation	Maximum power (W)	Distance (m)	Immunity compliance level (V/m)	Immunity test level (V/m)
930							
1720	1700 to 1990	GSM 1800; CDMA 1900; GSM 1900; DECT; LTE Band 1, 3, 4, 25; UMTS	Pulse Modulation 217 Hz	2	0.3	28	28
1845							
1970							
2450	2400 to 2570	Bluetooth, WLAN, 802.11 b/g/n, RFID 2450, LTE Band 7	Pulse Modulation 217 Hz	2	0.3	28	28
5240	5100 to 5800	WLAN 802.11 a/n	Pulse Modulation 217 Hz	0.2	0.3	9	9
5500							
5785							



NOTE

The distance values represent the recommended separation distance between interfering equipment and the monitor, modules, and accessories.

Guidance and manufacturer's declaration — Test specifications for enclosure part immunity to proximity magnetic fields		
Test frequency	Modulation	Immunity test level (A/m)
134.2 kHz	Pulse modulation ^{a)} 2.1 kHz	65 ^{b)}
13.56 MHz	Pulse modulation ^{a)} 50 kHz	7.5 ^{b)}
^{a)} The carrier shall be modulated using a 50% duty cycle square wave signal. ^{b)} r.m.s (root mean square), before modulation is applied.		

Guidance and manufacturer's declaration — electromagnetic immunity (AIM STANDARD 7351731, MEDICAL ELECTRICAL EQUIPMENT AND SYSTEM ELECTROMAGNETIC IMMUNITY TEST FOR EXPOSURE TO RADIO FREQUENCY IDENTIFICATION READERS)				
Test frequency	RFID standard the test is based on ^{*1}	Distance	Immunity compliance level	Immunity test level
134.2 kHz	ISO 14223	2.5 cm	65 A/m RMS	65 A/m RMS
13.56 MHz	ISO/IEC 14443-3 (Type A)	1.0 mm	7.5 A/m RMS	7.5 A/m RMS
13.56 MHz	ISO/IEC 14443-4 (Type B)	1.0 mm	7.5 A/m RMS	7.5 A/m RMS
13.56 MHz	ISO/IEC 15693 (ISO 18000-3 Mode 1)	1.0 mm	5.0 A/m RMS	5.0 A/m RMS
13.56 MHz	ISO 18000-3 Mode 3	5.0 cm ^{*2}	8 A/m	12 A/m
433 MHz	ISO/IEC 18000-7	20.0 cm	3 V/m	3 V/m
860 - 960 MHz	ISO/IEC 18000-63 Type C	20.0 cm	54 V/m	54 V/m
2.45 GHz	ISO/IEC 18000-4 Mode 1	20.0 cm	54 V/m	54 V/m

Guidance and manufacturer's declaration — electromagnetic immunity (AIM STANDARD 7351731, MEDICAL ELECTRICAL EQUIPMENT AND SYSTEM ELECTROMAGNETIC IMMUNITY TEST FOR EXPOSURE TO RADIO FREQUENCY IDENTIFICATION READERS)

Test frequency	RFID standard the test is based on ^{*1}	Distance	Immunity compliance level	Immunity test level


NOTE

The distance values represent the recommended separation distance between interfering equipment and the monitor.

^{*1} Tests are based on the listed RFID ISO standards that RFID systems can comply with.

^{*2} RFID readers emitting RF per ISO 18000-3 Mode 3 at 13.56 MHz should be more than 5 cm away from the device during patient monitoring.

Minimizing electromagnetic interference

Electromagnetic interference (EMI) can cause erratic readings, cessation of operation, or other incorrect functioning. If this occurs, survey the site of use to determine the source of this disruption, and take the listed actions to eliminate the source:

- Turn equipment in the vicinity off and on to isolate the interfering equipment.
- Reorient or relocate the interfering equipment.
- Increase the separation between the interfering equipment and this device.

The device can radiate radio frequency energy and, if not installed and used in accordance with these instructions, may itself cause harmful interference with other susceptible devices in the vicinity.

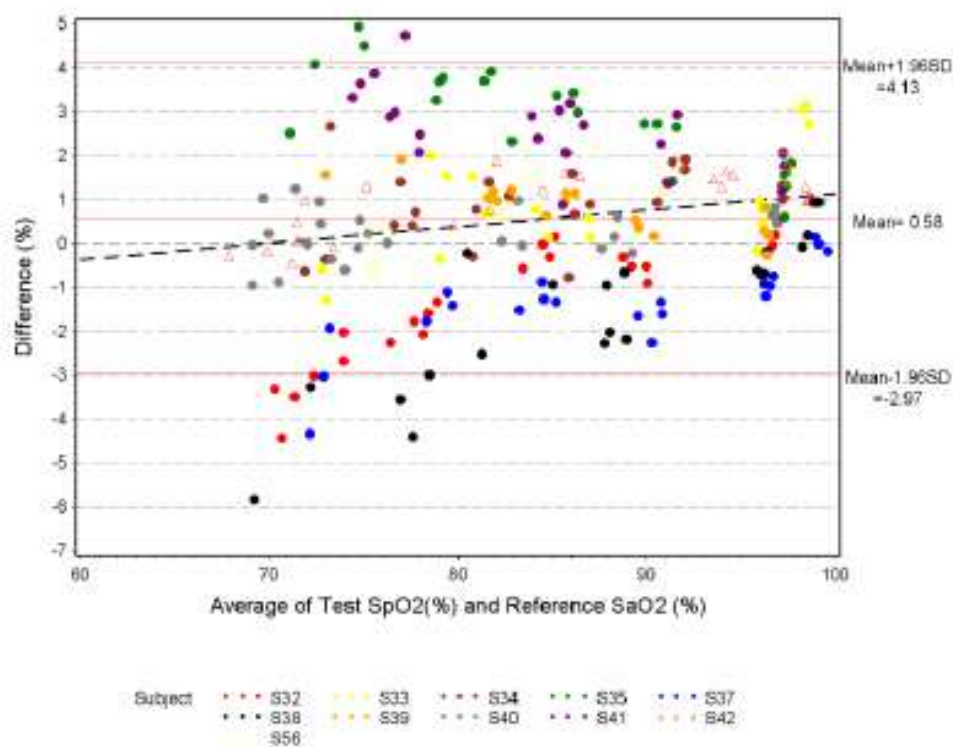
SpO2 supplemental analysis graphs

Additional accuracy information for GE TruSignal sensors

The table information provides supplemental data analysis for GE TruSignal sensors' measurement accuracy.

The following modified Bland-Altman plots show SpO₂ data by sensor type.

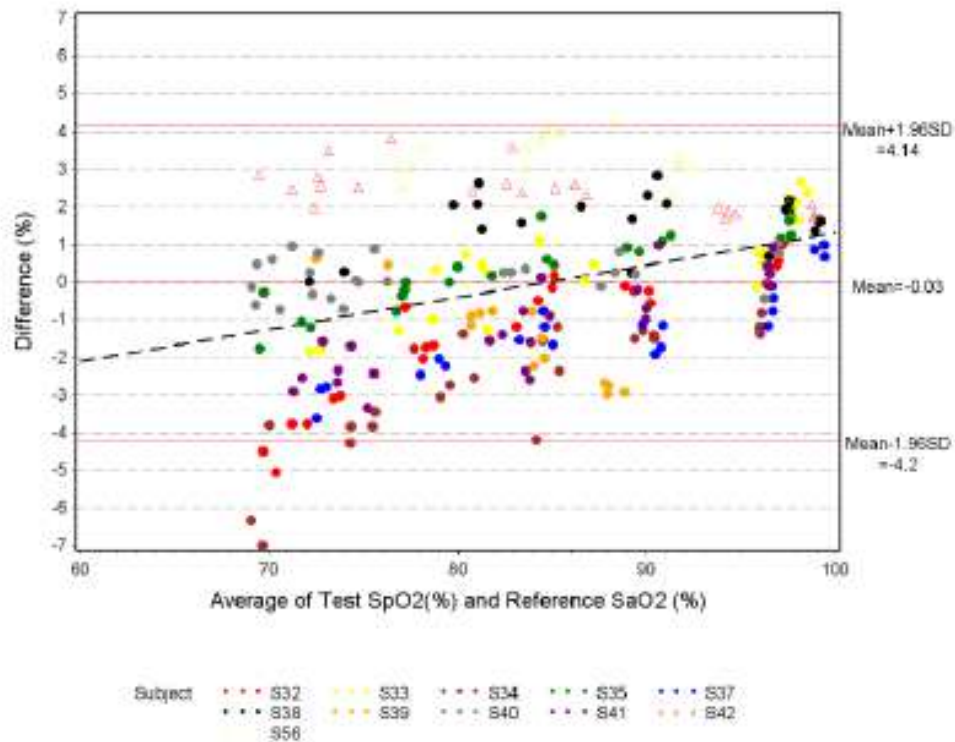
Figure 1 Bland-Altman plot for SpO₂ - TS-W-D sensor



The TS-W-D sensor is a reusable sensor. It is not provided sterile.

Table 3 TS-W-D sensor accuracy

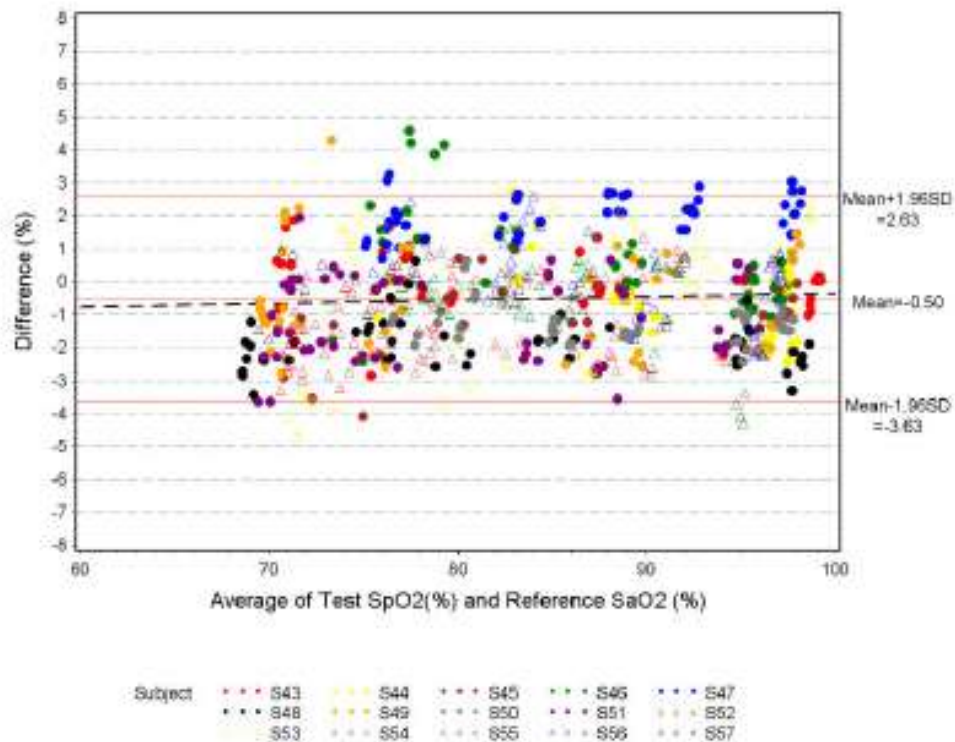
Accuracy 70-80% (ARMS)	Accuracy 80-90% (ARMS)	Accuracy 90-100% (ARMS)
2.503	1.555	1.411

Figure 2 Bland-Altman plot for SpO₂ - TS-SE-3 sensor

The TS-SE-3 sensor is a reusable sensor. It is not provided sterile.

Table 4 TS-SE-3 sensor accuracy

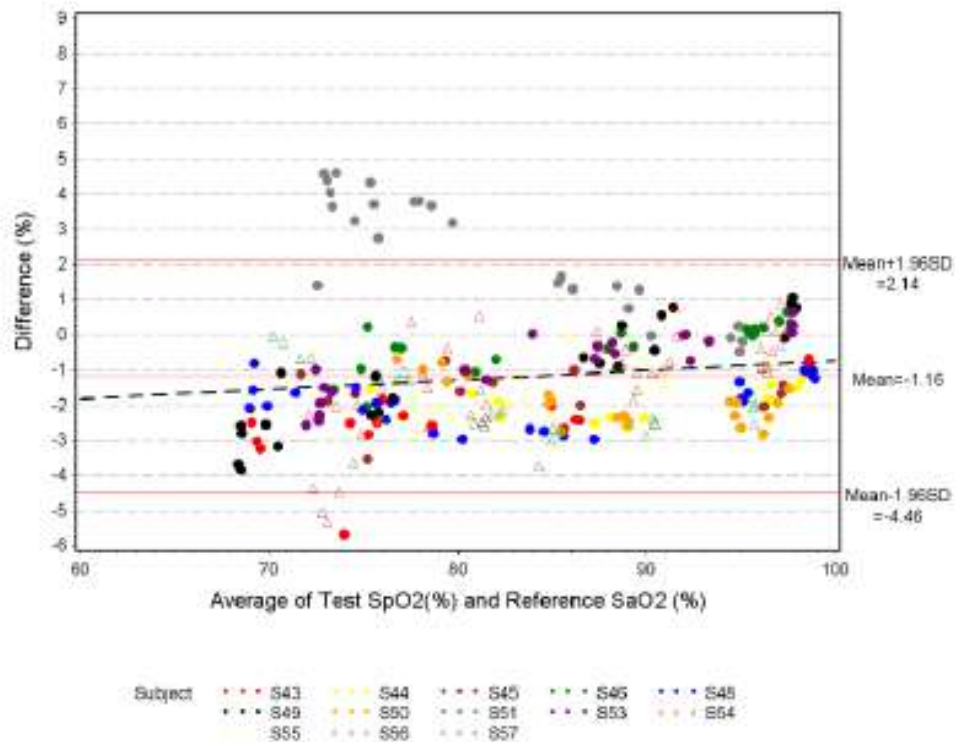
Accuracy 70-80% (ARMS)	Accuracy 80-90% (ARMS)	Accuracy 90-100% (ARMS)
2.586	1.997	1.52

Figure 3 Bland-Altman plot for SpO₂ - TS-E-D, TS-E2-GE, TS-E4-GE sensors

The TS-E-D, TS-E2-GE, TS-E4-GE sensors are reusable sensors. They are not provided sterile.

Table 5 TS-E-D, TS-E2-GE, TS-E4-GE sensor accuracy

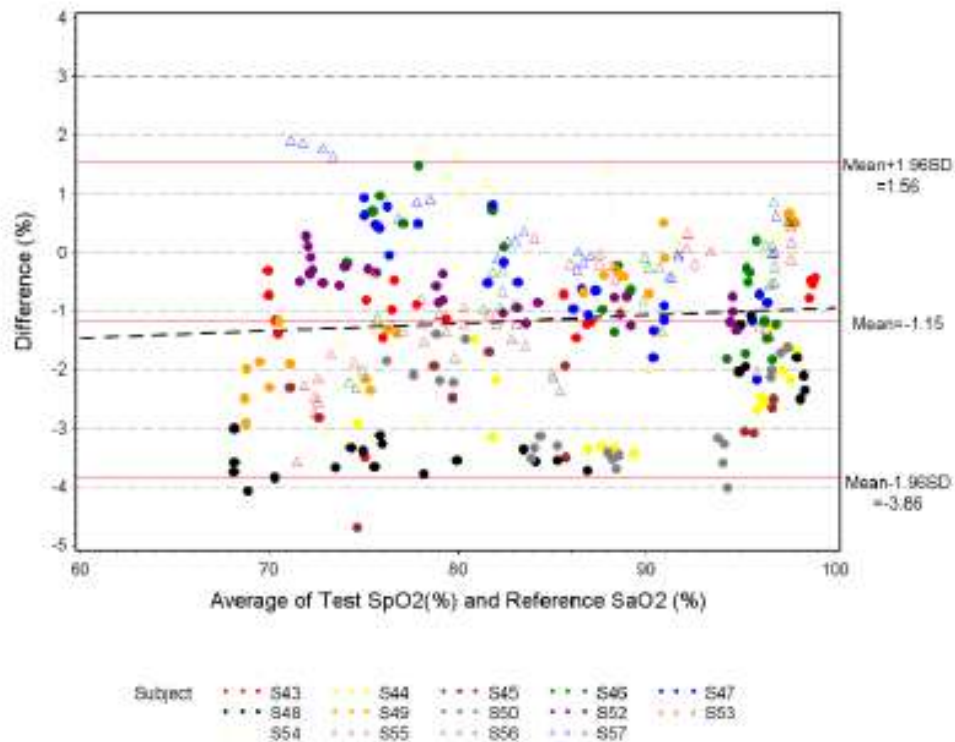
Accuracy 70-80% (ARMS)	Accuracy 80-90% (ARMS)	Accuracy 90-100% (ARMS)
1.831	1.502	1.567

Figure 4 Bland-Altman plot for SpO₂ - TS-F-D, TS-F2-GE, TS-F4-GE sensors

The TS-F-D, TS-F2-GE, TS-F4-GE sensors are reusable sensors. They are not provided sterile.

Table 6 TS-F-D, TS-F2-GE, TS-F4-GE sensor accuracy

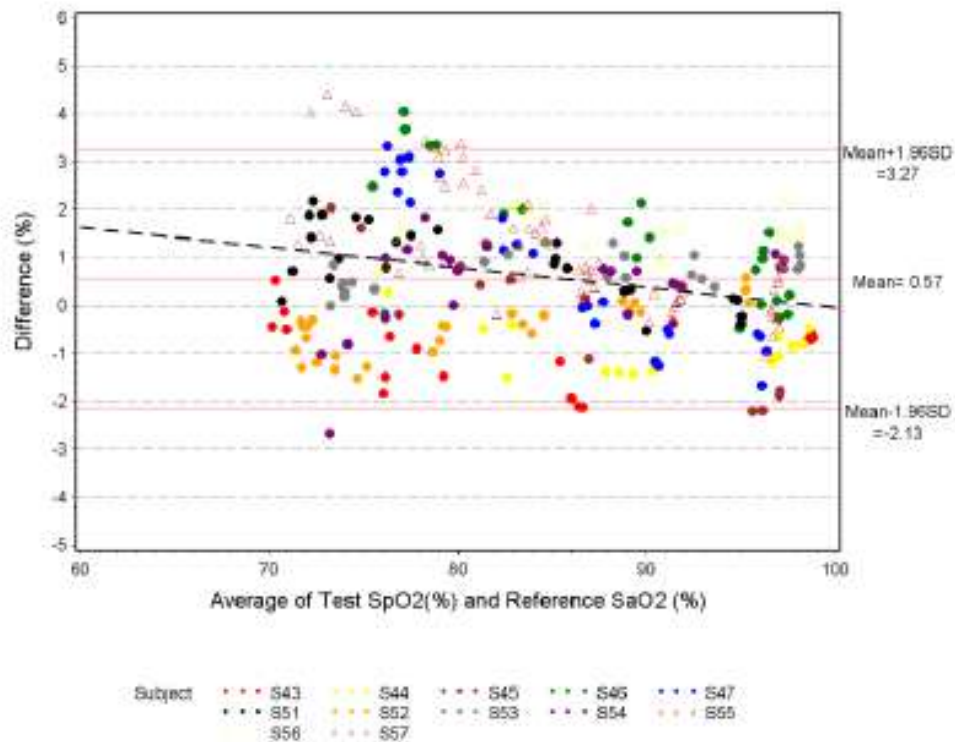
Accuracy 70-80% (ARMS)	Accuracy 80-90% (ARMS)	Accuracy 90-100% (ARMS)
2.587	1.895	1.376

Figure 5 Bland-Altman plot for SpO₂ - TS-SA-D, TS-SA4-GE, and TS-SP-D sensors

The TS-SA-D, TS-SA4-GE, and TS-SP-D sensors are reusable sensors. They are not provided sterile.

Table 7 TS-SA-D, TS-SA4-GE, and TS-SP-D sensor accuracy

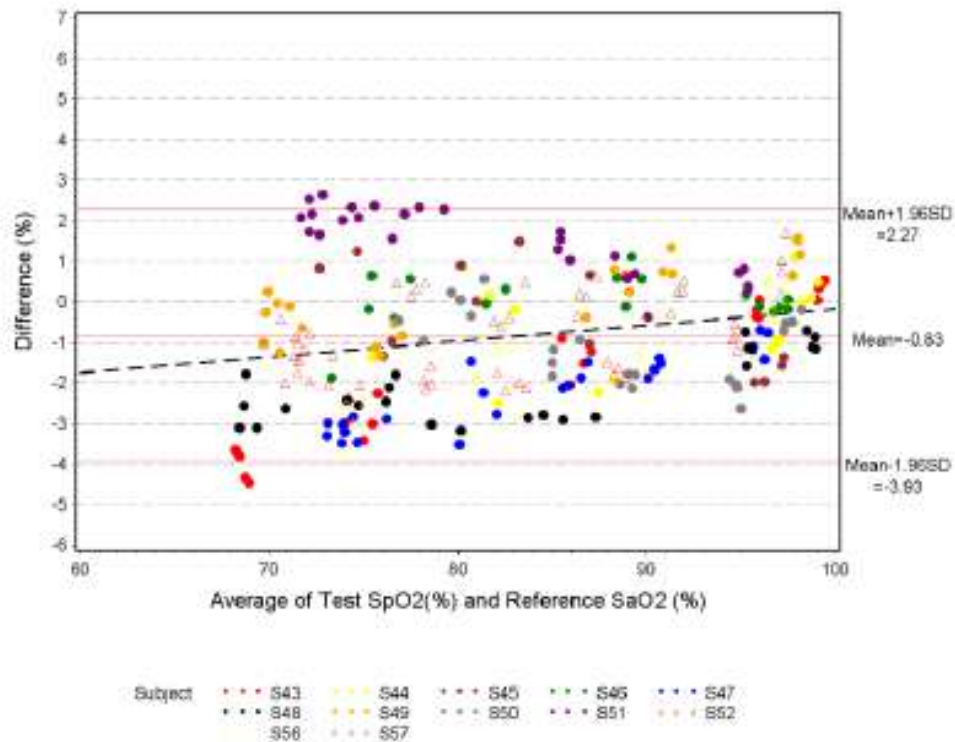
Accuracy 70-80% (ARMS)	Accuracy 80-90% (ARMS)	Accuracy 90-100% (ARMS)
1.874	1.78	1.597

Figure 6 Bland-Altman plot for SpO₂ - TS-AF-10, TS-AF-25 sensors

The TS-AF-10, TS-AF-25 sensors are single-patient-use sensors. They are not provided sterile.

Table 8 TS-AF-10, TS-AF-25 sensor accuracy

Accuracy 70-80% (ARMS)	Accuracy 80-90% (ARMS)	Accuracy 90-100% (ARMS)
1.971	1.23	0.898

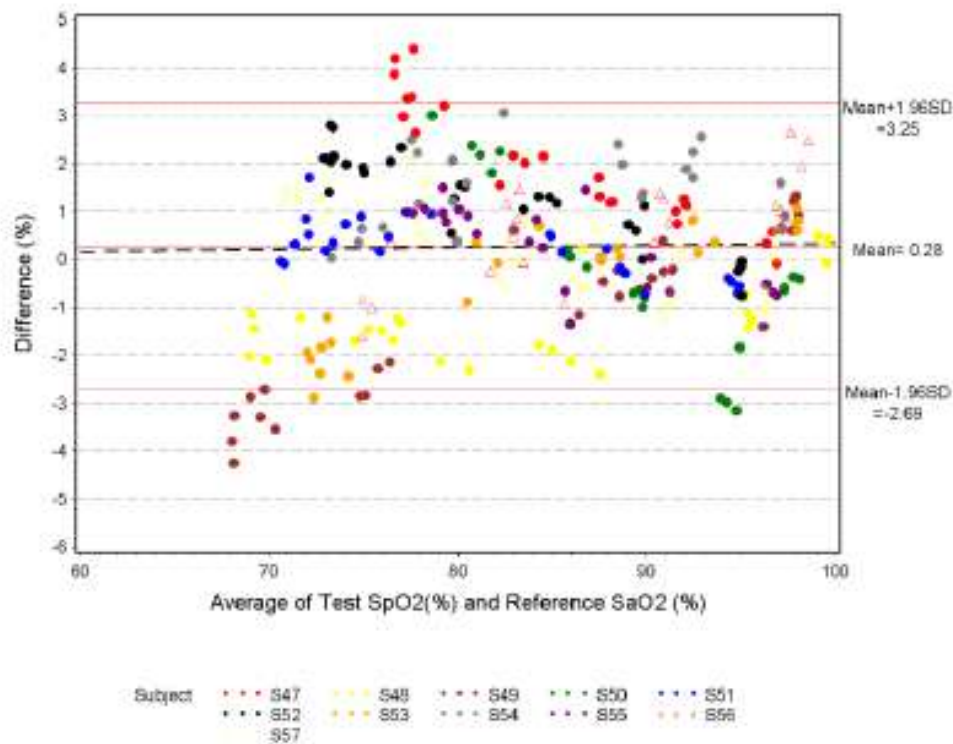
Figure 7 Bland-Altman plot for SpO₂ - TS-AP-10 and TS-AP-25 sensors

The TS-AP-10 and TS-AP-25 sensors are single-patient-use sensors. They are not provided sterile.

Table 9 TS-AP-10 and TS-AP-25 sensor accuracy

Accuracy 70-80% (ARMS)	Accuracy 80-90% (ARMS)	Accuracy 90-100% (ARMS)
2.342	1.572	1.058

Figure 8 Bland-Altman plot for SpO₂ - TS-AAW-10, TS-AAW-25, TS-PAW-10, and TS-PAW-25 sensors



The TS-AAW-10, TS-AAW-25, TS-PAW-10, and TS-PAW-25 sensors are single-patient-use sensors. They are not provided sterile.

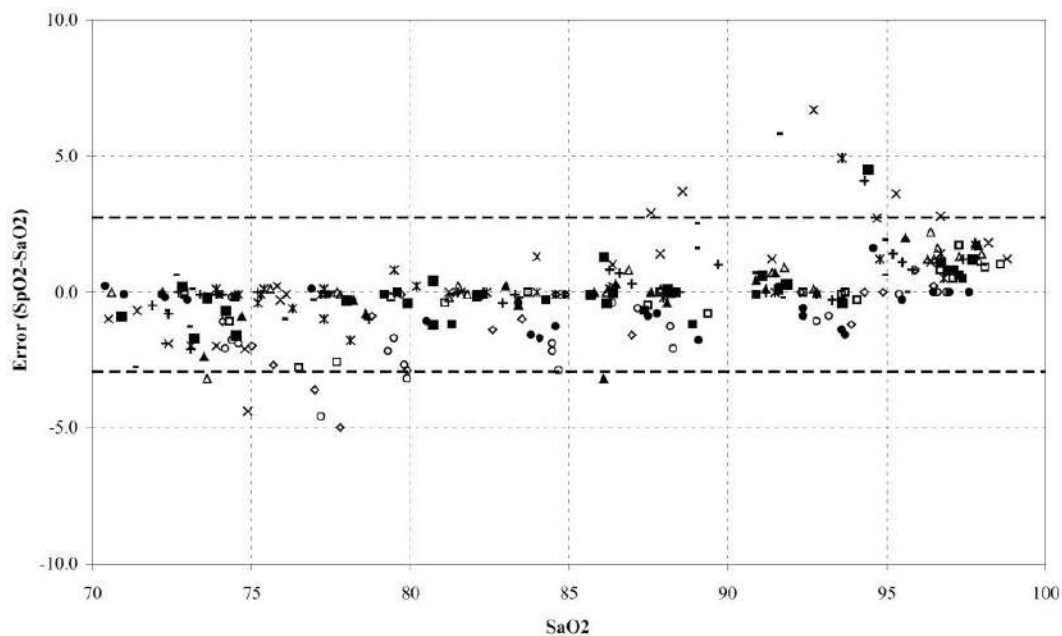
Table 10 TS-AAW-10, TS-AAW-25, TS-PAW-10, and TS-PAW-25 sensor accuracy

Accuracy 70-80% (ARMS)	Accuracy 80-90% (ARMS)	Accuracy 90-100% (ARMS)
1.945	1.156	1.117

Additional accuracy information for Masimo sensors

The table information provides supplemental data analysis for Masimo sensors’ measurement accuracy. The tables are provided by Masimo.

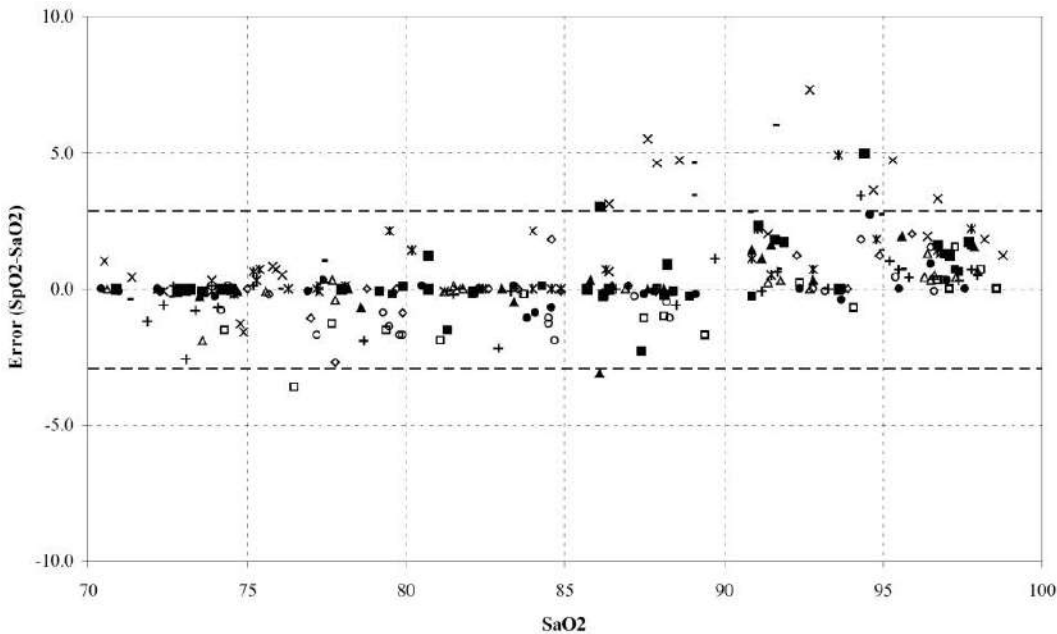
The table information for the plots below show A_{RMS} values measured with Masimo SET Oximetry Technology in a clinical study.

Figure 9 Adtx/Pdtx

The Adtx/Pdtx are single-patient-use sensors. They are not provided sterile.

Measured A_{RMS} values	
Range	A_{RMS}
90-100%	1.64%
80-90%	1.07%
70-80%	1.55%
Overall claimed accuracy value	
Range	A_{RMS}
70-100%	$\pm 2\%$

Figure 10 Inf/Neo/NeoPt



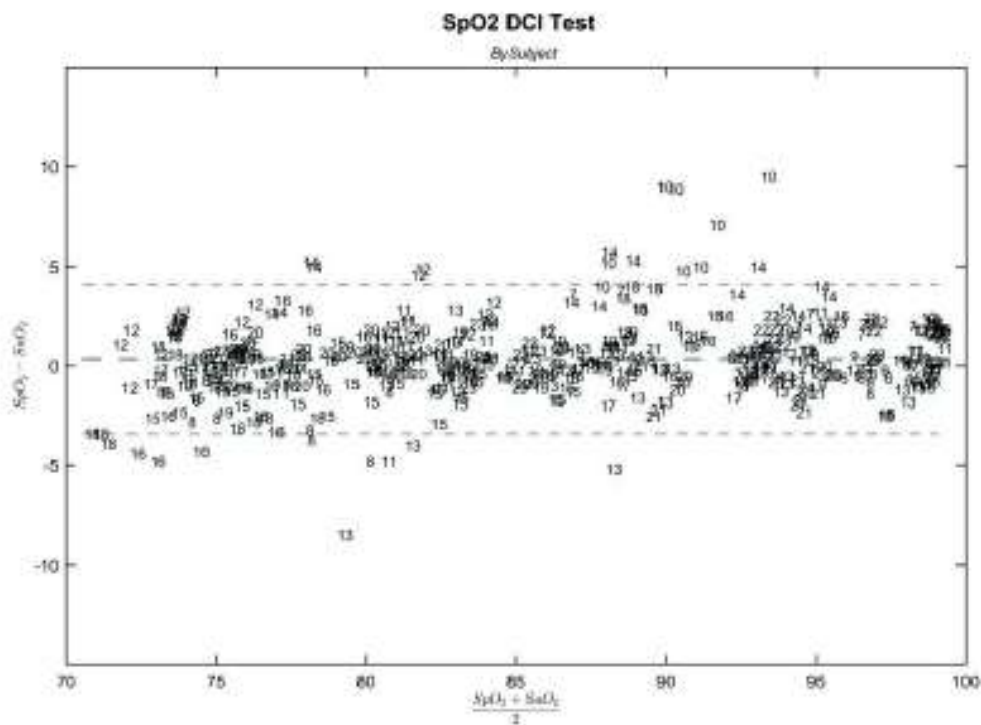
The Inf/Neo/NeoPt sensors are single-patient-use sensors. They are not provided sterile.

Measured A _{RMS} values			
Range		A _{RMS}	
90-100%		1.85%	
80-90%		1.44%	
70-80%		0.89%	

Overall claimed accuracy value			
Range		A _{RMS}	
	Inf	Neo*	Neo Pt*
70-100%	± 2%	± 2% Adult ± 3% Neonatal	± 3%

* The saturation accuracy of the Neonate and Preterm sensors was validated on adult volunteers and 1% was added to account for the properties of fetal hemoglobin.

Figure 11 DCI/DCIP

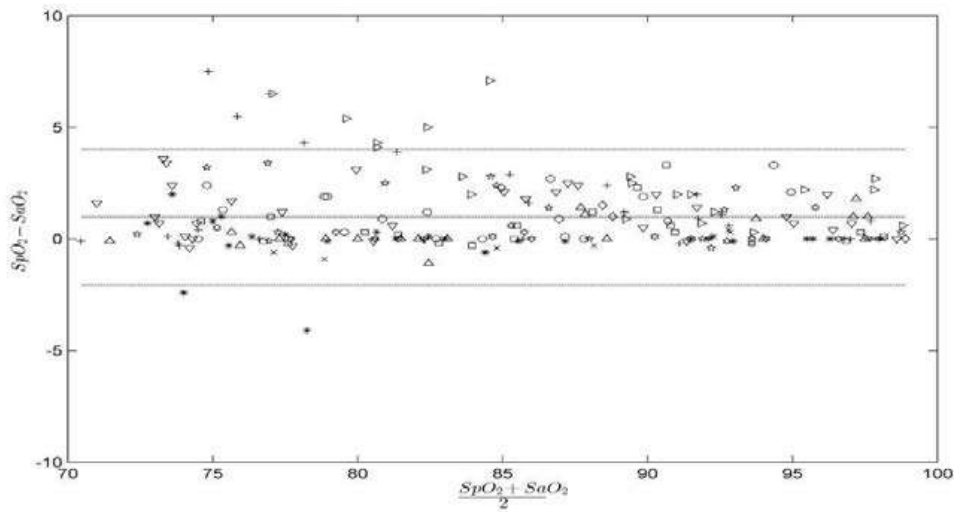


The DCI/DCIP sensors are reusable sensors. They are not provided sterile.

Measured A_{RMS} values	
Range	A_{RMS}
90-100%	1.44%
80-90%	2.30%
70-80%	1.84%

Overall claimed accuracy value	
Range	A_{RMS}
70-100%	1.90%

Figure 12 TCI



The TCI sensor is a reusable sensor. It is not provided sterile.

Measured A _{RMS} values	
Range	A _{RMS}
90-100%	1.05%
80-90%	1.67%
70-80%	2.43%

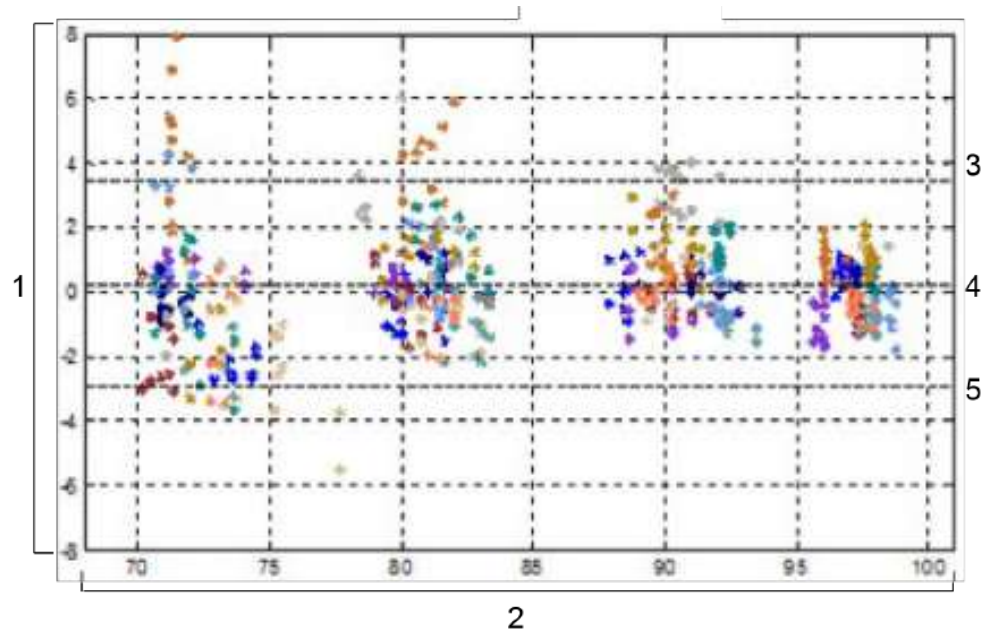
Overall claimed accuracy value	
Range	A _{RMS}
70-100%	3.5%

Additional accuracy information for Nellcor™ sensors

The table information provides supplemental data analysis for Nellcor sensors’ measurement accuracy. The tables are provided by Covidien.

The following modified Bland-Altman plots show SpO₂ data by sensor type. Each individual subject is represented by a unique marker on the plots. Subject identification numbers are indicated in the legend with each plot.

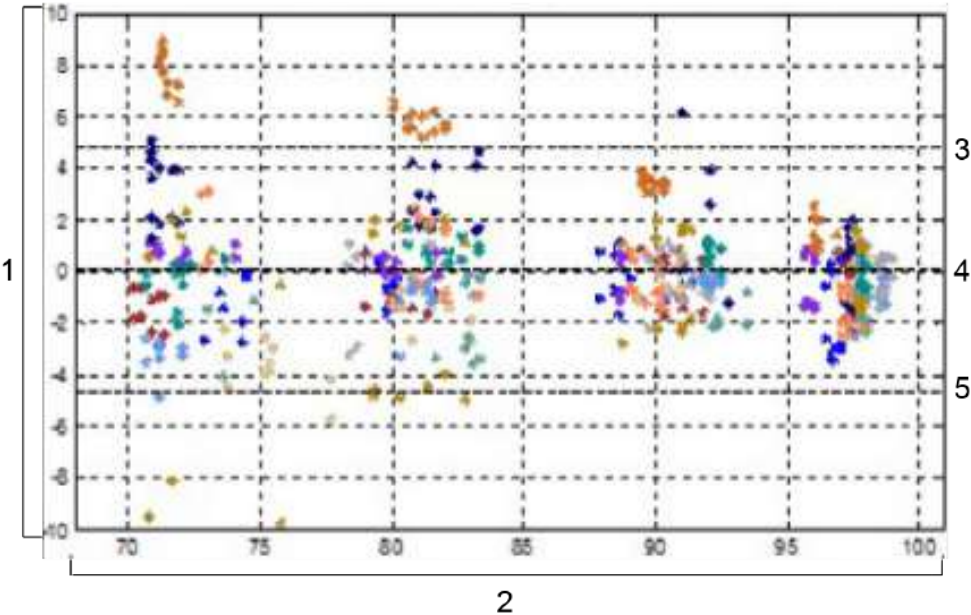
Figure 13 Modified Bland-Altman for SpO₂ - DS-100A Sensor: SaO₂ vs. (SpO₂ - SaO₂)



1.	SpO ₂ - SaO ₂ (%)	4.	Bias
2.	SaO ₂ (%)	5.	Bias - (1.96 x σ (errs))
3.	Bias + (1.96 x σ (errs))		

Measured A _{RMS} values	
Range	A _{RMS}
90-100%	1.16%
80-90%	1.67%
70-80%	2.25%

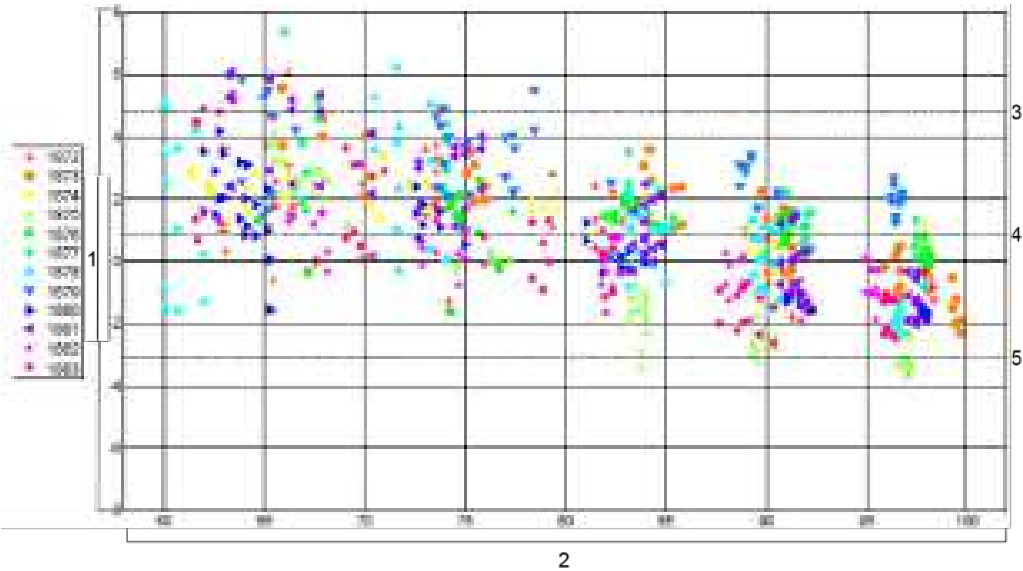
Figure 14 Modified Bland-Altman for SpO₂ - D-YS, D-YSE, D-YSPD, OXI-A/N, OXI-P/I Sensors: SaO₂ vs. (SpO₂ - SaO₂)



1.	SpO ₂ - SaO ₂ (%)	4.	Bias
2.	SaO ₂ (%)	5.	Bias - (1.96 x σ (errs))
3.	Bias + (1.96 x σ (errs))		

Measured A _{RMS} values	
Range	A _{RMS}
90-100%	1.38%
80-90%	2.5%
70-80%	3.6%

Figure 15 Modified Bland-Altman for SpO₂ - MAX-A, MAX-AL, MAX-N, MAX-I, MAX-P, MAX-R Sensor: SaO₂ vs. (SpO₂ - SaO₂)



1.	SpO ₂ - SaO ₂ (%)	4.	Mean Bias
2.	SaO ₂ (%)	5.	Lower 95%
3.	Bias + (1.96 x σ (errs))		

Measured A _{RMS} values	
Range	A _{RMS}
90-100%	1.49%
80-90%	1.57%
70-80%	2.5%



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TS-F-D



2001589-212



2001589-213





Tec 820 Vaporizer

Combining clinical performance with ergonomic design

The agent specific Tec™ 820 Vaporizer from GE Healthcare delivers isoflurane and sevoflurane effectively and efficiently. Each Tec 820 presents an improved ergonomic design, with consistent agent delivery and reliability while reducing total cost of ownership

Features

- Tec 820 agent specific vaporizers are designed to deliver isoflurane and sevoflurane anesthetic agents
- Provides output consistent with the dial setting throughout the clinical flow range
- Easy to turn dial and fine graduations help control agent delivery
- Enhanced design with consistent, reliable operation over the product life
- Tec 820 vaporizer supports the Easy-Fil agent filling mechanism
- Improved ergonomics and contemporary design complements GE Healthcare's anesthesia systems
- Attaches to GE Healthcare interlocking Selectatec™ manifold
- No planned factory service needed
- Three-year warranty



Clinical performance

- Tec 820 Vaporizers are designed to provide consistent output throughout the clinical flow range from 200 ml/min to 15 l/min. Models are available for isoflurane and sevoflurane
- Tec 820 Vaporizers are equipped with a large diameter control dial with graduations up to 5% V/V (isoflurane models) or 8% V/V (sevoflurane models)
- The easy turning dials and small graduations on the Tec 820 Vaporizer help you fine tune anesthetic delivery over the full range of dial settings and flow rates

Enhanced ergonomics

- The ergonomic dial release on the Tec 820 Vaporizer allows either left or right hand operation
- Wide, centered liquid level indicator provides a clear indication of the fill level of the vaporizer
- Easy to turn dial with enhanced readability

Lower overall ownership costs

- The Tec 820 Vaporizer has no planned factory service, which helps lower the total cost of ownership and eliminate the logistical challenges associated with the return of vaporizers to the factory. For complete user maintenance requirements, refer to the User Reference Manual
- The Tec 820 Vaporizer comes with a three-year warranty

Reliability, convenience, and operating excellence

- Tec 820 is compatible with modern agent filling systems that simplify filling and help minimize agent leaks while filling
- To minimize filling frequency, the Tec 820 Vaporizer can hold up to 300 ml of anesthetic agent
- The Tec 820 Vaporizer can be mounted on GE Healthcare anesthesia systems equipped with the Selectatec manifold without tools and without taking the anesthesia system out of service
- The Tec 820 Vaporizer also interlocks in series with GE Healthcare Tec 7 and Tec 6 Plus Vaporizers
- The non-spill system in the Tec 820 Vaporizer limits movement of liquid agent if the vaporizer is tilted or inverted, protecting internal components and helping maintain output within clinically acceptable limits



Easy-Fil helps simplify agent filling



Tec 820 agent specific vaporizers

Physical specifications

Dimensions		
Height:		25 cm
Depth:		22 cm
Width:		11 cm
Weight:		7 kg dry

Agent capacity		
Total capacity:		300 ml
Capacity between min/max fill marks:		170 ml
Wick system capacity:		75 ml approximately

Pneumatics specifications

Calibration and flow resistance		
Calibration:		Calibration of all models is done at 21°C using O ₂ as carrier gas, 5 l/min fresh gas flow, at sea-level ambient pressure
Isoflurane models:		Control dial calibrated up to 5% V/V. The control dial is marked in steps of 0.25% up to 1% and in steps of 0.5% between 1% and 5%.
Sevoflurane models:		Control dial calibrated up to 8% V/V. Control dial is marked in steps of 0.25% up to 1% and in steps of 0.5% between 1% and 8%.
Flow resistance:		OFF: Isolated, no resistance from vaporizer ON: 5 l/min O ₂ : <20 cmH ₂ O

Accuracy		
Isoflurane models:		±0.25% of delivered agent or ±20% of control dial setting (whichever is greater)
Sevoflurane models:		+0.6/-0.4% of delivered agent or ±20% of control dial setting (whichever is greater)
Fresh gas flow:		200 ml/min to 15 l/min

Environmental specifications

Operation		
Temperature:		15°C to 35°C
Humidity:		15% to 95% relative humidity (non-condensing)
Ambient pressure:		500-800 mmHg

Storage and Transport		
Temperature:		-25°C to 60°C
Humidity:		15% to 95% relative humidity (non-condensing)
Ambient pressure:		400-800 mmHg

Service		
		Planned factory service free

MRI Safety Information		
		MR Conditional

Agent filling systems		
		Isoflurane models: Easy-Fil™
		Sevoflurane models: Easy-Fil

Note: may not be available in all regions

Warranty		
		Warranted to be free from functional defects in materials and workmanship for a period of three years from the date of original delivery.



Agent color coded Easy-Fil adapters



GE Healthcare provides transformational medical technologies and services to meet the demand for increased access, enhanced quality and more affordable healthcare around the world. GE (NYSE: GE) works on things that matter – great people and technologies taking on tough challenges.

From medical imaging, software & IT, patient monitoring and diagnostics to drug discovery, biopharmaceutical manufacturing technologies and performance improvement solutions, GE Healthcare helps medical professionals deliver great healthcare to their patients.

Imagination at work

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Tec 7 Vaporizer

Combining clinical performance
with ergonomic design

The Tec® 7 Vaporizer from GE Healthcare delivers isoflurane, sevoflurane, enflurane and halothane effectively and efficiently. Each agent specific Tec 7 incorporates significant performance, convenience and ergonomic benefits with important safety features to help improve agent delivery and reliability while reducing overall operating costs.



Features

- Tec 7 agent specific vaporizers are designed to deliver isoflurane, sevoflurane, enflurane and halothane anesthetic agents
- Provides output consistent with the dial setting throughout the clinical flow range
- Easy to turn dial and fine graduations help control agent delivery
- Three filling options: Easy-fil®, funnel fill, or Quik-Fil™ (sevoflurane only)
- Enhanced design helps improve reliability, operating excellence and product life
- Easy-fil filler is designed to simplify agent filling and help minimize agent leaks while filling. Tec 7 is also available in funnel fill and Quik-Fil (sevoflurane only) variants
- Improved ergonomics and contemporary design complements GE Healthcare's anesthesia systems
- Attaches to GE Healthcare interlocking Selectatec® manifold
- Planned factory service free
- Three year warranty period

Clinical performance

- Tec 7 Vaporizers are designed to provide consistent output throughout the clinical flow range from 200 mL/min to 15 L/min. Models are available for isoflurane, sevoflurane, enflurane and halothane.
- Tec 7 Vaporizers are equipped with a large diameter control dial which incorporates fine graduations of 0.2% between 0 and 1%, and 0.5% from 1% to 8%. The dial for sevoflurane is marked in steps of 0.2% up to 1% v/v, and in steps of 1% between 1% and 8%.
- The easy turning dials and small graduations on the Tec 7 Vaporizer help you fine tune anesthetic delivery over the full range of dial settings and flow rates.



Tec 7 agent specific vaporizers

Enhanced ergonomics

- The ergonomic agent dial release on the Tec 7 Vaporizer allows either left or right hand operation.
- A prismatic site glass on the front panel of the Tec 7 Vaporizer provides clear indication of liquid agent level.

Lower overall ownership costs

- The Tec 7 Vaporizer is planned factory service free, which helps lower ownership costs and eliminate the logistical challenges associated with the return of vaporizers to the factory. For complete user maintenance requirements, refer to the User Reference Manual.
- The Tec 7 Vaporizer comes with a three year warranty.



Easy-fil helps simplify agent filling

Reliability, convenience and operating excellence

- Easy-fil filler is designed to simplify agent filling and help minimize agent leaks while filling. The Tec 7 Vaporizer is also available with funnel fill and Quik-Fil (sevoflurane only) filling mechanisms.
- To minimize filling frequency, the Tec 7 Vaporizer accommodates 225 mL of anesthetic agent.
- The Tec 7 Vaporizer can be mounted on Datex-Ohmeda anesthesia systems equipped with the Selectatec manifold without tools and without taking the anesthesia system out of service.
- The Tec 7 Vaporizer also interlocks in series with Datex-Ohmeda Tec 4, Tec 5, Tec 6 and Tec 6 Plus Vaporizers.
- An innovative non-spill system in the Tec 7 Vaporizer limits movement of liquid agent if the vaporizer is tilted or inverted, protecting internal components and helping maintain output within clinically acceptable limits.

Physical specifications

Dimensions

Height:	25 cm/9.9 in
Depth:	21 cm/8.3 in
Width:	11.4 cm/4.5 in
Weight:	7 kg/15.4 lb dry

Agent capacity

Charged:	225 mL of free volatile anesthetic agent
Charging:	300 mL (nominal) to charge dry vaporizers
Retention:	75 mL (nominal) retained by wick system

Pneumatics specifications

Calibration and resistance

Calibration: The dials of the Tec 7 Vaporizers for enflurane, isoflurane and halothane are calibrated to 5% v/v in steps of 0.2% up to 1%, and in steps of 0.5% from 1% to 5% at 21°C using O₂ at 5 L/min as the carrier gas

Calibration of sevoflurane: The dial of the Tec 7 Vaporizer for sevoflurane is calibrated to 8% v/v

Dial is marked in steps of 0.2% up to 1% v/v, and in steps of 1% between 1% and 8%

Resistance to gas flow: "OFF": Isolated, no resistance from vaporizer
"ON": 5 L/min O₂: 10 to 15 cm H₂O at 21°C ±2°C

Accuracy:	5 L/min O ₂ @ 21°C ± 2°C:
Vaporizer 5%	±0.25% of delivered agent or ±15% of dial setting (whichever is greater)
Vaporizer 8%	±0.4% of delivered agent or ±15% of dial setting (whichever is greater)

Flowrate: Vaporizers are designed to provide consistent output throughout the clinical flow range from 200 mL/min to 15 L/min



Agent color coded Easy-fill bottle adapters

Environmental specifications

Operation

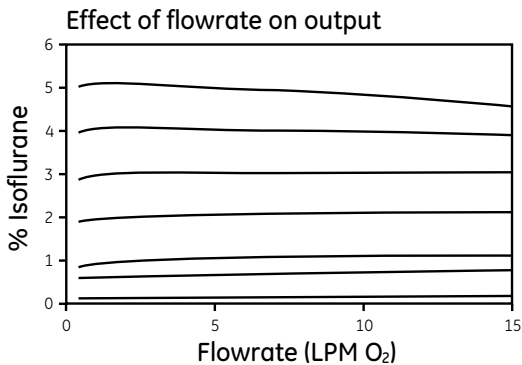
Temperature: 18° to 35°C/64° to 95°F
Humidity: 30% to 75% relative humidity (non-condensing)

Service

Planned factory service free.

Warranty

Warranted to be free from functional defects in materials and workmanship for a period of three years from the date of original delivery.



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