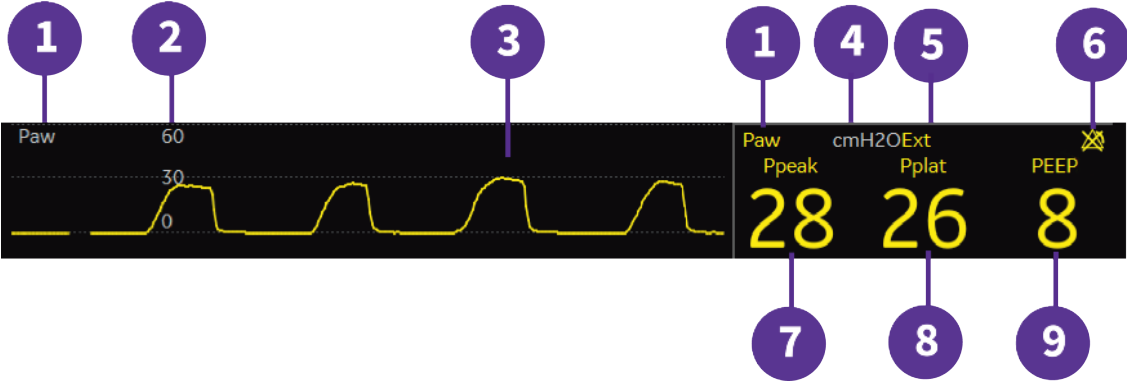
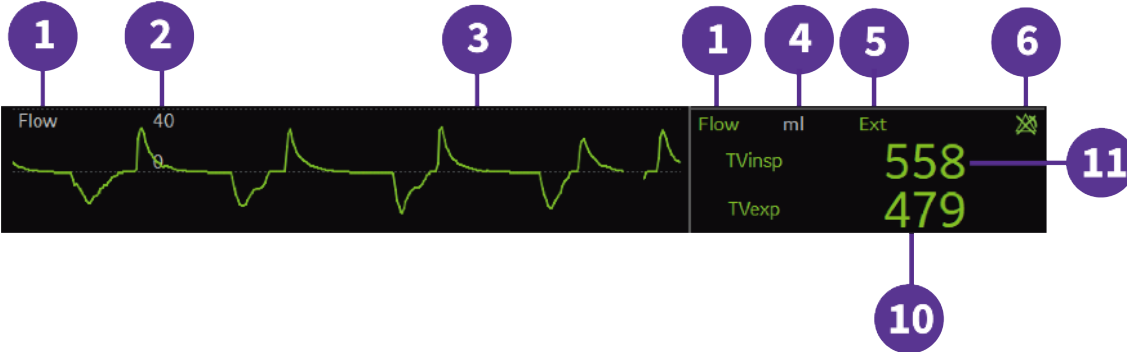




Paw parameter



Flow parameter

1.	Paw (Paw) or Flow (Flow): parameter or waveform label	2.	waveform scale
3.	waveforms	4.	cmH2O (cmH2O) or ml (ml): unit
5.	Ext (Ext): indicate external source	6.	alarm status, alarm limits, or other messages
7.	Ppeak (Ppeak): peak pressure	8.	Pplat (Pplat): plateau (pause) pressure
9.	PEEP (PEEP): total positive end expiratory pressure	10.	TVinsp (TVinsp): inspired tidal volume
11.	TVexp (TVexp): expired tidal volume		

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 (TV_{insp}/TV_{exp})
- Inspiratory and expiratory minute volumes (MV_{insp}/MV_{exp})
- 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
- Ratio of the inspiratory and expiratory time (I:E)

NOTE

I:E is displayed on the split screen only when an external device is connected via the Unity Network Interface Device.

Vent settings in numeric trends:

Table 8 Vent settings when an external device (referring only to an anesthesia device) is connected directly

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, P _{support} , T _{insp}
Synchronized Intermittent Mechanical Ventilation Pressure Control Volume Guaranteed (SIMV PCV-VG)	TV, RR, PEEP, P _{support} , T _{insp}
Synchronized Intermittent Mechanical Ventilation Pressure Control (SIMV PCV)	RR, PEEP, P _{insp} , P _{support} , T _{insp}
Pressure Supported Ventilation with apnea protection (PSVPro)	RR, PEEP, P _{insp} , P _{support} , T _{insp}
Pressure Control Ventilation - Volume Guaranteed (PCV-VG)	TV, RR, I:E, PEEP
Pressure Control Ventilation (PCV)	RR, I:E, PEEP, P _{insp}
Continuous Positive Airway Pressure plus Pressure Supported Ventilation (CPAP + PSV)	RR, PEEP, P _{insp} , P _{support} , T _{insp}

Table 9 Vent settings when an external device is connected via the Unity Network Interface Device

Vent mode	Display parameters
Volume Control Ventilation (VCV)	TV, RR, I:E, PEEP.

Table 9 Vent settings when an external device is connected via the Unity Network Interface Device
(Table continued)

Vent mode	Display parameters
Pressure Control Ventilation (PCV)	Vent Mode, RR, I:E, P _{insp} , PEEP.
Pressure Control Ventilation - Volume Guaranteed (PCV-VG)	Vent Mode, TV, RR, I:E, PEEP.
Synchronized Intermittent Mechanical Ventilation with Volume Control (SIMV VCV)	Vent Mode, TV, P _{support} , T _{insp} , PEEP.
Synchronized Intermittent Mechanical Ventilation Pressure Control (SIMV PCV)	Vent Mode, P _{insp} , P _{support} , T _{insp} , PEEP.
Pressure Supported Ventilation with apnea protection (PSVPro)	RR, PEEP.
Continuous Positive Airway Pressure plus Pressure Supported Ventilation (CPAP + PSV)	Vent Mode, P _{support} , PEEP.
Synchronized Intermittent Mechanical Ventilation Pressure Control Volume Guaranteed (SIMV PCV-VG)	TV, RR, PEEP.
Manual Ventilation	None.

Spirometry points to note

Refer to the instructions supplied with the external device for spirometry related information, such as safety precautions, limitations and points to note, measurement setup and check, clinical guidance.

NOTE

The device's data display may have delay compared with the external device, please observe the patient frequently.

Spirometry measurement setup

Connecting to external device

You can connect the device to any compatible external device, such as a directly connected anesthesia device or any compatible peripheral device (ventilator or anesthesia device) connected via the Unity Network Interface Device.

For the direct connection of the anesthesia device, refer to [Connecting the anesthesia device on page 86](#).

To connect the Unity Network Interface Device to the device, plug the cable into the ID connector on the back side of the Dock. For more information, see [Back view of Dock on page 68](#).

For how to connect the Unity Network Interface Device to the external device, refer to the Unity Network Interface Device User's Manual.

For the external device to patient connection, refer to the instructions for use supplied with external 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 **Apnea (Ext) and Technical Alarms, Ppeak, MVexp, TVexp, PEEP** alarm **ON** or **OFF**.

The **PEEP** option displays only when the device is properly connected to Unity Network Interface Device.

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.

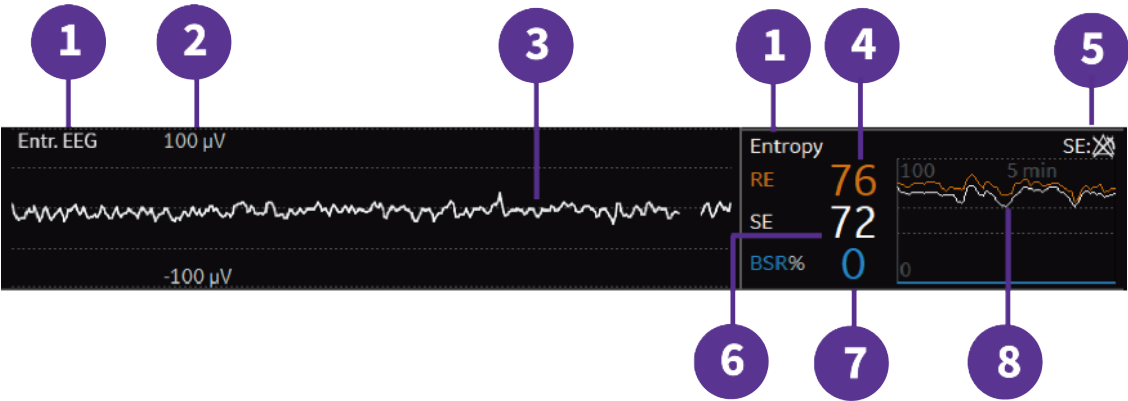
The use of Entropy parameters may help the clinician to improve drug management. It may also enable a faster recovery from anesthesia and a more predictable wake-up and extubation.

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 HealthCare 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 device screen

NOTE

Entropy is not displayed if the **Entropy & SPI** is set to disabled in the current mode. This setting is in the  >  **Service** menu (password protected). For more information, refer to the Service manual.



1.	Entr. EEG (Entr. EEG): parameter/waveform label	2.	waveform scale
3.	Entropy EEG waveform	4.	RE (RE): Response Entropy value
5.	alarm limits, alarm status or other messages	6.	SE (SE): State Entropy value
7.	BSR% (BSR%): Burst suppression ratio	8.	Entropy microtrend

NOTE
For which digits display in digit field is dependent on the **Display Format** settings configured in the Entropy menu.

NOTE
For the microtrend length display in digit field is dependent 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 not available in NEONATAL mode.
- 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.

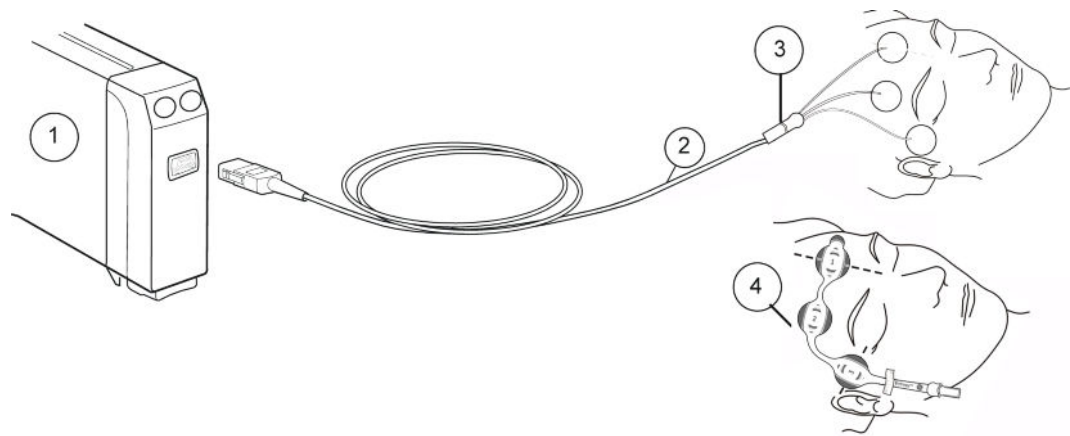
- During extended periods of electrocautery there may not be any good EEG epochs, and Entropy values will not be displayed.
- Entropy readings may be inconsistent when monitoring patients with neurological disorders, traumas or their sequelae.
- Entropy readings may be inconsistent when using benzodiazepines, 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 HealthCare 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	2.	Entropy cable
3.	Entropy sensor	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. Enable the toggle of **Automatic 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 **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 HealthCare 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 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.

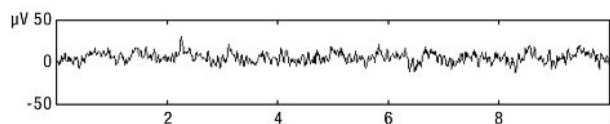
During general anesthesia with adequate anesthesia and hypnosis the RE and SE values will be within a narrow range or equal. The numbers will also merge during profound neuromuscular paralysis with neuromuscular blocking agents since the patient's facial muscles are unable to react.

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.

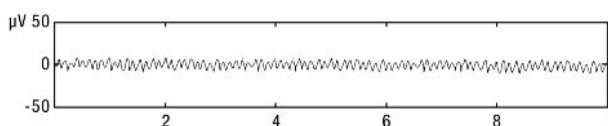
Relation of Entropy values to EEG and patient status

- Entropy values: High Entropy values
- EEG: Irregular EEG
- Patient Status: Awake
- Graphical display:



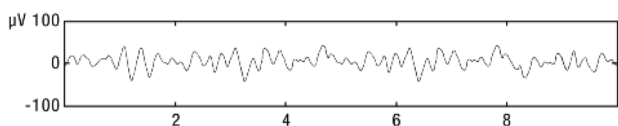
- Entropy values: High Entropy values
- EEG: Irregular EEG
- Patient Status: Deepening sedation

- Graphical display:



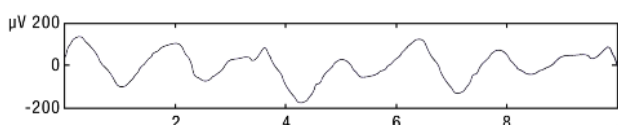
- Entropy values: Low Entropy values
- EEG: Regular EEG
- Patient Status: Moderate anesthesia

- Graphical display:



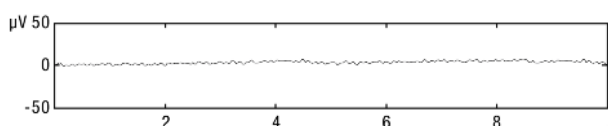
- Entropy values: Low Entropy values
- EEG: Regular EEG
- Patient Status: Very deep anesthesia

- 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 HealthCare.
- 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.**

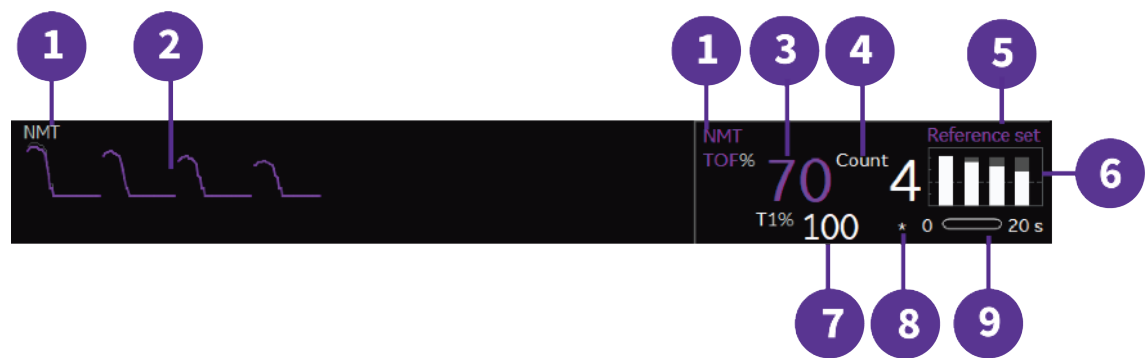
Always stop the NMT measurement before handling the stimulating electrodes or connectors.

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.

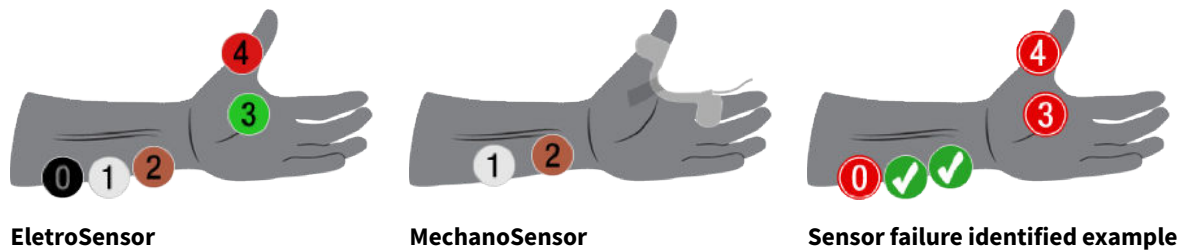
NMT measurement displayed on the device screen



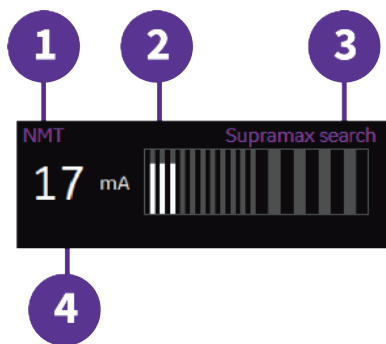
1.	NMT (NMT): waveform/parameter label	2.	NMT waveform
3.	TOF% (TOF%): TOF value. Different display according to stimulus mode selection. • TOF mode: TOF% ratio • DBS mode: DBS% ratio • ST mode: Only label Single TW.	4.	Count (Count): Count value
5.	Reference set (Reference set): digit field messages	6.	NMT response bar
7.	T1% (T1%): T1 value	8.	stimulus pulse asterisk, flash when a stimulus pulse is generated
9.	cycle time progress bar, or last manual measurement time		

The digit field has different view:

- Normal measurement view: see above
- Sensor check view: graphics indicate different type sensor is connected. If sensor failure is identified, the related sensor will be in red to indicate, and the passed sensor will be displayed as .

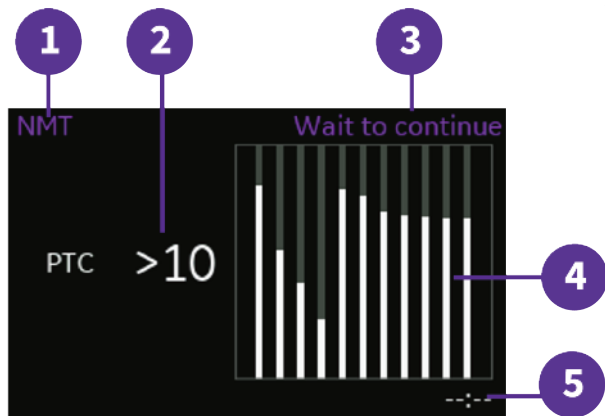


- Calibration view: when supramaximal current or reference (When not using supramax) search is started, current value and response bar will be displayed.



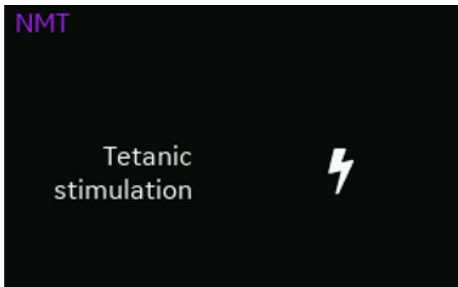
1.	NMT (NMT): parameter label
2.	response bar
3.	Supramax search (Supramax search): digit field messages
4.	current value with unit

- PTC view: during and after PTC measurement, the count of detected responses, the measurement time, response bar will be displayed.

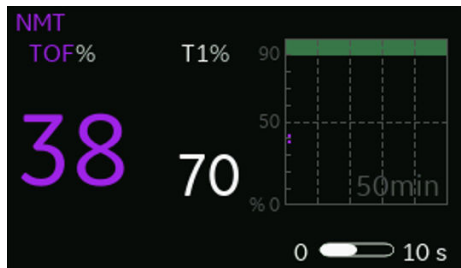


1.	NMT (NMT): parameter label
2.	PTC (PTC): the count of detected responses
3.	Wait to continue (Wait to continue): digit field messages
4.	response bar
5.	the measurement time

- 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 also displays 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.

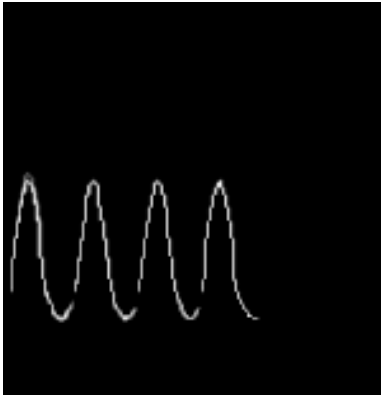
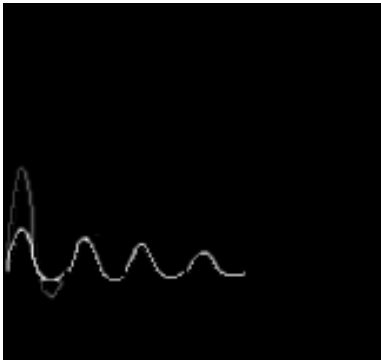
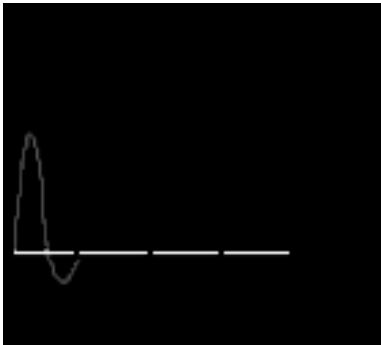
NMT waveforms on the device screen

Both ElectroSensor and MechanoSensor have a characteristic stimulus-response waveform that is available on the device waveform field.

Typical ElectroSensor TOF responses

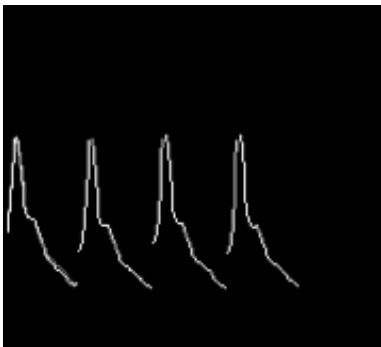
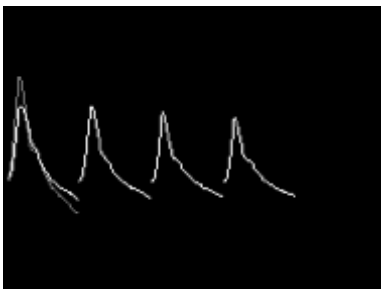
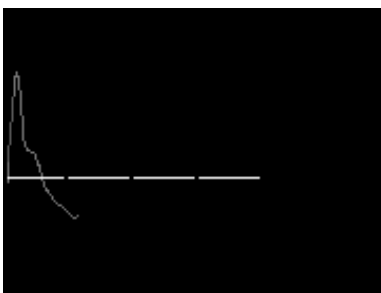
ElectroSensor measures the evoked electromyogram (EMG) response. A typical response is a compound muscle action potential (CMAP).

The following graphs present typical ElectroSensor TOF responses:

Unrelaxed state (no fade)	
Moderate block (four responses with fade)	
Deep block (no 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 device screen

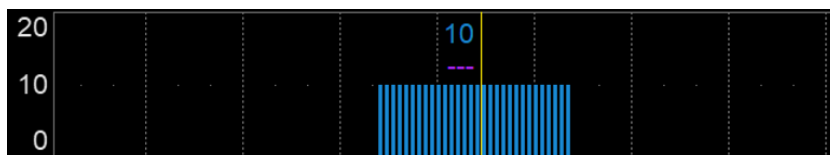
The NMT related parameters display in 2 fields of graphic trends, different NMT values have their own specific colors in the graphic trends. The values are shown as follows:

- 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	- Depending on the Start-up Settings selection: AUTO: Starts the search for supramaximal current and reference level. Recall Patient: Retrieves the supramaximal current and reference from the module. Relaxed Patient: Uses the current set in Current (mA) and does not use a reference. - Proceeds with the selected measurement cycle.
Stop Continue	- Stops monitoring without resetting the current or reference. - Continues monitoring of the same patient with unchanged current and 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.

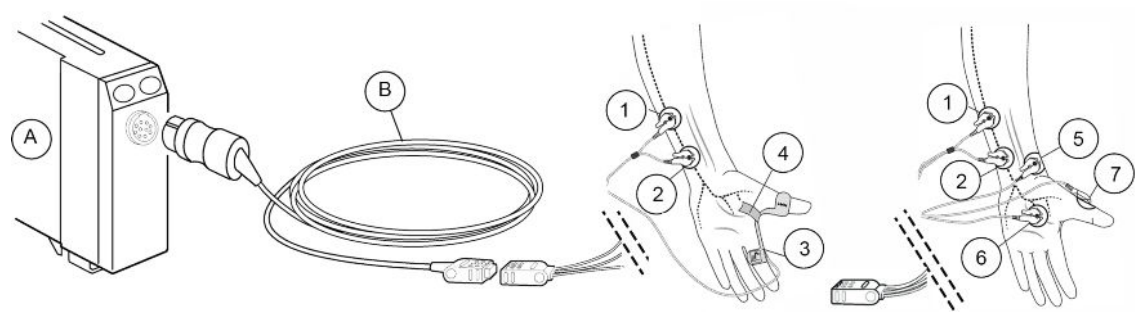
NMT points to note

- 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

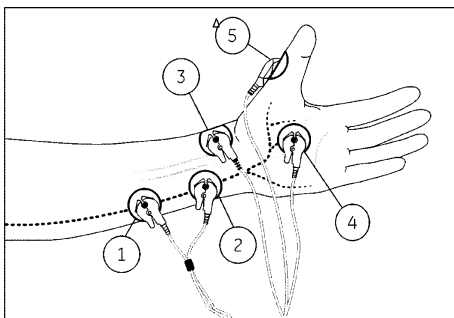
B = NMT sensor cable

1.	Electrode, white (stimulating)	2.	Electrode, brown (stimulating)
3.	Sensor (measuring)	4.	Tape
5.	Electrode, black (ground)	6.	Electrode, green (measuring)
7.	Electrode, red (measuring)		

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

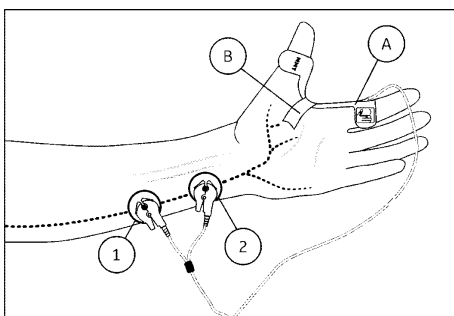


1.	White (stimulating)	2.	Brown (stimulating)
3.	Black (ground)	4.	Green (measuring)
5.	Red (measuring)		

--- = 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

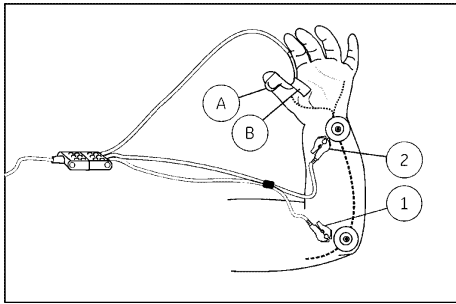


1.	White (stimulating)	2.	Brown (stimulating)
A.	Sensor (measuring)	B.	Tape

--- = 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)	2.	Brown (stimulating)
A.	Pediatric MechanoSensor	B.	Tape

--- = Ulnar nerve

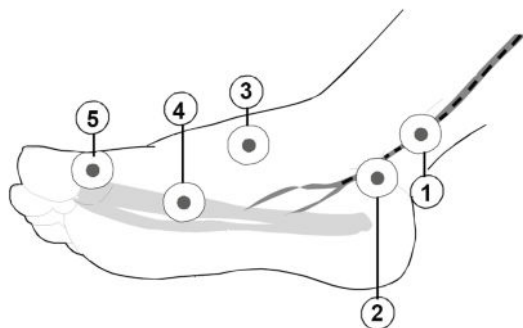
1. Place the two electrodes along the ulnar nerve. Ensure that the entire electrode surface has optimal contact with the skin. Ensure that the electrodes do not touch each other.
2. Attach the sensor in the groove between thumb and index finger. Secure with narrow tape only, allowing free finger movement. 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	2.	Brown stimulating electrode
3.	Black ground electrode	4.	Green measuring electrode
5.	Red measuring electrode		

-- = Tibial nerve

Using the NMT measurement

Starting the NMT measurement

Press the **Start-Up** module key, or:

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, enable the toggle of **Use Supramax**.

To select the stimulus current manually:

1. Select the NMT digit field.
2. Disable the toggle of **Use Supramax**.
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 device measures T1% even though the values are not displayed on the device.

To activate the feature:

1. Select the NMT digit field > **Advanced** tab.
2. Enable the toggle of **Show Ratio Microtrend**.

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 device, 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 device 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 HealthCare 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 HealthCare 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 device 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	0
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 device 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 HealthCare 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 device 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 HealthCare device. 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

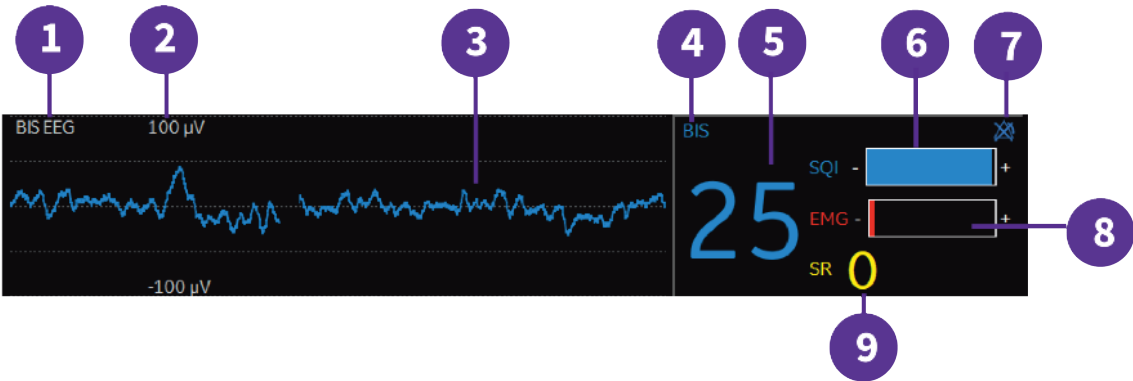
A sensor placed on the patient's forehead transmits EEG signals to the BIS module. The BIS module filters the data, analyzes it for artifact and processes it using digital signal processing techniques,

then sends the data to the device 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 device screen



1.	BIS EEG (BIS EEG): waveform label	2.	Waveform scale
3.	BIS EEG waveform	4.	BIS (BIS): parameter label
5.	Bispectral Index (BIS index) value	6.	SQI (SQI): Signal Quality Index, the quality of the EEG signal. ^{*1}
7.	Alarm status, alarm limits, or other messages	8.	EMG (EMG): Electromyograph, the absolute power in the 70 Hz to 110 Hz frequency band, the range from 30 to 55 dB. ^{*2}
9.	SR (SR): Suppression ratio, the percentage of suppressed (flatline) EEG detected over the last 63 seconds.		

^{*1} When the SQI is in the range 15% to 50%, the BIS index value is displayed in gray.
^{*2} When the EMG value is less than 30 dB, this EMG bar will not display.

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

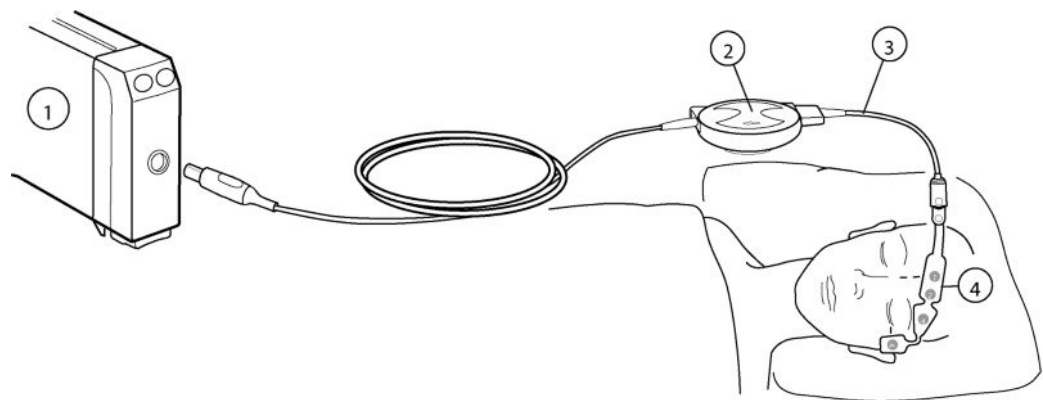
- This measurement is not available in neonatal mode.
- E-modules used for this measurement are not suitable for use with neonatal patients.
- BIS is a complex monitoring technology intended for use only as an adjunct to clinical judgment and training. Clinical judgment should always be used when interpreting 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	2.	BISx
3.	Patient Interface Cable, PIC Plus	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 μV** 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. Enable the toggle of **Filters** to open the filters.

Using the manual BIS sensor check

Whenever required, you can perform the sensor check manually. Press the  module key, or:

1. Press the  module key or select the BIS digit field.
2. Select **Check Sensor**.
3. 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. Enable the toggle of **Automatic 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 **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
- gas consumption data
- snapshot
- alarm history
- OxyCRG
- full disclosure

The snapshot can be configured through  >  **Service** > **Snapshot**. These selections are password protected.

For more information, see the Service manual.

The graphic trends include a pre-defined 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  from the soft key field.
2. Select the  on the right corner of the panel 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  from the soft key field.
2. Select the  on the right corner of the panel to shift to graphic trends view, if necessary.
3. Select the  on the right corner of the panel.
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

Time scale	Resolution
72 h	36 min
96 h	48 min
120 h	60 min
144 h	72 min
168 h	84 min

Setting the graphic trend pages

1. Select the  from the soft key field.
2. Select the  on the right corner of the panel to shift to graphic trends view, if necessary.
3. Select the  on the right corner of the panel.
4. Select the **Pages** tab.
5. Select the **Page 1**, **Page 2**, **Page 3** and **Page 4** vertical tab for trend pages.
6. Set up the parameters for related field.

Printing currently viewed graphic trends

Before start, make sure you have set up the printing options. For more information, see the "Printing" chapter.

1. Select the  from the soft key field.
2. Select the  on the right corner of the panel to shift to graphic trends view, 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 8 pages with 168 hours (7 days) of trend data.

You cannot configure the layout of the **Numeric Trends** view.

1. Select the  from the soft key field.
2. Select the  on the right corner of the panel 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  from the soft key field.
2. Select the  on the right corner of the panel to shift to numeric trends view, if necessary.
3. Select the  on the right corner of panel.
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, CO, NMT measurement will always add one column independent of the **Trends Interval** setting.

Printing numeric trends

Before start, make sure you have set up the printing options. For more information, see the "Printing" chapter.

Manual printing is possible only when the printing device is not processing another job at the same time.

1. Select the  from the soft key field.
2. Select the  on the right corner of the panel to shift to numeric trends view, if necessary.
3. Select the  on the right corner of the panel.
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 all the numeric trends of current patient to the USB storage device.

NOTE

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

1. Insert the USB storage device to the USB port of the device.
2. Select the  >  **Export Patient Data** > **Table**.
3. Select **Numeric Trend**.
4. Select **Export**.

When finish to export, a message "**Export trends data to USB Disk successfully.**" displays on the menu.

The trend file is saved to the \PSP\trends folder of the USB disk.

5. 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) hasn't been set, there will be a **Set Key for Patient Data Export** menu. To access 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.

The **Set Key for Patient Data Export** menu can also be accessed from  >  **Service** (password needed) > **USB Import/Export**. You can modify key if necessary.

For more information, refer to the Service manual.

Gas consumption



Hub connects to Dock only.

NOTE

This feature is only available when you connect an external device. The external device can be a directly connected anesthesia device, or any compatible peripheral device connected via the Unity Network Interface Device.

Viewing gas consumption data

The gas consumption data view shows the amount of Air, O₂, N₂O, and anesthetic agents used by a connected external device during the ongoing patient case.

If the values for Air, O₂, or N₂O exceed the range limit (0 to 32767 liter), the text **>32767 l** appears instead of the value. For the anesthetic agents (0 to 999 ml), the text is **>999 ml**.

1. Select the  from the soft key field.
2. Select the **Trends** tab.

3. Select the  on the right corner of the panel to switch among three views: graphic trends, numeric trends and gas consumption data view.

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 400 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 21 seconds.

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 Service manual.

Manually created snapshots

You can create a snapshot manually by selecting  on the main menu. The device 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**
 - **Fem Sys high / Fem Sys low / Fem Mean high / Fem Mean low / Fem Dia high / Fem Dia low**

To enable this feature:

 >  **Service** > **Snapshot** > **Create on Alarms**, this setting is password protected.

For more information, see the Service 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  from the soft key field.
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  from the soft key field.
2. Select the **Snapshot** horizontal tab.
3. Select  (in the top right of this menu) to start printing.
4. 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  from the soft key field.
2. Select the **Alarm History** horizontal tab.
 - The alarm history list displays the latest 1000 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  from the soft key field.

2. Select the **Alarm History** horizontal tab.
3. Select  (in the top right of trends menu) to start printing.
4. Select  to stop printing, if necessary.

OxyCRG

OxyCRG description

The OxyCRG (oxycardiopneurogram) 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 the  > .

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  > .
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 set up these limits.

1. In the NEONATAL mode, select the  > .
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  from the soft key field.
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  from the soft key field.
2. Select the **Full Disclosure** horizontal tab.
3. Select the  on the top 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  from the soft key field.
2. Select the **Full Disclosure** horizontal tab.
3. Select the  on the top 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 device is configured to the Carescape Network, independent on its connection status to the network. When the time is adjusted, the device 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 device 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 data out of time or quantity

Erased snapshots cannot be recovered.

Discharge the patient to erase patient data.

NOTE

This will also return device settings to their defaults.

1. Select the information area.
2. Select **Discharge Patient** > **Confirm**.

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 device provides some useful clinical guidelines and tools, which gathering parameter measurements together and provides comprehensive analysis results.

Clinical applications are not intended to replace the competent judgment of a clinician. They must be used in conjunction with observation of clinical signs and symptoms.

The device provides following clinical applications:

- Early Warning Score
- Customized Notification
- Hemodynamic calculations

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 HealthCare provides the National Early Warning Score reference from the Royal College of Physicians to enable caregivers to track patient conditions. National Early Warning Score 2 (NEWS2): 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 the  >  **Screen Setup**, and the required screen.
2. Set up 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 device, 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 you fully understand the score's meaning.

1. Select  >  **EWS**.

2. Confirm if the patient meets the intended use, if needed.
3. Select the **Clinical Risk** or **Patient Risk** tab.
4. Swipe down and up to scroll the page to review **Thresholds and Triggers** and **Scoring System**.

Viewing EWS guidance

NOTE

NEWS2 type only.

1. Select  >  **EWS**.
2. Select the **Guidance** tab to review EWS guidance.

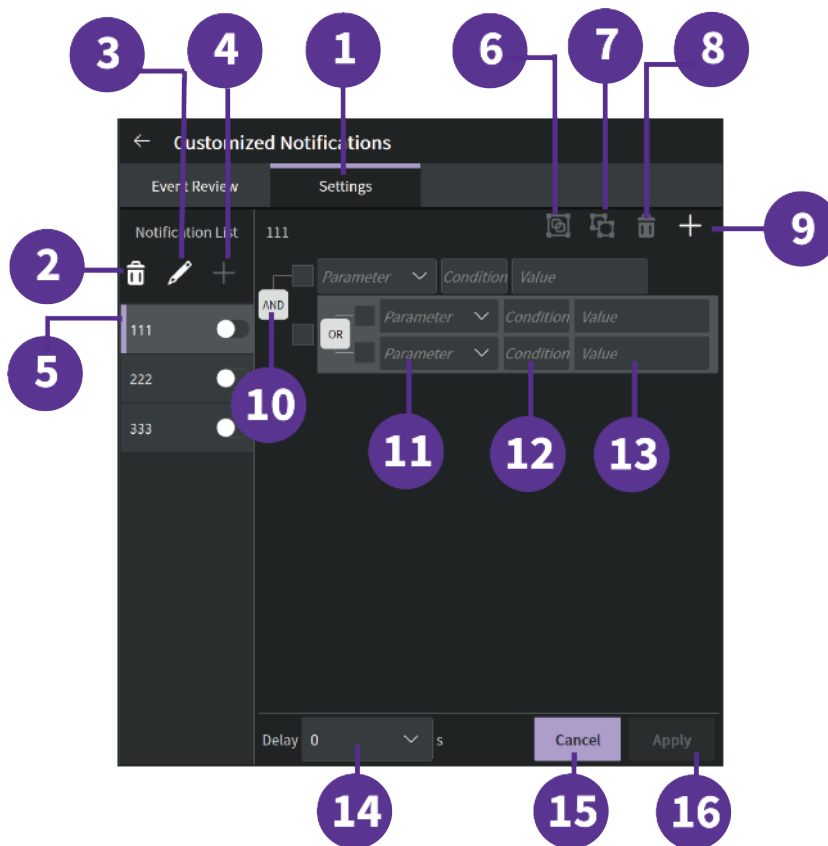
Customized Notification

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 set up the notification group to customize conditions first. The following is the **Settings** menu of customized notifications. (The menu is active only when Hub connects to Dock.)



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 disable or enable this notification group.
6.		Create a subgroup for multiple selected conditions.
7.		Release the selected subgroup.
8.		Delete the selected condition(s).
9.		Add a new condition for the notification group.
10.	AND (AND) and OR (OR)	Criteria softkey, select to switch between AND and OR.
11.	Parameter (Parameter)	Select the specific parameter.
12.	Condition (Condition)	Condition softkey, select to switch between "<" and ">".
13.	Value (Value)	Set parameter's value with arrows.
14.	Delay (Delay)	Set delay time for notifications.

No.	Items	Description
15.	Cancel (Cancel)	Cancel the settings setup.
16.	Apply (Apply)	Apply the settings and activate current notification group.

1. Select  >  **Customized Notifications**.
 - First time to use: select **Create Notification Group**, the **Settings** menu appears.
 - Update settings or create new groups: select **Settings** tab.
2. Manage the notification group:
 - Select  on the left column to create a notification group.
 - Select  on the left column to edit the notification group name, if needed.
 - Select  on the left column to delete the selected notification group, if needed.
3. Set up conditions for the notification group.
 - 3.1. Select the desired notification group.
 - 3.2. Disable the selected notification group by swiping  to .
 - 3.3. Select  on the right upper corner to add a new parameter condition (item).
 - 3.4. Set up the **Parameter**, **Condition**, and **Value**.
 - 3.5. Select the check box of item, then select  to delete the parameter condition, if needed.
 - 3.6. To create a subgroup, at least two parameter conditions need to be created. Select the check boxes of desired items, then select .
 - 3.7. To release the subgroup, select the check box of subgroup, then select .
 - 3.8. Select **AND** or **OR** to setup criteria of the notification group.
The notification group conditions will be textual displayed on screen.
 - 3.9. Select the time of **Delay** for this notification group that all the conditions have been met.
 - 3.10. Select **Apply** to save changes.
The current notification group will be enabled.
You can also select **Cancel** to cancel the settings setup.
4. Swipe the  or  to disable or enable the selected notification group.

NOTE

Users are not allowed to edit the notification group conditions when the notification group is enabled. Before editing, disable the selected notification group first by swiping  to .

Customized notification displays on device's screen

The customized notification is displayed in the notification menu, or in the notification bar, which locates 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**.
Then 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 can help you to check.
A purple circle  will appear on the upper right corner to indicate unread instances.

Viewing customized notification from notification bar

Set up the notification bar to the normal screen first:

1. Select  >  **Screen Setup**, and the required screen.
 2. Select the **Side Pane** vertical tab.
 3. Select **Notification Bar** from the **Show** list.
 4. Go to the normal screen.
The notification bar displays the group name and unread instances count for each group.
A purple circle  will appear on the upper right corner to indicate unread instance.
 5. 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 can help you to check.
A purple 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 351](#).

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 right 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.

Hemodynamic calculations

Calculations are used to derive calculated hemodynamic values from actual measurements. Calculations also provide trending for the input and calculated values.

Viewing calculations

A list of displayed input and calculated parameters is given in the supplemental information provided.

1. Select  >  **Calculations**.
2. Select **View**.

Parameter data is now displayed in two columns: **Input Parameters** and **Calculated Parameters**.

Source data for Hemodynamic calculations

The device uses CO values as source data for hemodynamic calculations, from the E-PiCCO module (first priority) or the E-COP module (second priority). However, CO or CCO and/or their indexed values that are older than 15 minutes are not used as source data. Other input values (for example, HR, PA Mean, CVP, Art Mean) used in the calculation are chosen from the same time the cardiac output is measured.

The device also allows the manual entry of source data for hemodynamic calculations.

Estimated values in Hemodynamic calculations

You can select different measurement sources for the PCWP. If you select **LAP mean** or **PA dia**, the PCWP value in **Hemo Calculations > Trend** will be marked as an estimated value with the letter e. Instead, the **Hemo Calculations > Edit Input** and **Hemo Calculations > View** show the actual selected label.

Selecting the PCWP source

1. Select  >  **Calculations**.
2. Select the **Edit Input** horizontal tab.
3. Select the source from the **PCWP Source** list.
 - **PCWP**
 - **LAP mean**
 - **PA dia**

Indexing parameters for hemodynamic calculations

Indexed values are calculated only if the patient's BSA (body surface area) value is available at the time when the calculations take place.

The BSA value is calculated automatically once the height and weight have been selected.

1. Select  >  **Calculations**.
2. Select **View**.
3. Toggle on **Indexed** at the lower part of the view.

Those parameters that can be indexed are now displayed as indexed, and indexed values are calculated.

Editing calculation input values

1. Select  >  **Calculations**.
2. Select the **Edit Input** horizontal tab.
3. Edit the parameter values in the **Value** column.
4. To perform the actual calculation and save the values, select the **View** horizontal tab > **Save**.

Saving calculation values

1. Select  >  **Calculations**.
2. Select **View**.
3. Select **Save** to save the input parameter values and calculated parameter values to the corresponding calculation trends.

Save is disabled if the input parameters or the calculated parameters are empty (regardless of BSA), or if the displayed values have already been saved.

Viewing saved calculations

To display indexed values on the device, select the **Trend** tab in the calculations menu, toggle on **Indexed**, and save the calculations to the trends on the **View** tab. The indexed values are calculated and trended only if the patient's BSA (body surface area) value is available at the time when the calculations are performed.

1. Select  >  **Calculations**.
2. Select the **Trend** horizontal tab.

To navigate between the pages of the **Trend** menu, use the arrow keys in the lower part of the menu.

Printing

Printing description

Depending on the system configuration, the following printing capabilities are available:

- Printing to a local thermal recorder connected directly to the Dock.
- 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.

NOTE

Local thermal recorder can be detected only when Dock is connected to AC mains power.

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 location 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 > Page 2 > Printer**, and they are password protected.

Please consult qualified and trained technical users to set up the printer. For more information, refer to the Service 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**
- **Fem Sys high**
- **Fem Sys low**
- **Fem Mean high**
- **Fem Mean low**

- **Fem Dia high**
- **Fem Dia low**

1. Select the  >  **Printing Setup** > **Waveforms** tab.
2. Choose a value from the **Print on Alarm** 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 the following option to start a waveform printout:
 - Select the  on Dock screen. 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 the following option to stop printing a waveform:
 - Select the  on Dock screen. 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 of a remote print device, or 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 152](#).

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 338](#)
- [Printing numeric trends on page 339](#)
- [Printing snapshots on page 342](#)
- [Printing alarm history on page 342](#)

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 is FAT32.

1. Insert the USB storage device to the USB port of the device.
2. Select the  >  **Export Patient Data** > **PDF**.
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 \PSP\v1\[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) hasn't been set, there will be a **Set Key for Patient Data Export** menu. To access 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.

The **Set Key for Patient Data Export** menu can also be accessed from  >  **Service** (password needed) > **USB Import/Export**. You can modify key if necessary.

For more information, refer to the Service manual.

Printing format

Network laser printer print header

Laser printer print header can include:

- Patient name (displayed if configured through  >  **Service** (password protected) > **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** (password protected) > **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** (password protected) > **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

NOTE

The system supports displaying bed-to-bed view only on the Dock screen.

When the device 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	Device 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** (password protected) > **Alarm Options** > **Remote Alarms**.

- **From Remote Location:** Selecting which remote locations are allowed to pause audio alarms on this device.
- **For Remote Bed:** Enabling or disabling audio pausing remotely for another device.
- **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** (Toggle tab): Enabling or disabling the display of the remote patient name.
- **Remote Alarm Tone:** Selecting the remote alarm tone.
- **Restore Remote Bed after Discharge** (Toggle tab) : 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 device 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 device 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 **Care 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 **Care 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 **Care 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 **Care 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 close indicator.

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**, and they are password protected. Please consult qualified and trained technical users to set up. For more information, refer to the Service manual.

Manual printing of remote bed waveforms

Waveform data of a remote device can be manually printed by selecting  from the bed-to-bed window. The waveforms that appear on the printout are determined by the remote device'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 device

Service personnel should perform the following checkout procedures every 24 months after installation. Refer to the service manuals for planned maintenance procedures.

- Visual inspection

- Electrical safety tests
- Functional check

Planned maintenance for the E-modules

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, E-PiCCO 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

Planned maintenance for the micro-modules

For Microstream CO₂ micro-module, Masimo SpO₂ micro-module, Nellcor SpO₂ micro-module and TruSignal Pressure micro-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.

- Visual inspection
- Electrical safety tests, if needed
- Functional check

Recommended check schedules

Daily checks

- Check that the accessories, cables, cable connectors, device, module and display parts are clean and intact.
- Check the charge of the device battery.

Check every two months

- Change the water trap.
- Check the airway gases calibration (when using E-modules) if the measurement is in continuous use.

Check every six months

- Check the airway gases calibration (when using E-modules) if the measurement is in normal (not continuous) use.

Check every 12 months

- Check the Microstream CO₂ calibration every year.

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

- Calibrating airway gases with E-modules:

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 HealthCare 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 device. For maximum accuracy, let the device 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  >  **Service > Service > Parameters > Gas Calibration**, and the settings are password protected. Please consult qualified and trained technical users to set up. For more information, refer to the Service manual.
 - Calibrate Microsteam CO₂:

For recommendations regarding the calibration of Microsteam CO₂ micro-module, refer to its instructions for use.

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 Service manual of the device.

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

Battery safety instructions

Failure to read and follow the battery safety instructions below may result in personal injury, and property damages.

- Do not disassemble or modify the battery.
- Excessive vibration outside the final product, puncture, contact with metals, or tampering with the battery can cause it to fail.
- Do not short circuit the battery.
- Do not keep a battery in your pocket, purse, or anywhere together with other metal (conductive) objects.
- Never use force to install(insert) the battery.
- If the battery is damaged in any way stop using immediately.
- Immediately discontinue use of the battery if, while using, charging, or storing the battery, the battery emits an unusual smell, feels hot, changes color or shape, or appears abnormal in any other way.
- Do not leave battery discharged. If the battery is fully discharged, charge the battery as soon as possible.
- Only charge batteries in authorized GE HealthCare devices or chargers. Never use a third-party charger.
- Only use GE HealthCare designated batteries inside a GE HealthCare system and or GE HealthCare Charger. Never use an aftermarket or non-GE HealthCare authorized battery. If you are unsure, contact GE HealthCare for confirmation.
- Store in a cool, dry place. Never store or charge batteries in extreme temperatures, such as a hot car; near heat sources or fire; in pressurized or very cold environments.
- The battery contains safety and protection devices, which, if damaged, may cause the battery to fail.
- Exposure to liquids can cause internal corrosion or damage to the cells or to the Battery Management System (BMS). The BMS protects the battery from overcharging, high self- discharge, or imbalanced charging of the cells, any of which can present the possibility of hazards during charging or use.
- Avoid unattended charging of batteries, or where objects such as carpet, furniture, wood, vinyl floors, curtains or other flammable objects are nearby.
- If the battery is not meeting expected capacity or the battery and/or software is indicating end of service life, discontinue using the battery immediately and replace with an authorized GE HealthCare battery for this product.

Device battery

The Hub, Dock and Mini Dock each has one rechargeable lithium-ion battery to supply device operation without mains power.

- Condition battery: Charge the device battery. If the message **Hub Condition battery** or **Dock Condition battery** still persists, contact authorized service personnel to replace battery.

To charge the device battery, follow the instructions:

- Hub: Connect the Hub to Dock or Mini Dock.
- Dock: Connect the Dock to the AC mains supply.
- Mini Dock: Connect the Mini Dock to the AC mains supply by a DC power adapter.
- Check battery status and performance: see [Checking the battery status with device software on page 76](#).
- Recycle battery: When the battery fails, or its runtime is significantly less than the specification, it should be replaced. A **Replace Hub battery** or **Replace Dock 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 Hub 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 device 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 HealthCare 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 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 HealthCare. 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 HealthCare, 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.

About cleaning and disinfection

- 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.

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 Dock or Mini Dock, do not tilt the device more than +/-15 degrees. 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 device. Pressure may destroy sensitive elements.

Cleaning points to note

Observe these guidelines while cleaning the devices.

- 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 using 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.
- The warranty does not cover any damage caused by using any substances and methods other than those approved by GE HealthCare.

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.
- Do not disinfect any part of the system with automated disinfection techniques.

Visual inspection before cleaning and disinfection

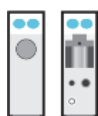
Carefully inspect devices visually to verify proper function. Do not use improperly functioning, damaged, or excessively worn devices, or devices with unrecognizable markings or missing or worn device labeling or marking. Evidence of damage and wear on a device may include but is not limited to discoloration, 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.

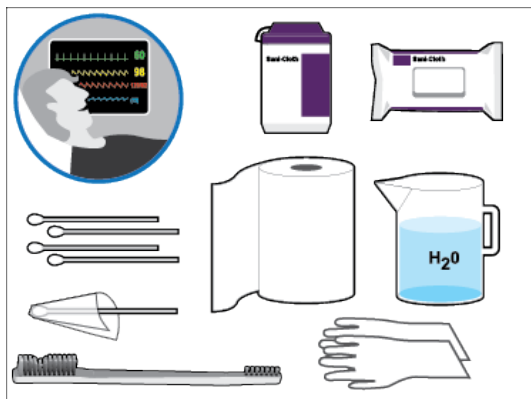
Cleaning and disinfection frequency

The following table indicates the frequency of visual inspection, cleaning, and disinfection procedures.

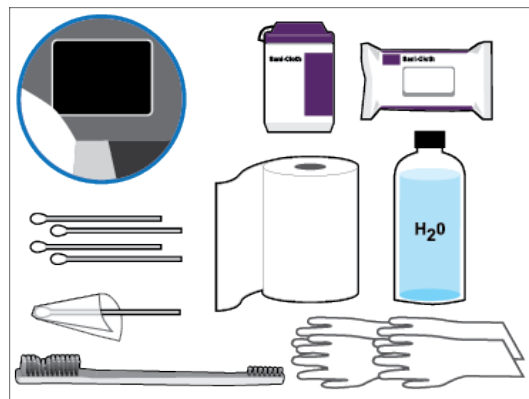
Device	Visual inspection	Cleaning	Disinfection
Hub 	• Before and after each patient use • Before and after cleaning or disinfection	• After each patient use • When in use and visible soil is present	• After each patient use • Perform disinfection after cleaning, not before
Dock 	• Before and after each 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
Mini Dock 	• 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
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 405	• After each patient use • Perform disinfection after cleaning, not before For instructions refer to: • Cleaning and disinfecting the B1X5-F2 frame between patients on page 405
Micro-module 	• 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 Hub between patients on page 389	• After each patient use • Perform disinfection after cleaning, not before For instructions refer to: • Cleaning and disinfecting the Hub between patients on page 389

Supplies needed for cleaning and disinfection



Cleaning supplies



Disinfection supplies

1. Cleaning/disinfection wipes (commercial) or detergent/disinfectant
2. 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).

NOTE

Lukewarm water: Refers to water temperature ranges from 27 to 44 °C, 81 to 111 °F.

3. Non-linting cloths
4. Cotton swabs
5. Brush
6. 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

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.

Carevance products		
Product	Manufacturer	Type of Disinfectant
Bacillol 30 Sensitive Tissues	Bode Chemie GmbH	Alcohol and amines
Clorox Hydrogen Peroxide Wipes	Clorox Professional	Hydrogen Peroxide
Virex II 256	Diversey	Quaternary Ammonium
Oxivir TB wipes*	Sealed Air (was Johnson Diversey)	Accelerated Hydrogen Peroxide
Cleanisept Wipes	Dr. Schumacher GMBH	Quaternary Ammonium
Incidin OxyWipes	Ecolab	Hydrogen peroxide
Incidin Alcohol Wipes	Ecolab	Alcohol
Clinell Universal Range	GAMA Healthcare	Quaternary Ammonium
Clinell Peracetic Acid Wipes, Red	GAMA Healthcare	Peracetic Acid
Rely+On Virkon	LANXESS Corporation	Organic salts and organic acids
Caviwipes Bleach	Metrex Research, LLC.	Chlorine
Caviwipes	Metrex Research, LLC.	Quaternary ammonium and alcohol
Super Sani-Cloth®	Professional Disposables Inc. (PDI)	Quat & Isopropyl Alcohol, Quaternary Ammonium Compounds
PDI Easy Screen Cleaning Wipes	Professional Disposables Inc. (PDI)	Alcohol
PDI Sani-Cloth Bleach Germicidal Disposable Wipes	Professional Disposables Inc. (PDI)	Chlorine
Sani-Cloth Plus Germicidal Disposable Cloth*	Professional Disposables Inc. (PDI)	Quaternary Ammonium
Premier detergent and disinfectant Wipes	Reynard Health Supplies	Quaternary Ammonium
Terralin Liquid*	Shülke & Mayr GmbH	Alcohol
Mikrozid Universal Wipes	Shülke & Mayr GmbH	Alcohol
Mikrozid Sensitive Wipes	Shülke & Mayr GmbH	Quaternary Ammonium
Sodium hypochlorite 5.25% (Bleach) diluted to 10:1.	Generic	Chlorine
Ethanol 70 to 96%*	Generic	Alcohol
Isopropyl alcohol 70%*	Generic	Alcohol
All generic agents: check the minimum disinfection times as per your healthcare facility guidelines.		

B1X5-F2 frame, B1X5-REC recorder			
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%
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	• Didecyltrimethyl 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%

B1X5-F2 frame, B1X5-REC recorder			
Product	Manufacturer	Type of Disinfectant	Active Ingredients*
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.			

TruSignal Pressure micro-module			
Product	Manufacturer	Active ingredient(s)*	Type of disinfectant
Super Sani-Cloth (PDI Super Sani-Cloth Germicidal Disposable Wipes)	Professional Disposables Inc.	• Quaternary ammonium compounds, C12-18-alkyl [(ethyl-phenyl) methyl] dimethyl, chlorides 0.25% • n-Alkyl dimethyl benzylammonium chloride 0.25% • Isopropanol 55.00%	Quaternary ammonium compounds and alcohol
PDI Sani-Cloth AF3 Germicidal Disposable Wipes	Professional Disposables Inc.	• n-Alkyl (68% C12, 32% C14) dimethyl ethylbenzyl ammonium chlorides 0.14% • n-Alkyl (60% C14, 30% C16, 5% C12, 5% C18) dimethyl benzyl ammonium chlorides 0.14%	Quaternary ammonium compounds and alcohol

TruSignal Pressure micro-module			
Product	Manufacturer	Active ingredient(s)*	Type of disinfectant
PDI Sani-Cloth Bleach Germicidal Disposable Wipes	Professional Disposables Inc.	Sodium hypochlorite 0.63%	Chlorine
Sani-Cloth Plus Germicidal Disposable Cloth	Professional Disposables Inc.	- Quaternary ammonium compounds, C12-18-alkyl [(ethylphenyl) methyl] dimethyl, chlorides 0.125% - Benzyl-C12-18-alkyldimethyl ammonium chlorides 0.125% - Isopropyl alcohol 10-20%	Quaternary ammonium compounds
PDI Easy Screen Cleaning Wipes	Professional Disposables Inc.	- Isopropyl alcohol 60-80% - Water 30-40%	Alcohol
CaviWipes	Metrex Research, LLC.	- Isopropanol 17.20% - Diisobutylphenoxyethyl dimethyl benzyl ammonium chloride 0.28%	Alcohol
Mikrozid Sensitive Wipes	Shülke & Mayr GmbH	- Didecyl dimethyl ammonium chloride 0.26% - Alkyl (C12-C16) dimethyl benzyl ammonium chloride 0.26% - Alkyl (C12-C14) ethyl benzyl ammonium chloride 0.26%	Quaternary ammonium
Cleanisept Wipes	Dr. Schumacher GmbH	- Quaternary ammonium compounds, benzyl-C12-C16-alkyldimethyl, chlorides <1% - Didecyl dimethyl ammonium chloride 0.25%	Quaternary ammonium compounds
Clinell Universal Sanitizing Wipes	GAMA Healthcare	- Benzalkonium chloride <0.5% - Didecyl dimethyl ammonium chloride ≤0.5% - Polyhexamethylene biguanide (PHMB) ≤0.10%	Quaternary ammonium compounds and bisbiguanide
Clinell Sporicidal Wipes	GAMA Healthcare	- Sodium Percarbonate ≤50% - Citric acid ≤15% - Tetra acetyl ethylene diamine ≤25%	Hydrogen peroxide and peracetic acid
Oxivir TB Wipes	Diversey	- Benzyl alcohol 1 to 5% - Hydrogen peroxide >0.1% to <1%	Hydrogen peroxide
Clorox Healthcare Hydrogen Peroxide Cleaner Disinfectant Wipes	The Clorox Company	- Hydrogen peroxide 1.4% - Benzyl alcohol 1 to 5%	Hydrogen peroxide
Isopropyl alcohol max. 60% of weight	Generic	Isopropyl alcohol	Alcohol

TruSignal Pressure micro-module			
Product	Manufacturer	Active ingredient(s)*	Type of disinfectant
Sodium hypochlorite 5.25% (Bleach) diluted to 10:1. Do NOT use this disinfectant for touchscreen panels.	Generic	Sodium hypochlorite	Chlorine
*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.			

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

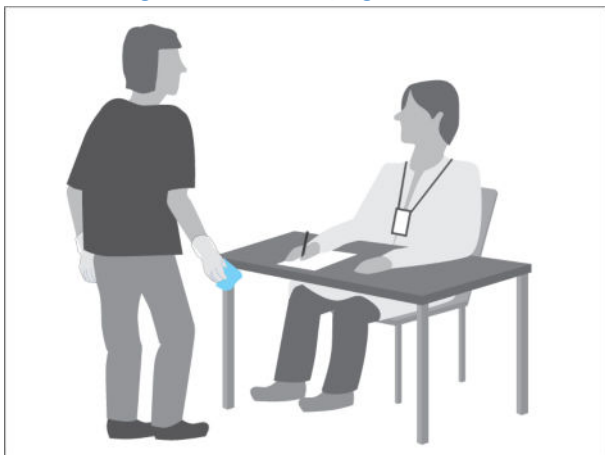
How to clean and disinfect

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:

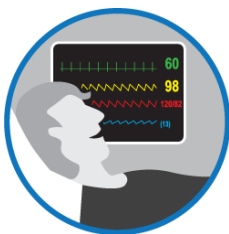
- Discharge patient, and disconnect cables or devices if between patients.
- Lock the touchscreen if necessary. For cleaning personnel, you can ask for clinical professionals' help for related instruction. For more information about how to lock the touchscreen, refer to [Locking the screen on page 103](#).



NOTE

It is recommended the cleaning/disinfection operation person to ask the clinician whether can start your cleaning and disinfection process or not.

Cleaning during patient monitoring



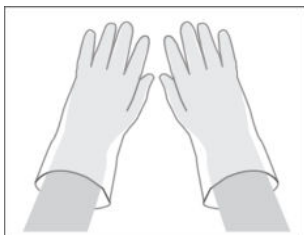
If cleaning is permitted during patient monitoring, do not clean any part of the system that is directly in contact with the patient. Otherwise, there may be a risk of contamination, loss of monitoring, or contact of detergents with the patient's skin.

NOTE

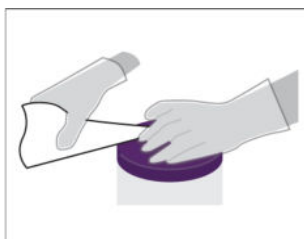
Follow this procedure only when there is a patient connected to the device.

Cleaning the Hub during monitoring

1. Put on new disposable gloves and any other Personal Protective Equipment (PPE) recommended by your professional healthcare facility guidelines.



2. Get a new wipe or dampen a soft non linting cloth with one of the permitted detergents.



3. Lock the screen if necessary.

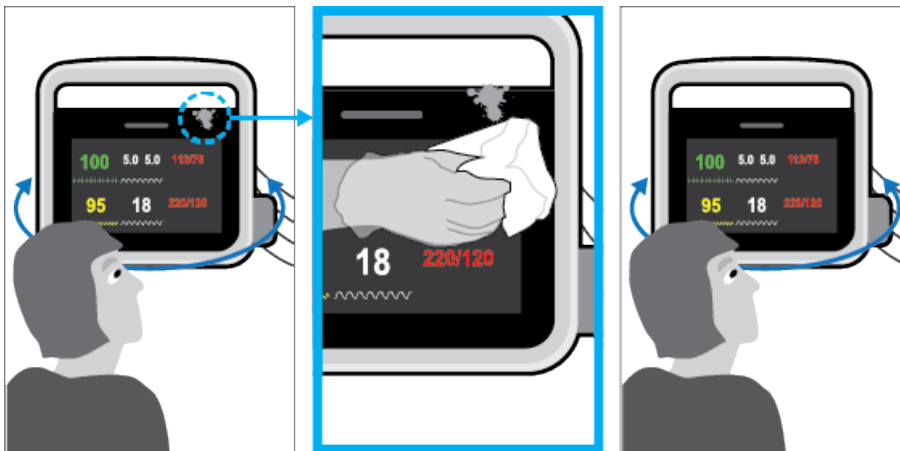
3.1. Select  >  **Lock** to lock the touchscreen when the device is in use.

3.2. To unlock the touchscreen, swipe down the  scroll bar on the right column of the screen.

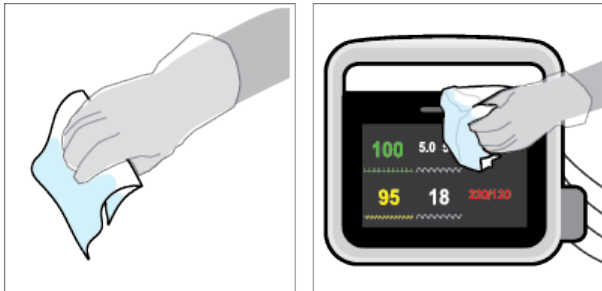
4. Wipe the device's exterior surface. Remove any soil by wiping the device until soil and organic matter have been visibly removed.



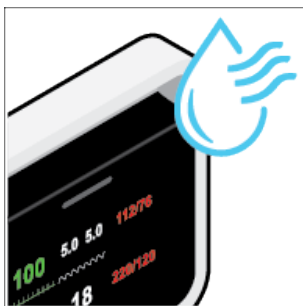
5. Inspect the device to ensure the complete removal of soil from surfaces, cavities, and movable parts. If visible soil remains, repeat cleaning procedure until the device is thoroughly clean.



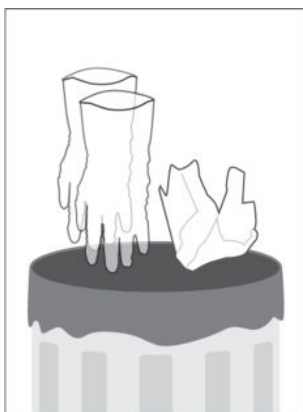
6. If required, wipe the device thoroughly using a soft non-linting cloth saturated with lukewarm tap (utility) water.



7. Allow the device to air dry until it is visibly dry. Drying times may vary based on the environmental conditions.

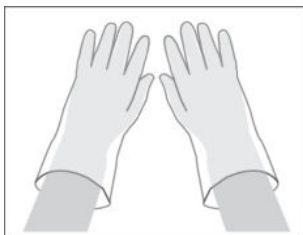


8. Discard disposable wipes and gloves according to your professional healthcare facility guidelines. Do not reuse wipes or gloves.

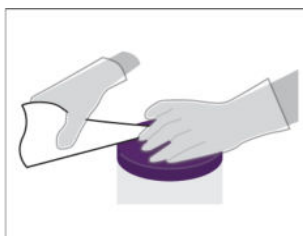


Cleaning the Dock during monitoring

1. Put on new disposable gloves and any other Personal Protective Equipment (PPE) recommended by your professional healthcare facility guidelines.



2. Get a new wipe or dampen a soft non linting cloth with one of the permitted detergents.

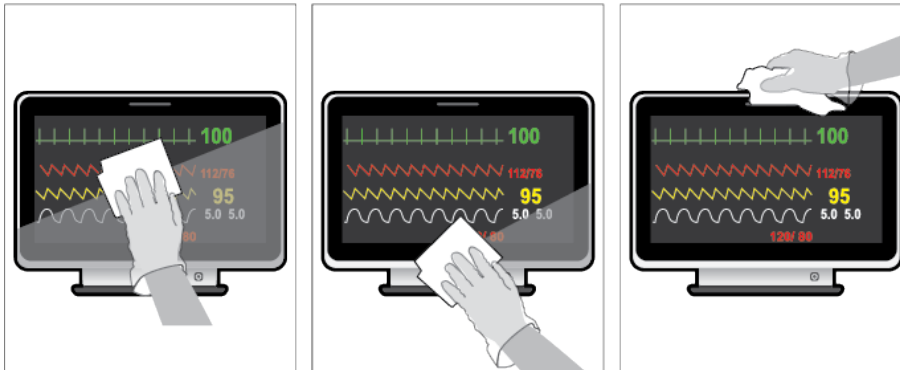


3. Lock the screen if necessary.

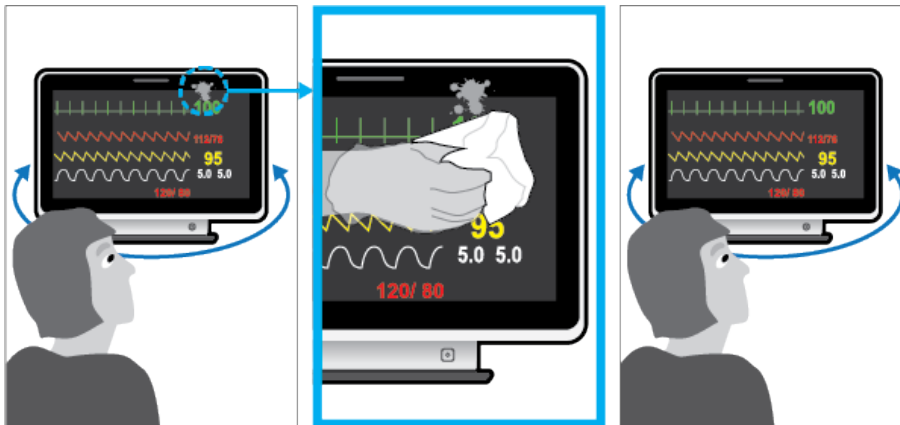
3.1. Select  >  **Lock** to lock the touchscreen when the device is in use.

3.2. To unlock the touchscreen, swipe down the  scroll bar on the right column of the screen.

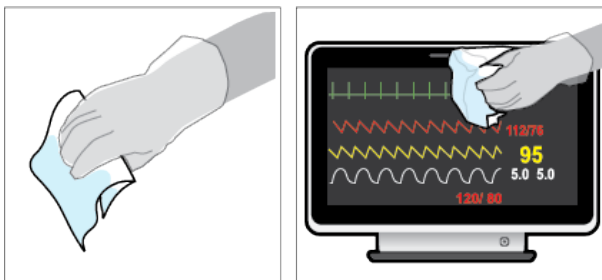
4. Wipe the device's exterior surface. Remove any soil by wiping the device until soil and organic matter have been visibly removed.



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.



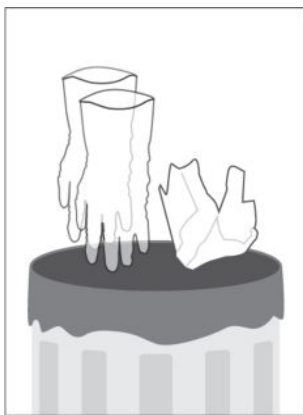
6. If required, wipe the device thoroughly using a soft non-linting cloth saturated with lukewarm tap (utility) water.



7. Allow the device to air dry until it is visibly dry. Drying times may vary based on the environmental conditions.

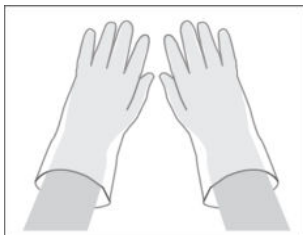


8. Discard disposable wipes and gloves according to your professional healthcare facility guidelines. Do not reuse wipes or gloves.

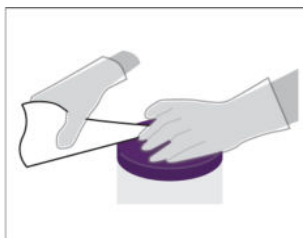


Cleaning the Mini Dock during monitoring

1. Put on new disposable gloves and any other Personal Protective Equipment (PPE) recommended by your professional healthcare facility guidelines.



2. Get a new wipe or dampen a soft non linting cloth with one of the permitted detergents.

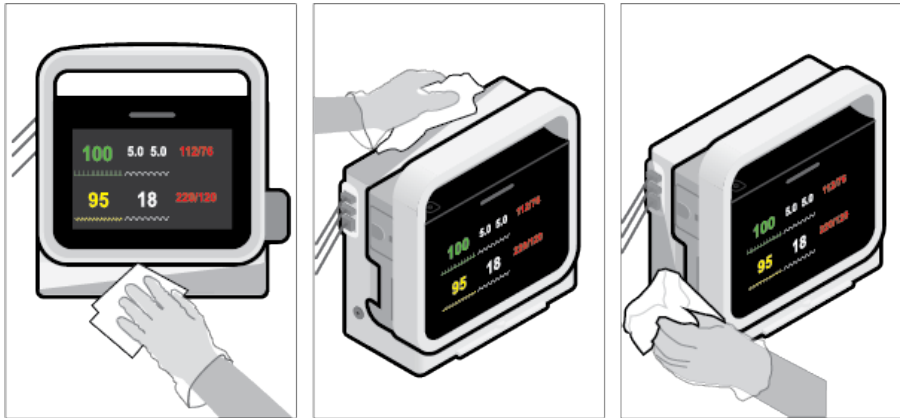


3. Lock the screen if necessary.

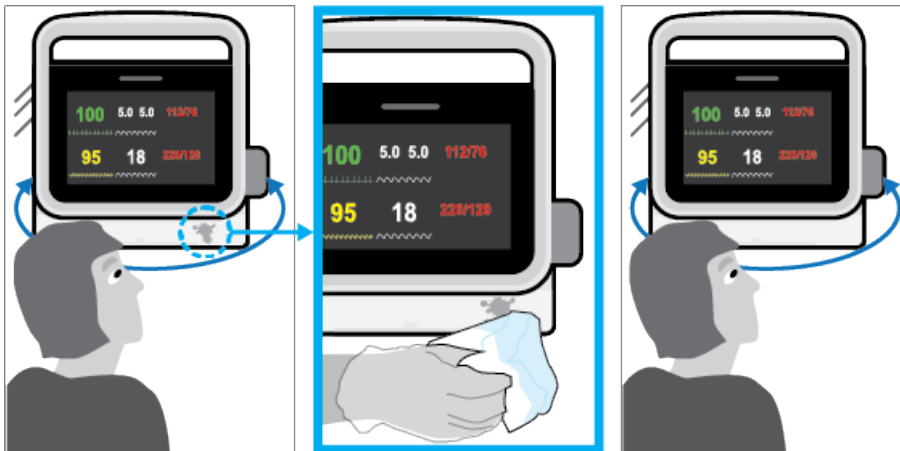
3.1. Select  >  **Lock** to lock the touchscreen when the device is in use.

3.2. To unlock the touchscreen, swipe down the  scroll bar on the right column of the screen.

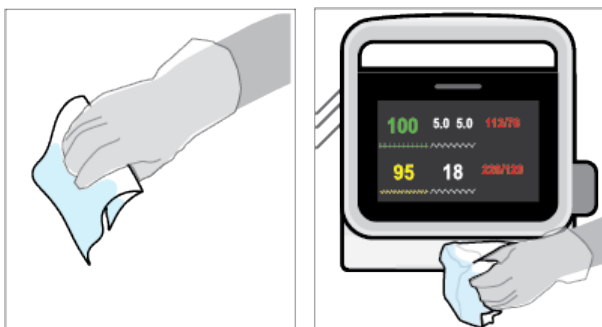
4. Wipe the device's exterior surface. Remove any soil by wiping the device until soil and organic matter have been visibly removed.



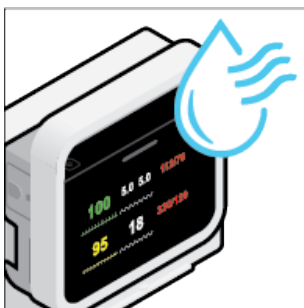
5. Inspect the device to ensure the complete removal of soil from surfaces, cavities, and movable parts. If visible soil remains, repeat cleaning procedure until the device is thoroughly clean.



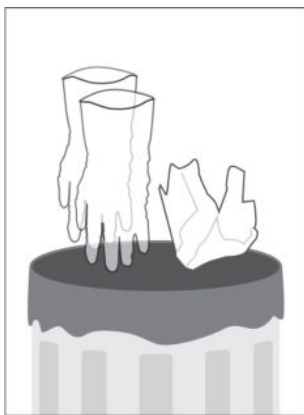
6. If required, wipe the device thoroughly using a soft non-linting cloth saturated with lukewarm tap (utility) water.



7. Allow the device to air dry until it is visibly dry. Drying times may vary based on the environmental conditions.

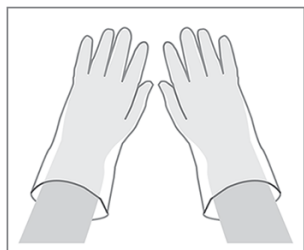


8. Discard disposable wipes and gloves according to your professional healthcare facility guidelines. Do not reuse wipes or gloves.

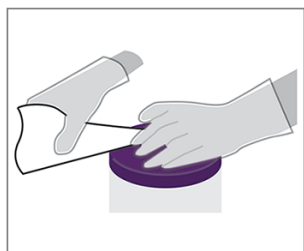


Cleaning the B1X5-F2 frame and B1X5-REC during monitoring

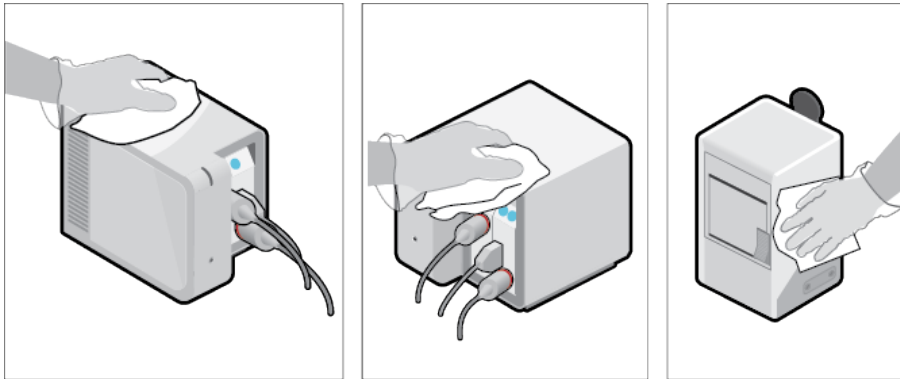
1. Put on new disposable gloves and any other Personal Protective Equipment (PPE) recommended by your professional healthcare facility guidelines.



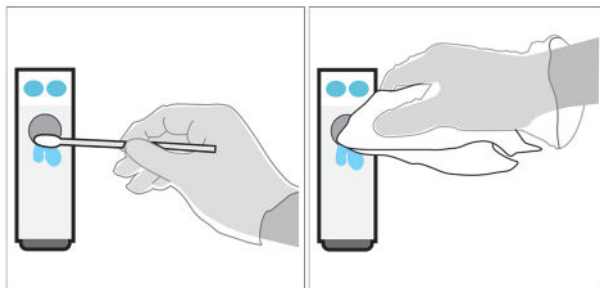
2. Get a new wipe or dampen a soft non linting cloth with one of the permitted detergents.



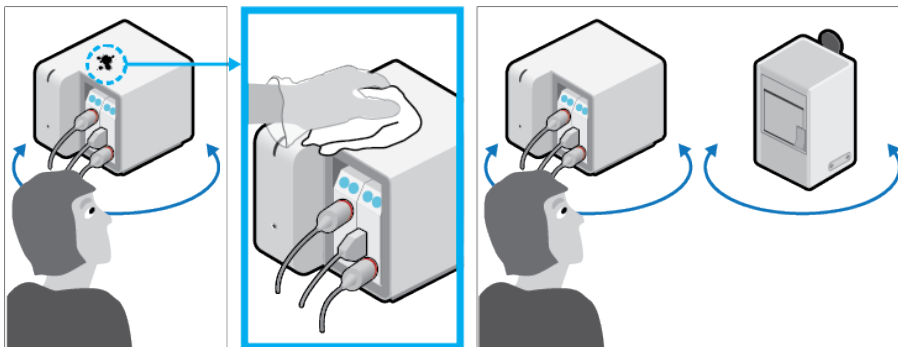
3. Wipe the device's exterior surface. Remove any soil by wiping the device until soil and organic matter have been visibly removed.



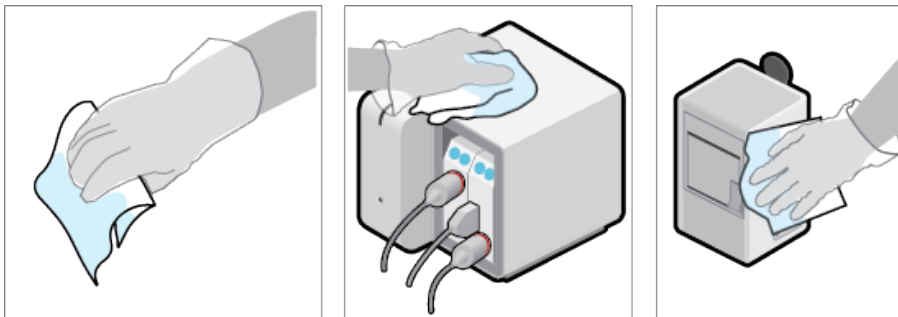
4. Ensure there is no liquid pooling around connection pins. If this happens, blot dry with a cotton swab or soft non-linting cloth.



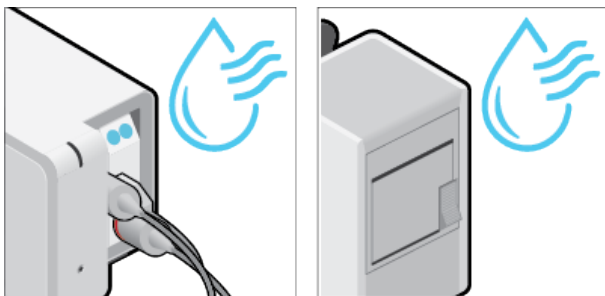
5. Inspect the device to ensure the complete removal of soil from surfaces, cavities, and movable parts. If visible soil remains, repeat cleaning procedure until the device is thoroughly clean.



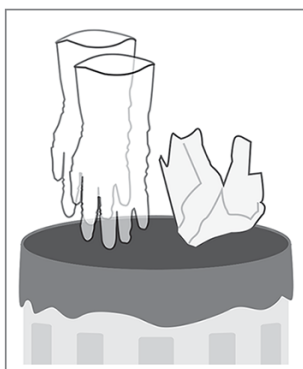
6. If required, wipe the device thoroughly using a soft non-linting cloth saturated with lukewarm tap (utility) water.



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.



Cleaning and disinfection between patients



NOTE

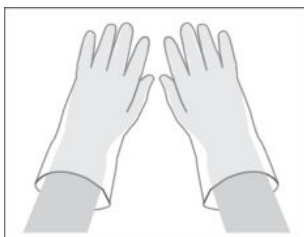
Follow this procedure only when there is no patient connected to the device and no ongoing monitoring.

Cleaning and disinfecting the Hub between patients

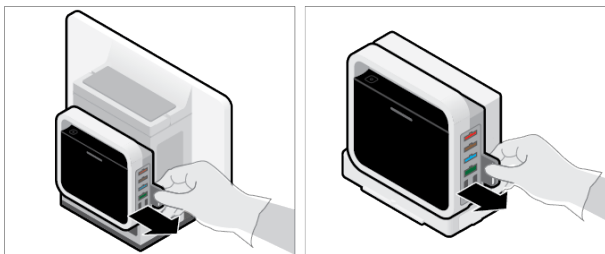
NOTE

Clean the devices thoroughly prior to disinfection. Follow these instructions.

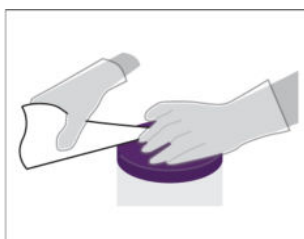
1. Put on new disposable gloves and any other Personal Protective Equipment (PPE) recommended by your professional healthcare facility guidelines.



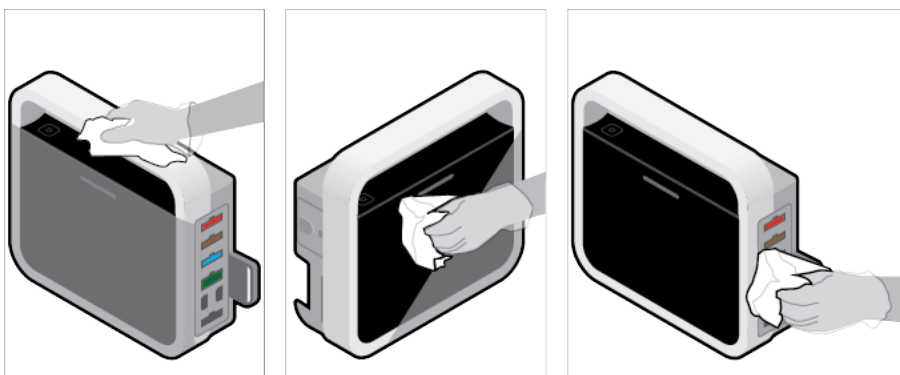
2. If needed, disconnect the device (remove the Hub from Dock or Mini Dock).

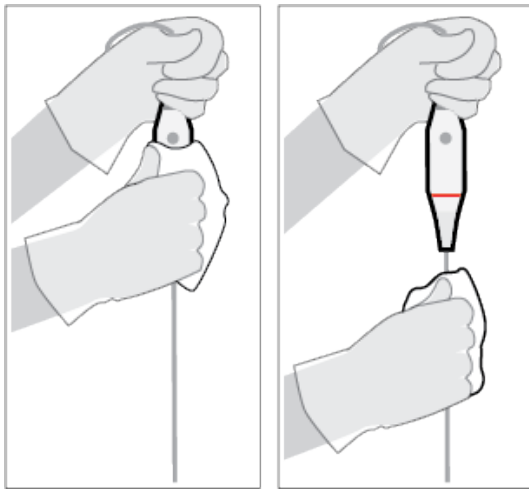


3. Get a new wipe or dampen a soft non linting cloth with one of the permitted detergents.

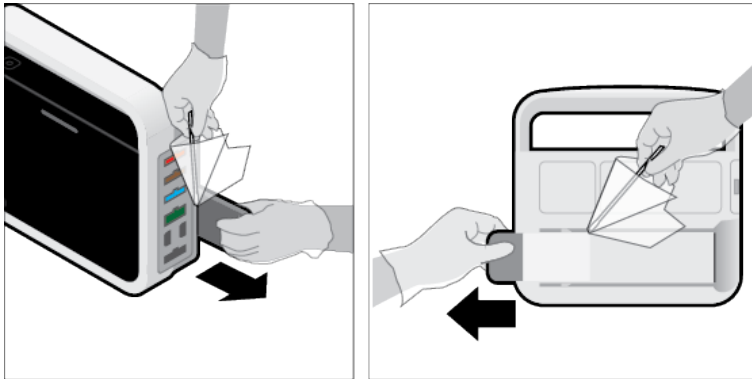


4. Wipe the device's exterior surface. Remove any soil by wiping the device until soil and organic matter have been visibly removed.

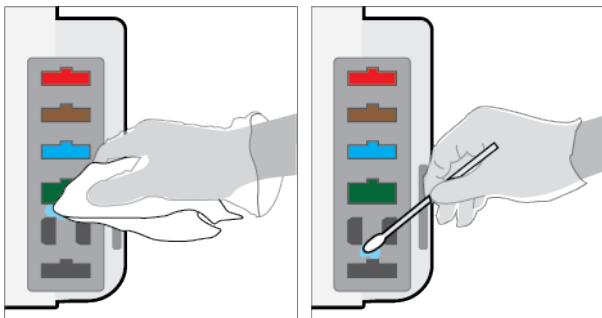




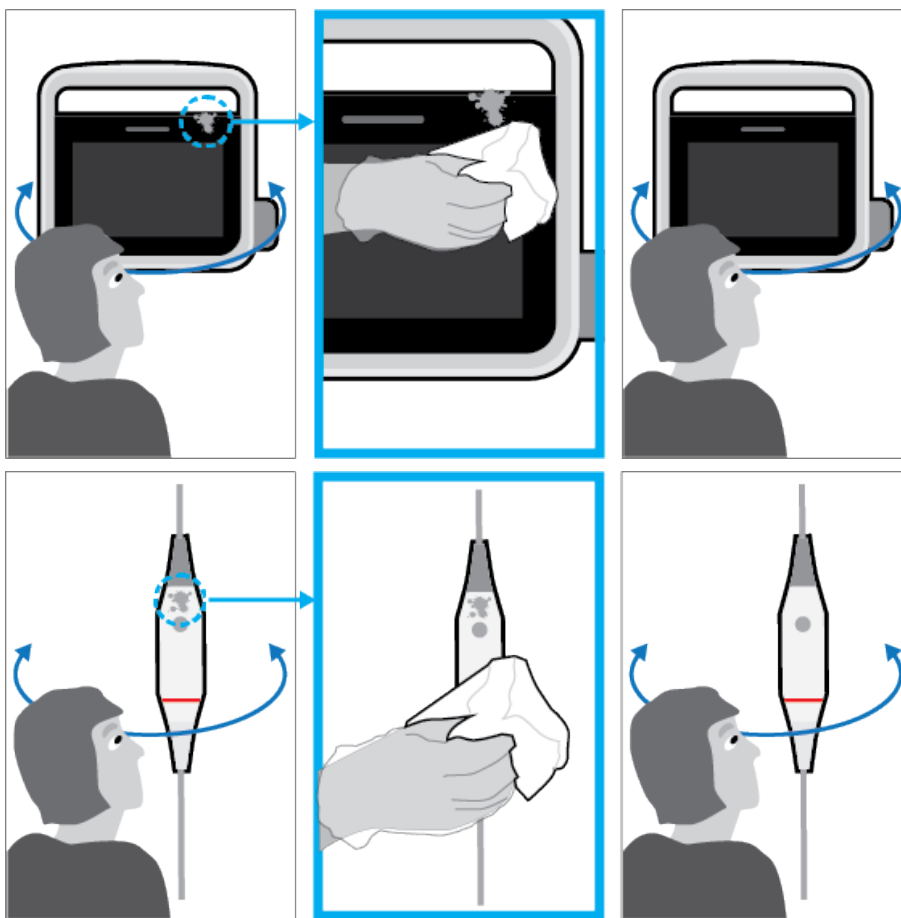
Pay special attention to hard-to-clean areas like grooves and crevices. Scrub these areas with a cotton swab inside a wipe.



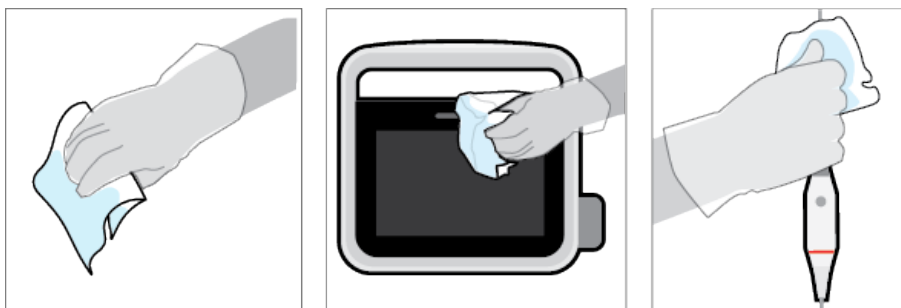
5. Ensure there is no liquid pooling around connection pins. If this happens, blot dry with a cotton swab or soft non-linting cloth.



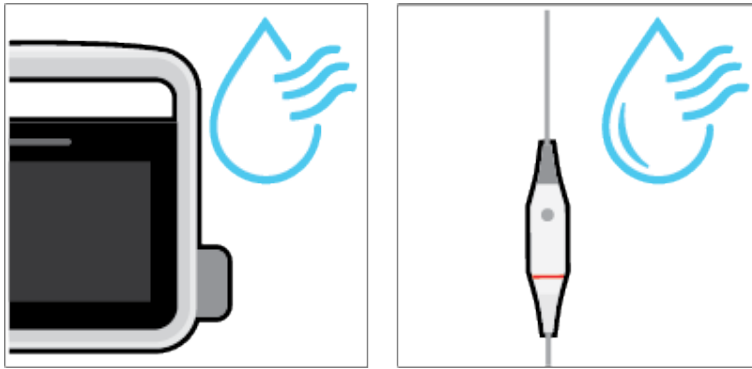
6. Inspect the device to ensure the complete removal of soil from surfaces, cavities, and movable parts. If visible soil remains, repeat cleaning procedure until the device is thoroughly clean.



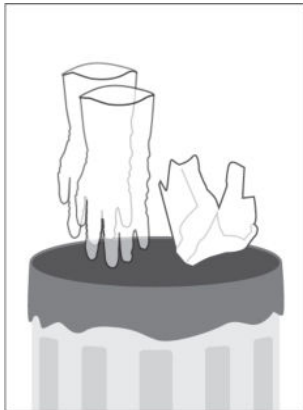
7. If required, wipe the device for 30 seconds using a sterile, soft, non-linting cloth saturated with lukewarm tap (utility) water.



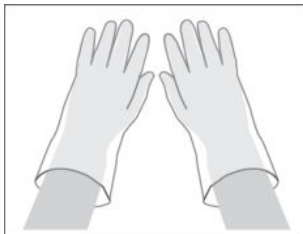
8. Allow the device to air dry until it is visibly dry. Drying times may vary based on the environmental conditions.



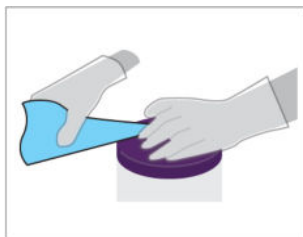
9. Discard disposable wipes and gloves according to your professional healthcare facility guidelines. Do not reuse wipes or gloves.



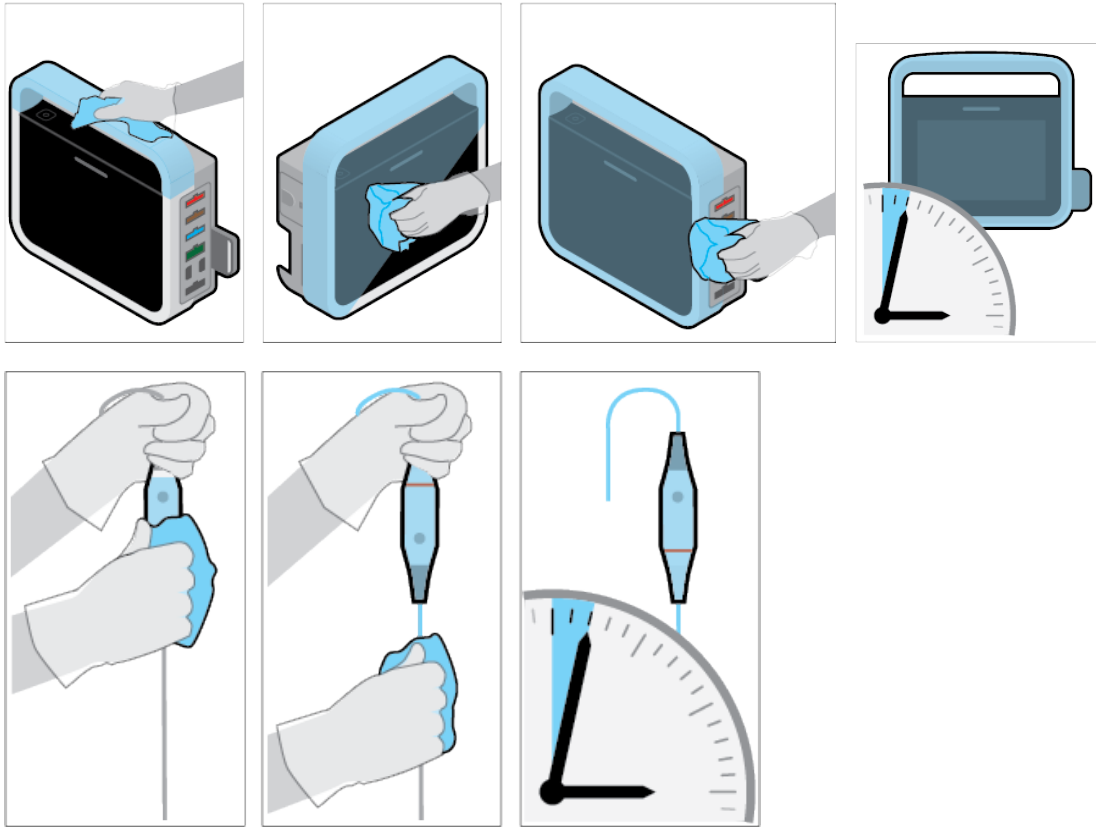
10. Start disinfection by putting on new disposable gloves and any other Personal Protective Equipment (PPE) recommended by your professional healthcare facility guidelines.



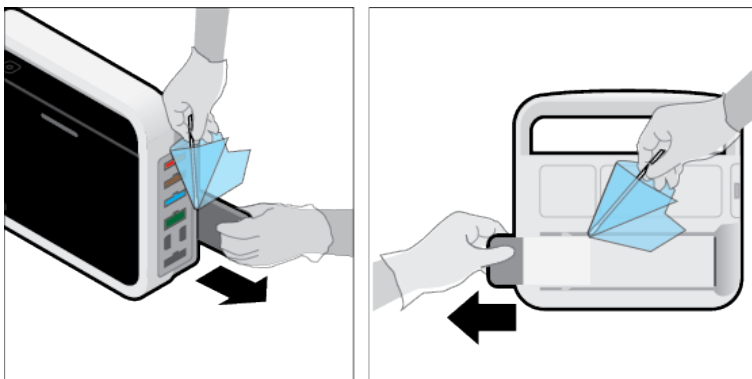
11. Get a new wipe or dampen a soft non linting cloth with one of the permitted disinfectants.



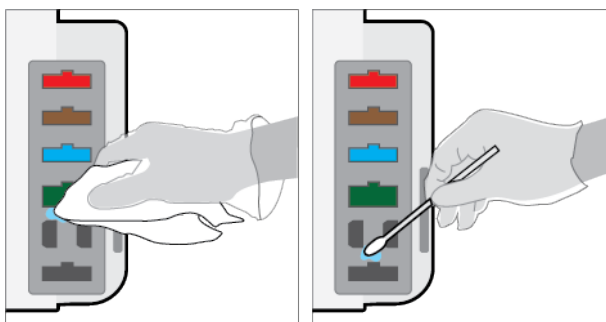
12. Wipe the device surface. Make sure all surfaces are uniformly wiped. Treated surfaces must remain visibly wet for a minimum of two minutes (Super Sani-Cloth) or according to the disinfectant manufacturer's instructions. To ensure this, use additional disinfectant wipes as necessary.



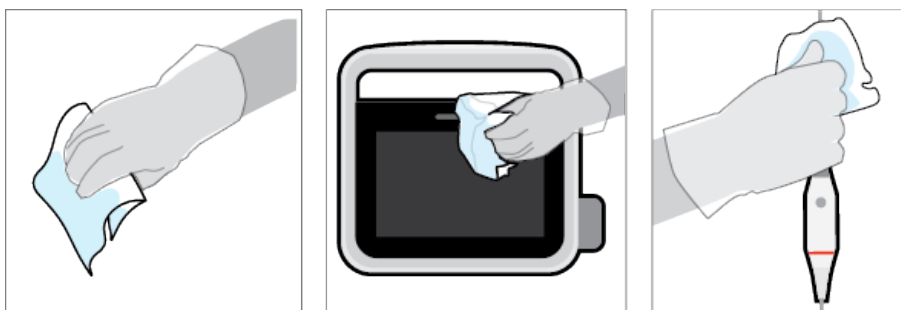
Pay special attention to hard-to-clean areas, like grooves and crevices. Scrub these areas using a cotton swab inside the wipe.



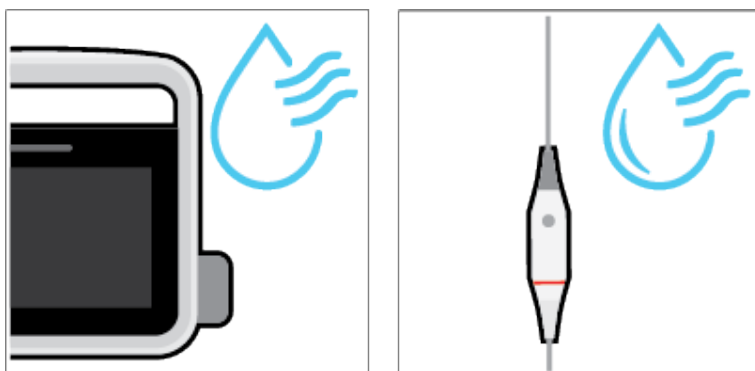
13. Ensure there is no liquid pooling around the pins. If this happens, blot dry with a cotton swab or soft non-linting cloth.



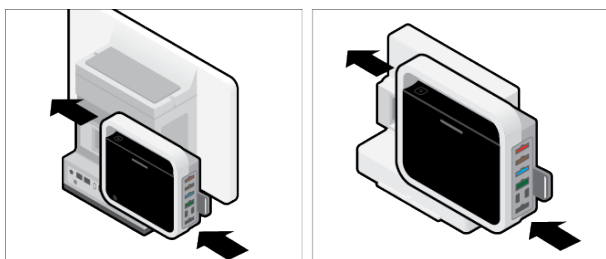
14. If required, wipe the device for 30 seconds using a sterile, soft, non-linting cloth saturated with lukewarm critical water.



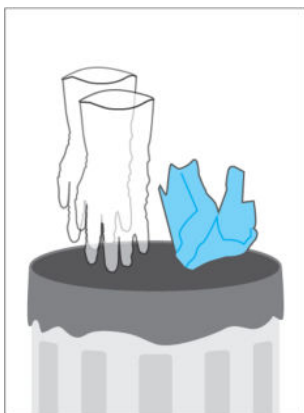
15. Allow the device to air dry until it is visibly dry. Drying times may vary based on the environmental conditions.



16. If needed, put on new gloves and reconnect the device (attach the Hub to the Dock or Mini Dock).



17. Discard disposable wipes and gloves according to your professional healthcare facility guidelines. Do not reuse wipes or gloves.

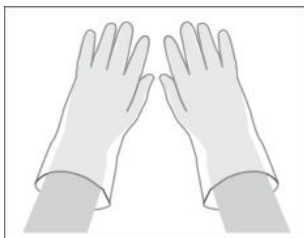


Cleaning and disinfecting the Dock between patients

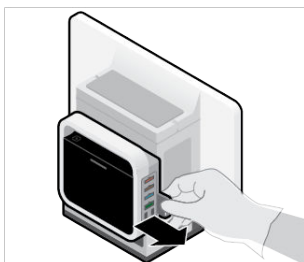
NOTE

Clean the devices thoroughly prior to disinfection. Follow these instructions.

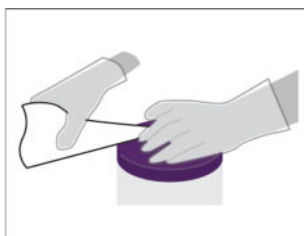
1. Put on new disposable gloves and any other Personal Protective Equipment (PPE) recommended by your professional healthcare facility guidelines.



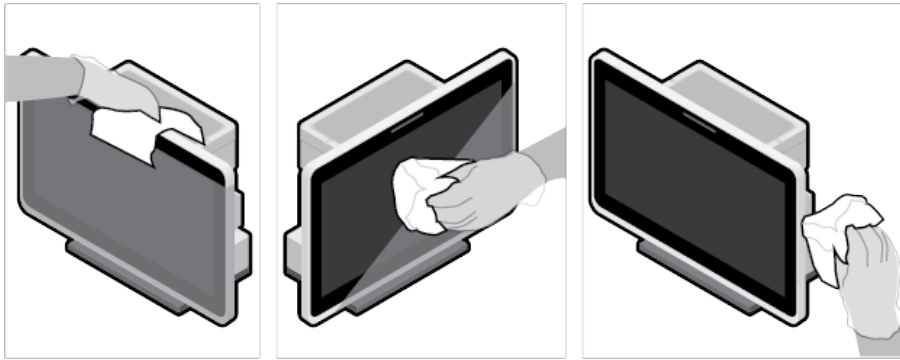
2. If needed, disconnect the device (remove the Hub from Dock).



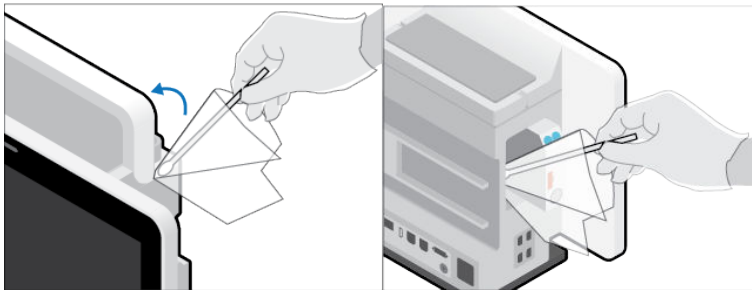
3. Get a new wipe or dampen a soft non linting cloth with one of the permitted detergents.



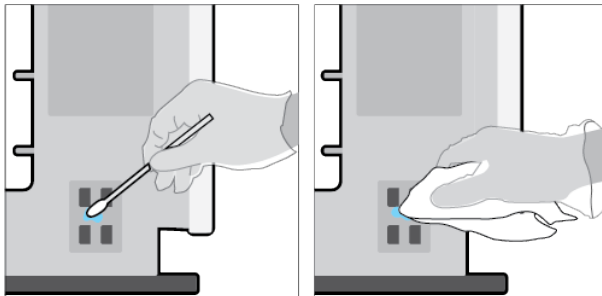
4. Wipe the device's exterior surface. Remove any soil by wiping the device until soil and organic matter have been visibly removed.



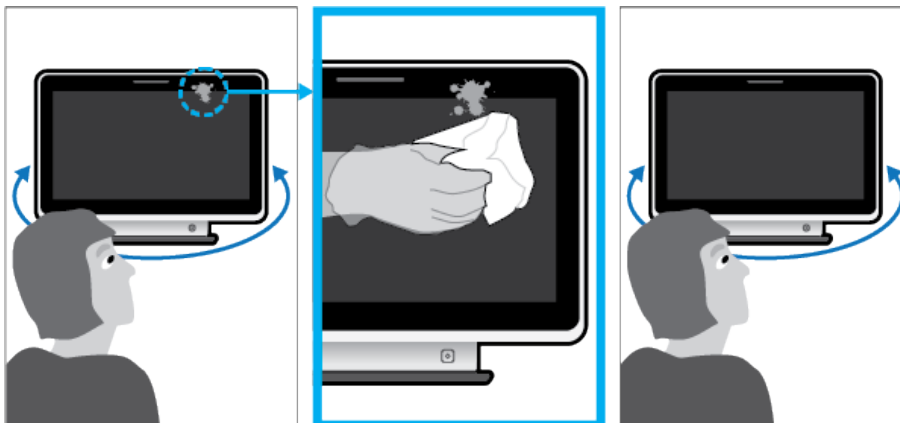
Pay special attention to hard-to-clean areas like grooves and crevices. If needed, scrub these areas with a cotton swab inside a wipe.



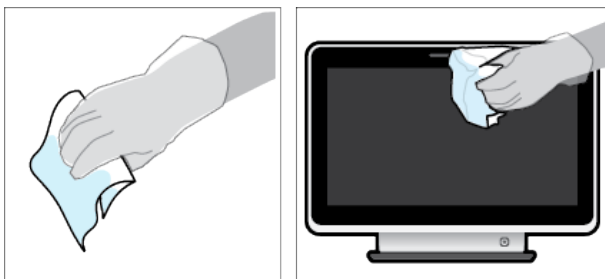
5. Ensure there is no liquid pooling around connection pins. If this happens, blot dry with a cotton swab or soft non-linting cloth.



6. 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.



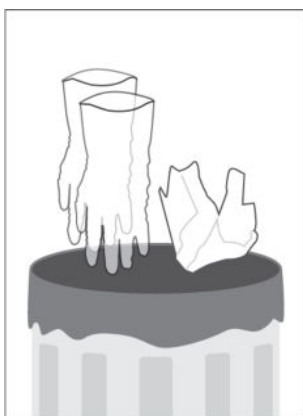
7. If required, wipe the device for 30 seconds using a sterile, soft, non-linting cloth saturated with lukewarm tap (utility) water.



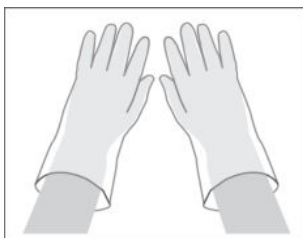
8. Allow the device to air dry until it is visibly dry. Drying times may vary based on the environmental conditions.



9. Discard disposable wipes and gloves according to your professional healthcare facility guidelines. Do not reuse wipes or gloves.



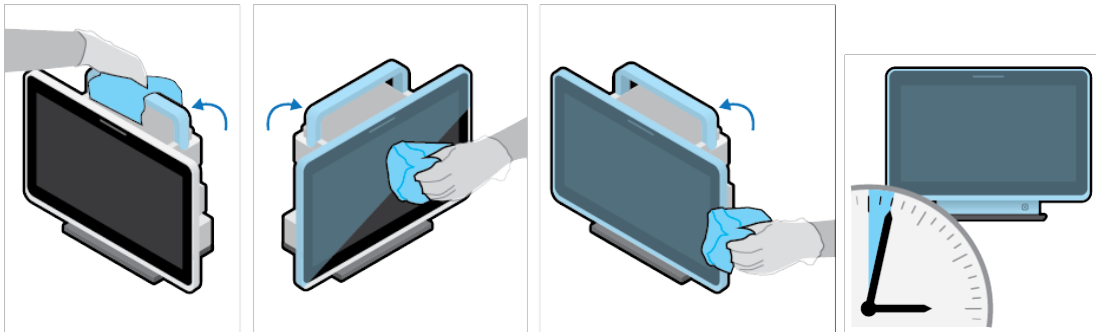
10. Start disinfection by putting on new disposable gloves and any other Personal Protective Equipment (PPE) recommended by your professional healthcare facility guidelines.



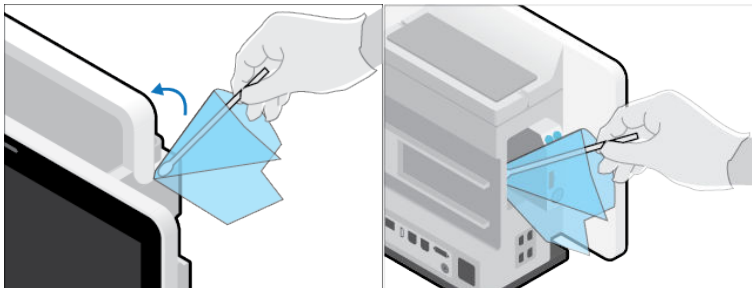
11. Get a new wipe or dampen a soft non linting cloth with one of the permitted disinfectants.



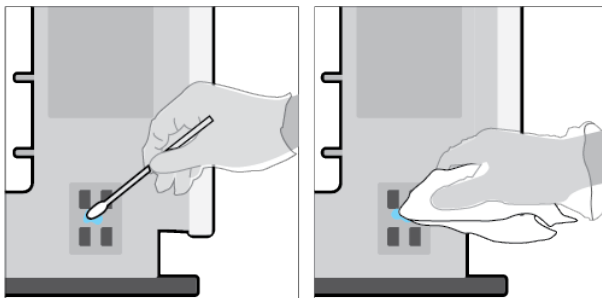
12. Wipe the device surface. Make sure all surfaces are uniformly wiped. Treated surfaces must remain visibly wet for a minimum of two minutes (Super Sani-Cloth) or according to the disinfectant manufacturer's instructions. To ensure this, use additional disinfectant wipes as necessary.



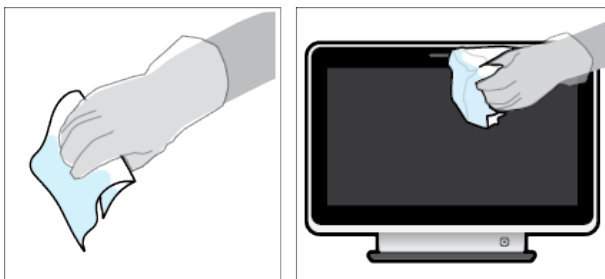
Pay special attention to hard-to-clean areas like grooves and crevices. If needed, scrub these areas with a cotton swab inside a wipe.



13. Ensure there is no liquid pooling around the pins. If this happens, blot dry with a cotton swab or soft non-linting cloth.



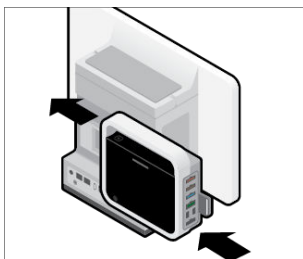
14. If required, wipe the device for 30 seconds using a sterile, soft, non-linting cloth saturated with lukewarm critical water.



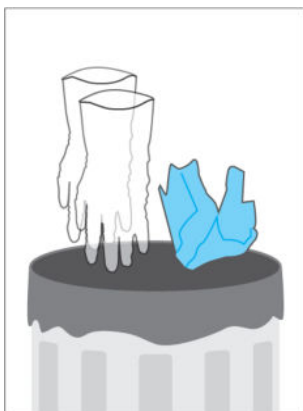
15. Allow the device to air dry until it is visibly dry. Drying times may vary based on the environmental conditions.



16. If needed, put on new gloves and reconnect the device (attach the Hub to Dock).



17. Discard disposable wipes and gloves according to your professional healthcare facility guidelines. Do not reuse wipes or gloves.

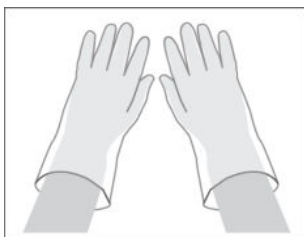


Cleaning and disinfecting the Mini Dock between patients

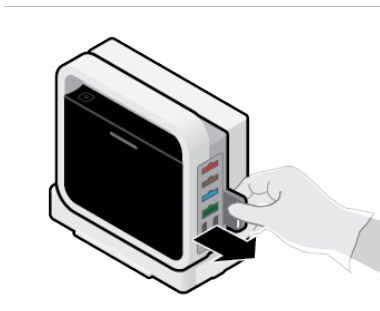
NOTE

Clean the devices thoroughly prior to disinfection. Follow these instructions.

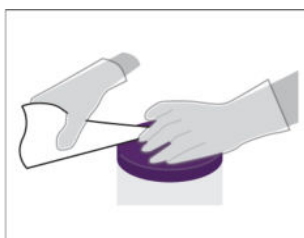
1. Put on new disposable gloves and any other Personal Protective Equipment (PPE) recommended by your professional healthcare facility guidelines.



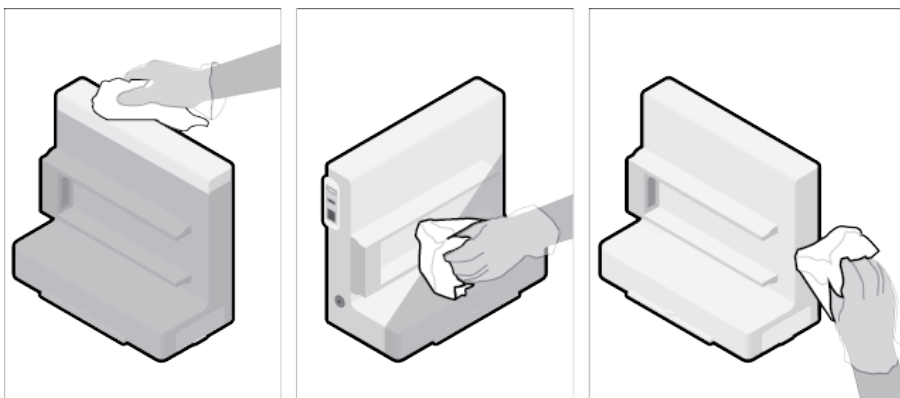
2. If needed, disconnect the device (remove the Hub from Mini Dock).



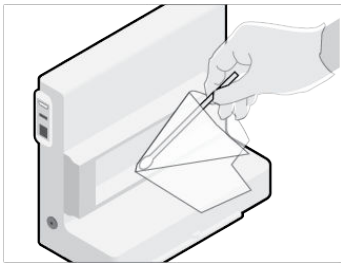
3. Get a new wipe or dampen a soft non linting cloth with one of the permitted detergents.



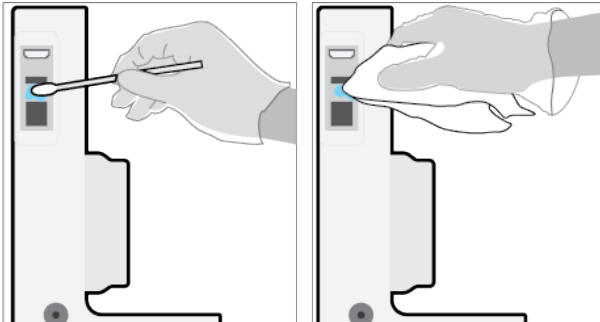
4. Wipe the device's exterior surface. Remove any soil by wiping the device until soil and organic matter have been visibly removed.



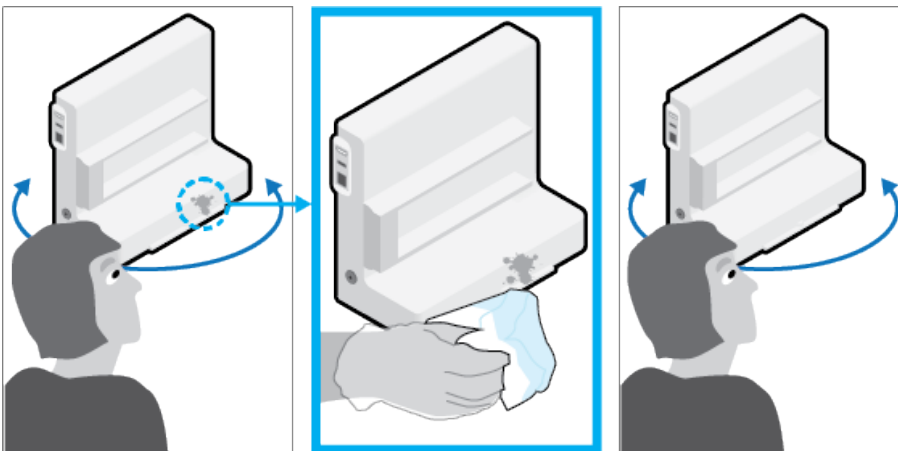
Pay special attention to hard-to-clean areas like grooves and crevices. Scrub these areas with a cotton swab inside a wipe.



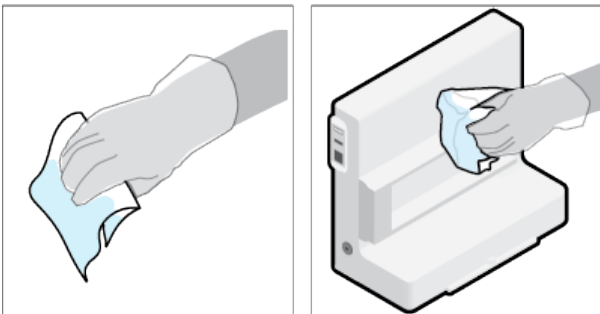
5. Ensure there is no liquid pooling around connection pins. If this happens, blot dry with a cotton swab or soft non-linting cloth.



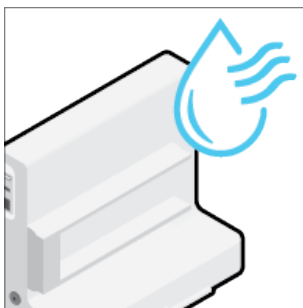
6. Inspect the device to ensure the complete removal of soil from surfaces, cavities, and movable parts. If visible soil remains, repeat cleaning procedure until the device is thoroughly clean.



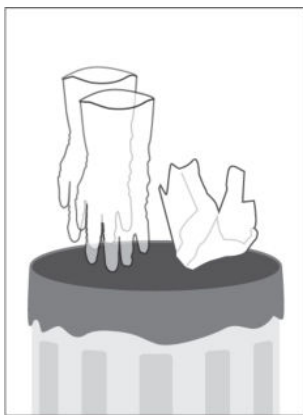
7. If required, wipe the device for 30 seconds using a sterile, soft, non-linting cloth saturated with lukewarm tap (utility) water.



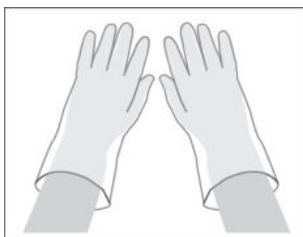
8. Allow the device to air dry until it is visibly dry. Drying times may vary based on the environmental conditions.



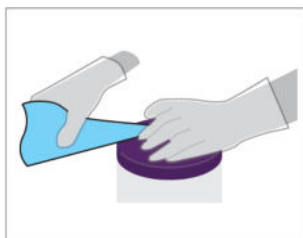
9. Discard disposable wipes and gloves according to your professional healthcare facility guidelines. Do not reuse wipes or gloves.



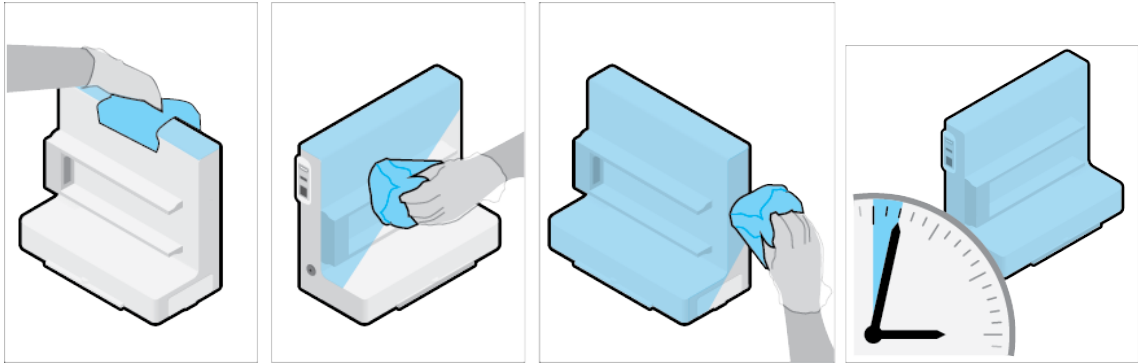
10. Start disinfection by putting on new disposable gloves and any other Personal Protective Equipment (PPE) recommended by your professional healthcare facility guidelines.



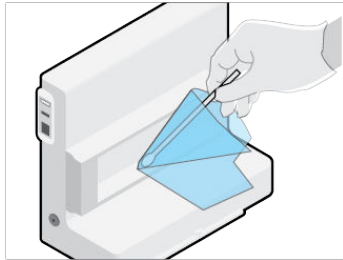
11. Get a new wipe or dampen a soft non linting cloth with one of the permitted disinfectants.



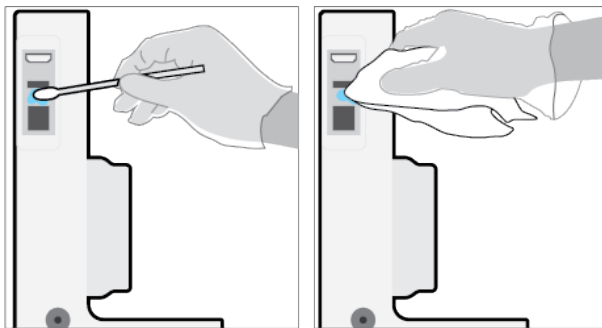
12. Wipe the device surface. Make sure all surfaces are uniformly wiped. Treated surfaces must remain visibly wet for a minimum of two minutes (Super Sani-Cloth) or according to the disinfectant manufacturer's instructions. To ensure this, use additional disinfectant wipes as necessary.



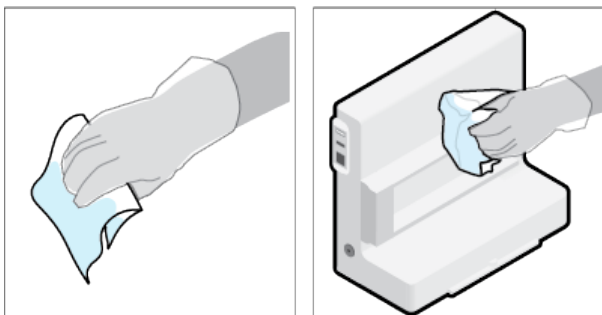
Pay special attention to hard-to-clean areas, like grooves and crevices. Scrub these areas using a cotton swab inside the wipe.



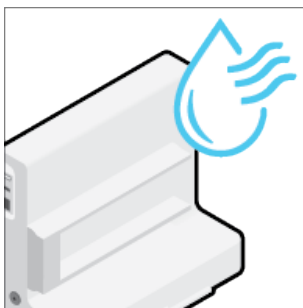
13. Ensure there is no liquid pooling around the pins. If this happens, blot dry with a cotton swab or soft non-linting cloth.



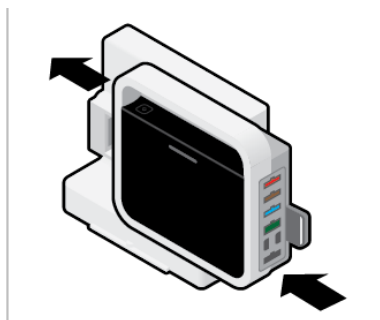
14. If required, wipe the device for 30 seconds using a sterile, soft, non-linting cloth saturated with lukewarm critical water.



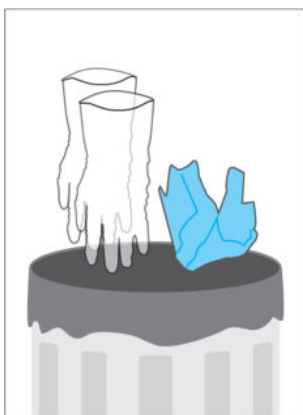
15. Allow the device to air dry until it is visibly dry. Drying times may vary based on the environmental conditions.



16. If needed, put on new gloves and reconnect the device (attach the Hub to Mini Dock).



17. Discard disposable wipes and gloves according to your professional healthcare facility guidelines. Do not reuse wipes or gloves.

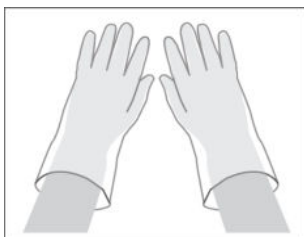


Cleaning and disinfecting the B1X5-F2 frame between patients

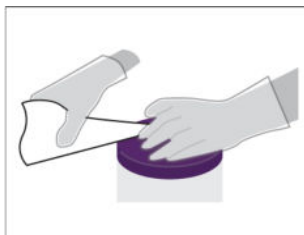
NOTE

Clean the devices thoroughly prior to disinfection. Follow these instructions.

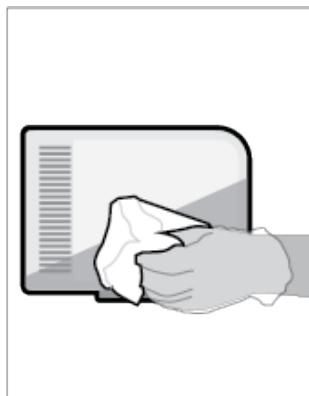
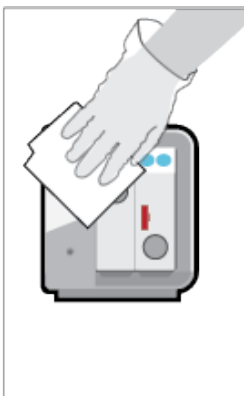
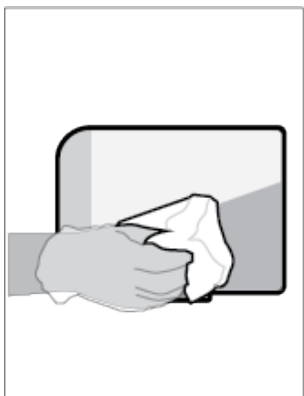
1. Put on new disposable gloves and any other Personal Protective Equipment (PPE) recommended by your professional healthcare facility guidelines.



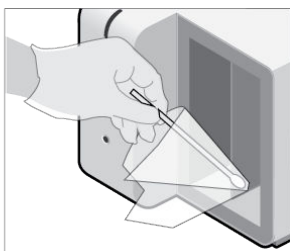
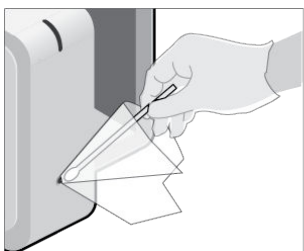
2. Get a new wipe or dampen a soft non linting cloth with one of the permitted detergents.



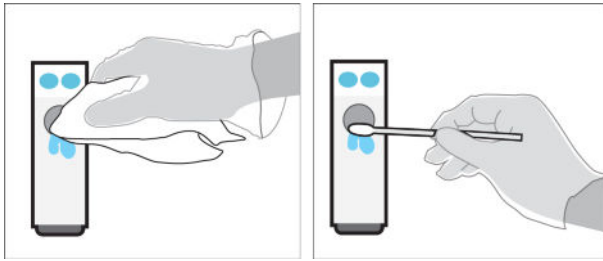
3. Wipe the device's exterior surface. Remove any soil by wiping the device until soil and organic matter have been visibly removed.



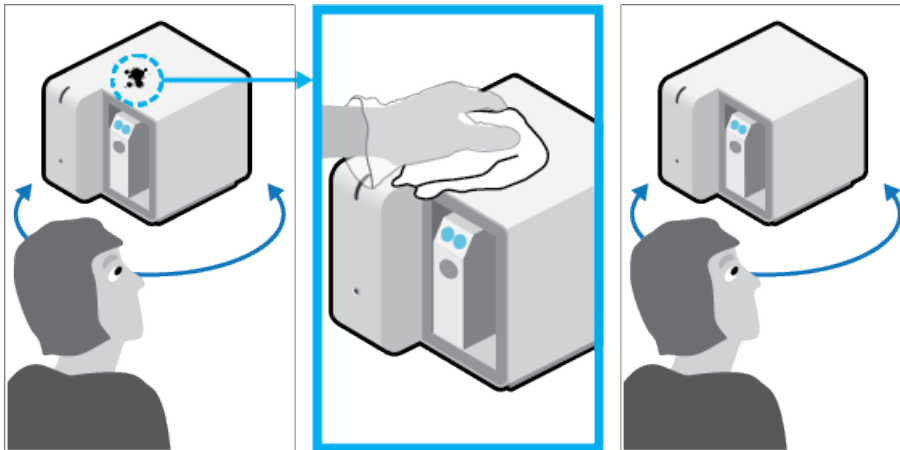
Pay special attention to hard-to-clean areas like grooves and crevices. Scrub these areas with a cotton swab inside a wipe.



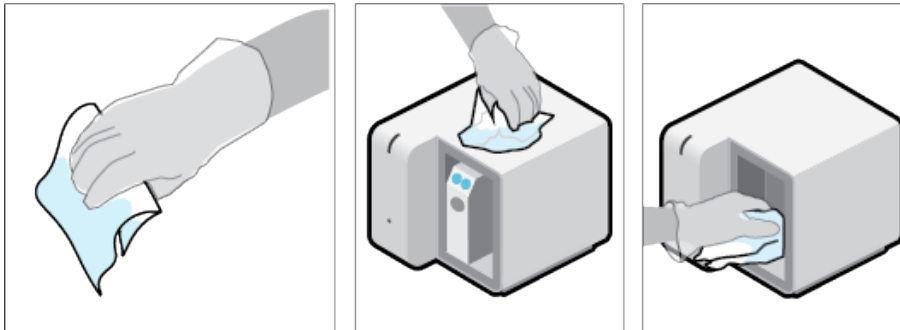
4. Ensure there is no liquid pooling around connection pins. If this happens, blot dry with a cotton swab or soft non-linting cloth.



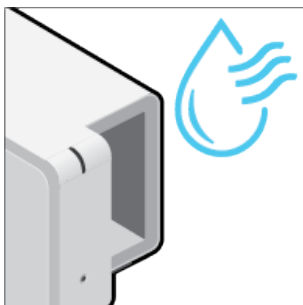
5. Inspect the device to ensure the complete removal of soil from surfaces, cavities, and movable parts. If visible soil remains, repeat cleaning procedure until the device is thoroughly clean.



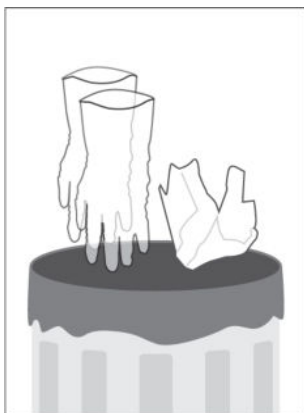
6. If required, wipe the device for 30 seconds using a sterile, soft, non-linting cloth saturated with lukewarm tap (utility) water.



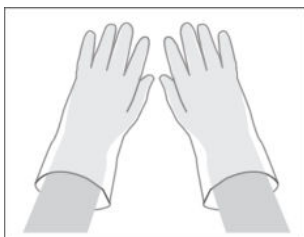
7. Allow the device to air dry until it is visibly dry. Drying times may vary based on the environmental conditions.



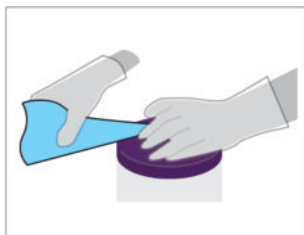
8. Discard disposable wipes and gloves according to your professional healthcare facility guidelines. Do not reuse wipes or gloves.



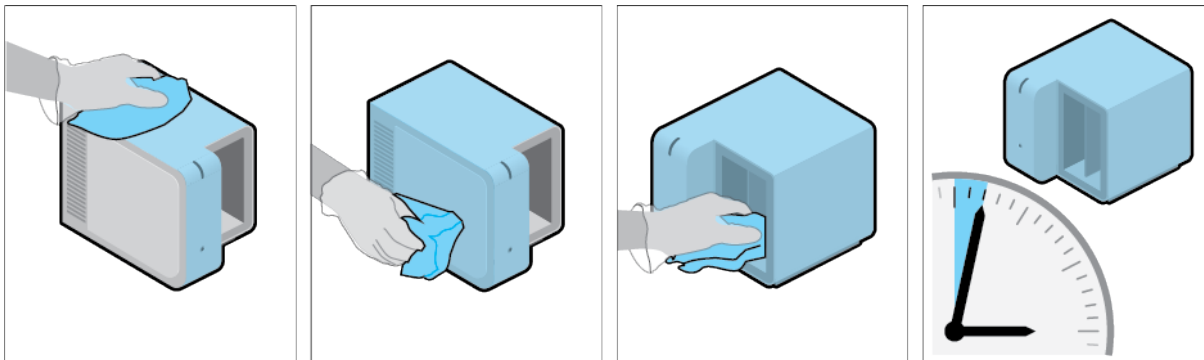
9. Start disinfection by putting on new disposable gloves and any other Personal Protective Equipment (PPE) recommended by your professional healthcare facility guidelines.



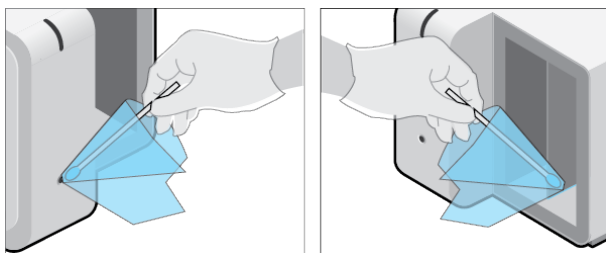
10. Get a new wipe or dampen a soft non linting cloth with one of the permitted disinfectants.



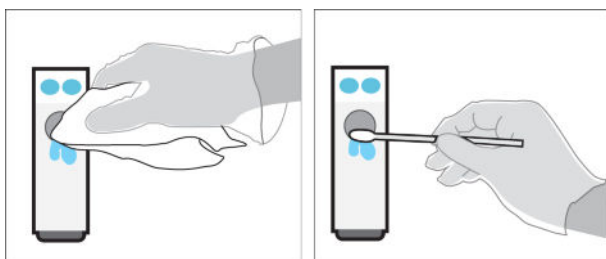
11. Wipe the device surface. Make sure all surfaces are uniformly wiped. Treated surfaces must remain visibly wet for a minimum of two minutes (Super Sani-Cloth) or according to the disinfectant manufacturer's instructions. To ensure this, use additional disinfectant wipes as necessary.



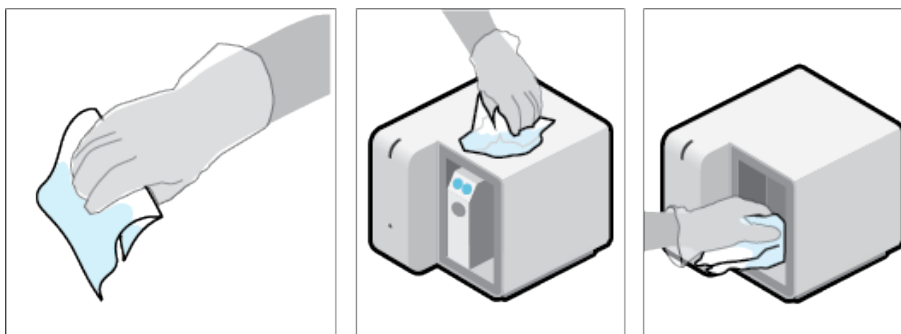
Pay special attention to hard-to-clean areas, like grooves and crevices. Scrub these areas using a cotton swab inside the wipe.



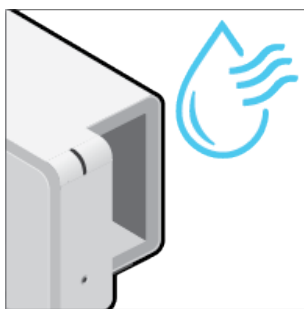
12. Ensure there is no liquid pooling around the pins. If this happens, blot dry with a cotton swab or soft non-linting cloth.



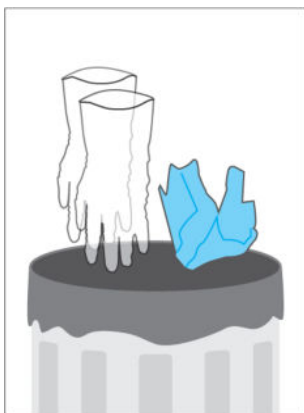
13. If required, wipe the device for 30 seconds using a sterile, soft, non-linting cloth saturated with lukewarm critical water.



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.

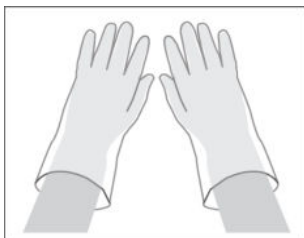


Cleaning and disinfecting the B1X5-REC recorder between patients

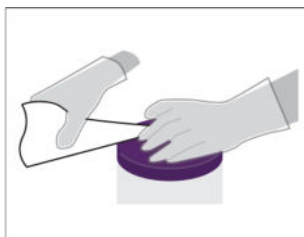
NOTE

Clean the devices thoroughly prior to disinfection. Follow these instructions.

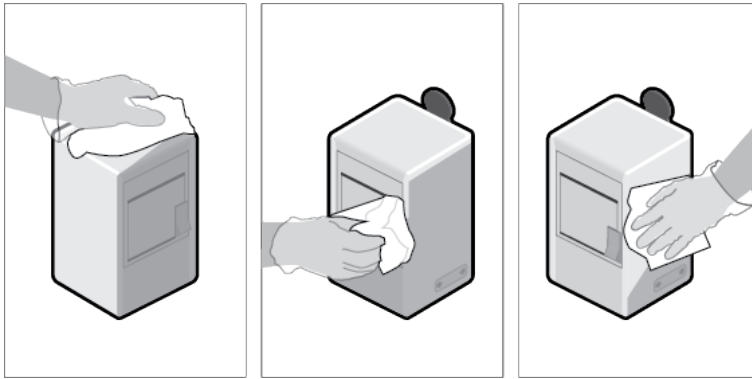
1. Put on new disposable gloves and any other Personal Protective Equipment (PPE) recommended by your professional healthcare facility guidelines.



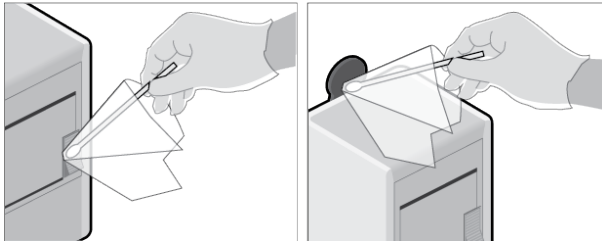
2. Get a new wipe or dampen a soft non linting cloth with one of the permitted detergents.



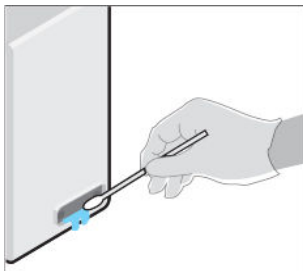
3. Wipe the device's exterior surface. Remove any soil by wiping the device until soil and organic matter have been visibly removed.



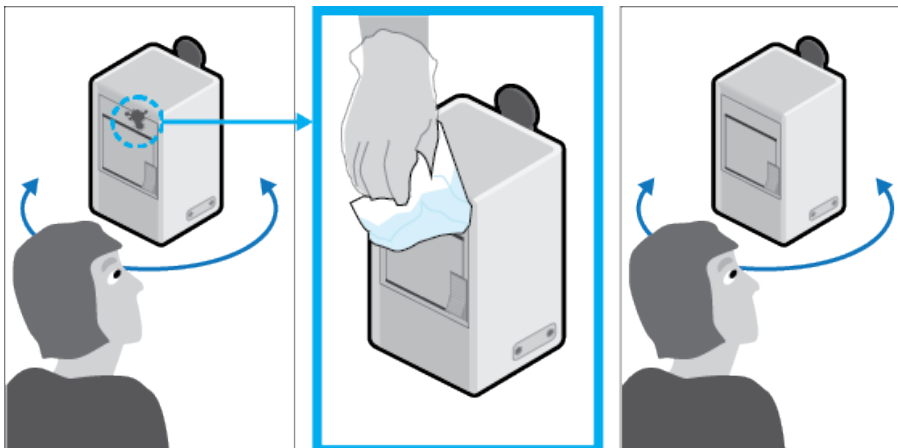
Pay special attention to hard-to-clean areas like grooves and crevices. Scrub these areas with a cotton swab inside a wipe.



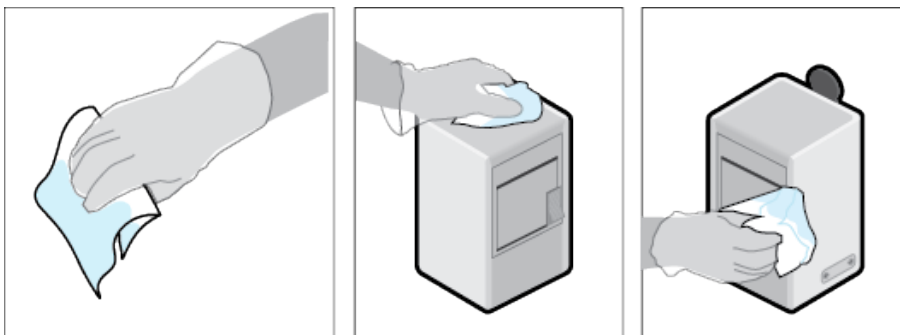
4. Ensure there is no liquid pooling around connection pins. If this happens, blot dry with a cotton swab or soft non-linting cloth.



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.



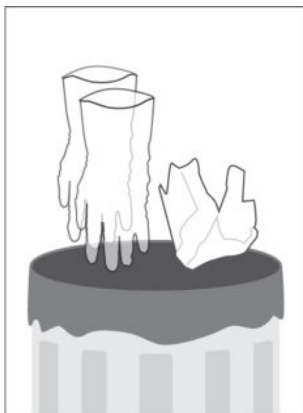
6. If required, wipe the device for 30 seconds using a sterile, soft, non-linting cloth saturated with lukewarm tap (utility) water.



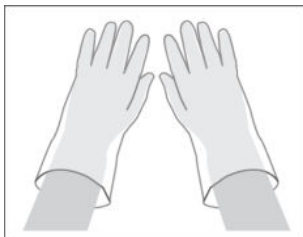
7. Allow the device to air dry until it is visibly dry. Drying times may vary based on the environmental conditions.



8. Discard disposable wipes and gloves according to your professional healthcare facility guidelines. Do not reuse wipes or gloves.



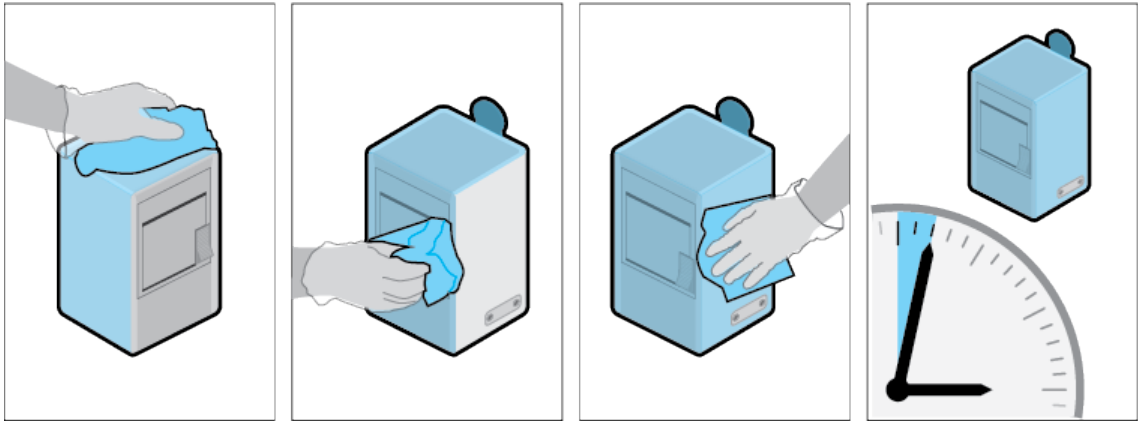
9. Start disinfection by putting on new disposable gloves and any other Personal Protective Equipment (PPE) recommended by your professional healthcare facility guidelines.



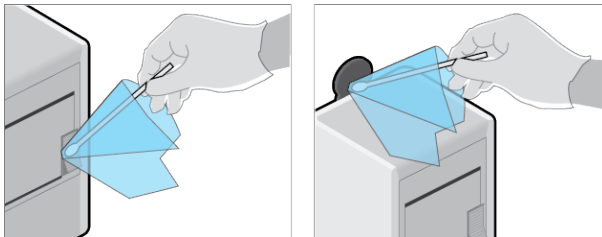
10. Get a new wipe or dampen a soft non linting cloth with one of the permitted disinfectants.



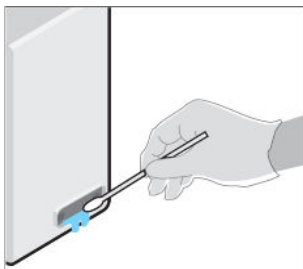
11. Wipe the device surface. Make sure all surfaces are uniformly wiped. Treated surfaces must remain visibly wet for a minimum of two minutes (Super Sani-Cloth) or according to the disinfectant manufacturer's instructions. To ensure this, use additional disinfectant wipes as necessary.



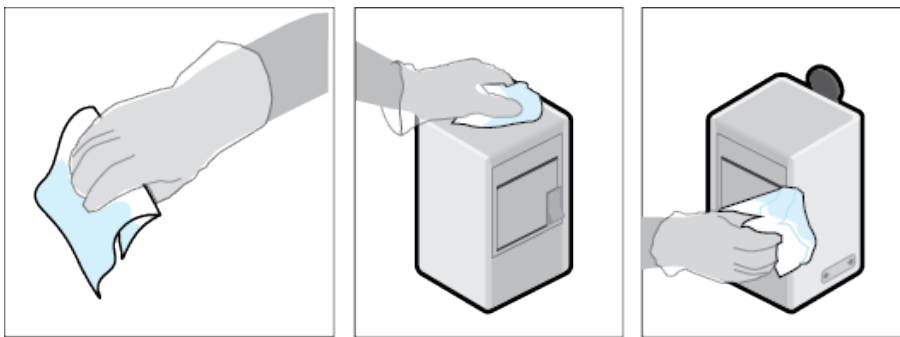
Pay special attention to hard-to-clean areas, like grooves and crevices. Scrub these areas using a cotton swab inside the wipe.



12. Ensure there is no liquid pooling around the pins. If this happens, blot dry with a cotton swab or soft non-linting cloth.



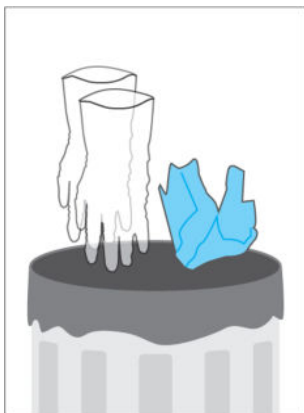
13. If required, wipe the device for 30 seconds using a sterile, soft, non-linting cloth saturated with lukewarm critical water.



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 17664-2. 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 device double-counting the heart rate, alarming for a low heart rate, or not detecting pacemaker spikes?	The device is not detecting pacemaker activity. Causes may include: • The pacemaker signal is too weak for the device to detect. • The ECG signal is too weak for the device to detect. • The device is detecting atrial pacemaker artifact or non-QRS features as beats. If the device 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 device alarming for asystole, bradycardia, or inaccurate heart rate when a visible QRS waveform is present?	The device 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 device 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 device.

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 device 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 device. • Make sure the sensor is attached to the interface cable and the cable is connected to the device. • 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 198 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 device 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 device 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 device 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 device detects the return of waveform and numeric data, the alarm will reset.
Why can't the device detect PA wedge?	The device must detect a 30% decrease in waveform amplitude to initiate a wedge. • Use the manual method for PA wedge measurement.
Why is the device 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 device displaying the Deflate the balloon message after the balloon was inflated?	The device 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 device. • 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 to use 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.

CO troubleshooting

Problem	Solution
CO 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 CO 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 CO 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 CO 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 CO 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 device 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 CO 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 CO 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 CO 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.

CCO troubleshooting

The following applies to transpulmonary thermodilution measurement.

Problem	Solution
CO measurement fails.	The amount of injectate is too small or the injectate is too warm. - Inject smoothly and within 4 to 5 seconds. - Add more injectate or use a colder injectate.
CCO/CCI values seem erroneous.	- Check that the arterial curve is of correct shape. - Check the catheter placement. - Remove any electromagnetic interference. - Ensure there is no interfering signal transmission.
What if the indexed values are not shown?	- Check that you have entered patient demographics. - Make sure that the patient weighs more than 15 kg (33 lb). - Check that you have toggled on Indexed.
What if a stable baseline temperature cannot be detected?	A message indicating a failure is displayed. - Check the patient and the 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 CO measurement, however, use caution and adhere to your care unit's policy 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.

PRAM CO troubleshooting

Problem	Solution
The CO Monitoring window does not show up.	Check the screen layout settings and ensure CO Monitoring has been selected. For more information, see Setting the split screen on page 109.
Dicrotic notch not detected, or not correctly detected.	- Check the invasive pressure connections. - Check the patient's condition. The cardiac output readings may be unreliable under specific pathological conditions when the dicrotic notch is not correctly detected for all consecutive heartbeats. In such cases, consider using an alternative method to measure the cardiac output.

Problem	Solution
What if the indexed values are not shown?	- Check that you have entered patient demographics. - Check that you have toggled on Indexed Values.

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.
E-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 module. - 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 (password protected) > Parameter Settings > Others > CO2 Numbers.

Spirometry troubleshooting

Problem	Solution
No measurement values	• Check that the device has license for this function. • Check connection to the anesthesia device if directly connected. • Check connection to the Unity Network Interface Device. • Check external device's status.
Values seem unstable or erroneous.	• The device only displays the reference data obtained from the external device. For more clinical troubleshooting, see the instructions for use of the external device.

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.

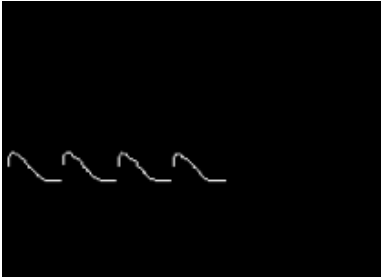
NMT troubleshooting

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.

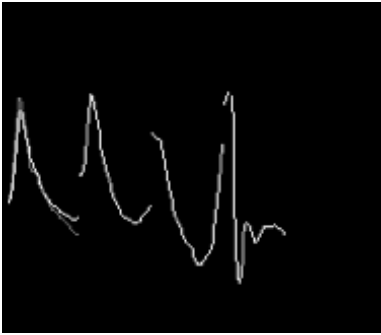
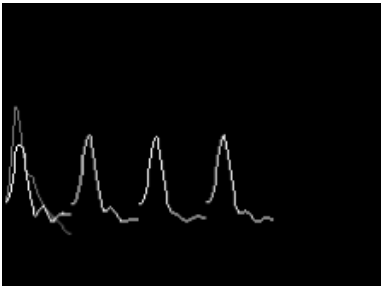
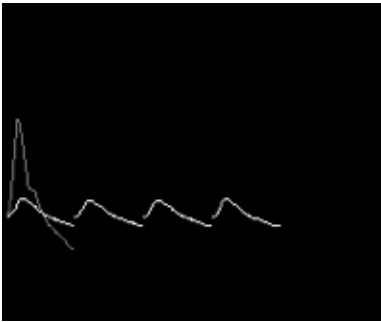
Faulty measurements with ElectroSensor

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.

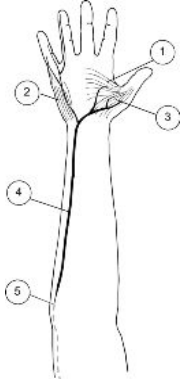
Faulty measurements with MechanoSensor

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.
	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.

Problem	Solution
What can I do if the device does not find the supramaximal stimulation current?	- If the device 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:  1. adductor pollicis 2. abductor digiti minimi (hypothenar) 3. flexor pollicis brevis (thenar) 4. ulnar medial 5. epicondyle - Also, supramaximal current may not be found if the patient has anatomical and/or physiological anomalies.
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.

Problem	Solution
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		
• 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.
• Asystole	• MF, WF	Physiological alarm.	• Check patient status.
• ASY	• DF		
• Brady	• MF, WF	Physiological alarm.	• Check patient status.
• ECG module error	• MF	The ECG module communication problem.	• If the problem persists, contact authorized service personnel.
• ECG measurements removed	• MF	Lost ECG measurement.	• If the problem persists, contact authorized service personnel.
• Frequent PVCs • Frequent SVCs	• MF, WF	Physiological alarm.	• Check patient status.
• 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.
• QT high	• MF	Measurement values are equal to or outside the alarm limits.	• Check the patient status. • Adjust alarm limits if necessary.
• QTc high	• MF	Measurement values are equal to or outside the alarm limits.	• Check the 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.
• A Fib	• MF, WF	Physiological alarm.	• Check patient status.
• Accel. Ventric.	• MF, WF	Physiological alarm.	• Check patient status.
• Bigeminy	• MF, WF	Physiological alarm.	• Check patient status.
• Couplet	• MF, WF	Physiological alarm.	• Check patient status.
• Irregular	• MF, WF	Physiological alarm.	• Check patient status.
• Missing Beat	• MF, WF	Physiological alarm.	• Check patient status.
• Multifocal PVCs	• MF, WF	Physiological alarm.	• Check patient status.
• Pause	• MF, WF	Physiological alarm.	• Check patient status.
• R on T	• MF, WF	Physiological alarm.	• Check patient status.
• SV Tachy	• MF, WF	Physiological alarm.	• Check patient status.

• Trigeminy	• MF, WF	Physiological alarm.	• Check patient status.
• V Brady	• MF, WF	Physiological alarm.	• Check patient status.
• VT > 2	• 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	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
• No pulse • No SpO₂ pulse	• DF • MF	No pulses detected.	• Try another measuring site.
• SpO₂ high • SpO₂ low	• MF	Measurement values are equal to or outside the set alarm limits.	• Check patient status. • Adjust alarm limits if necessary.
• Demo mode • SpO₂ demo mode	• DF • MF	Masimo SpO ₂ micro-module is in demo mode.	• Exit Demo mode. See the Service Manual. • If the problem persists, contact authorized service personnel.
• SpO₂ only mode	• MF, DF	Masimo SpO ₂ micro-module has no adequate signal for measurement. The sensor may be defective or poorly connected.	• Reposition sensor. • Replace sensor.
• Probe off • SpO₂ probe off	• DF • MF	The sensor may be defective or it is not connected to the patient.	• Check patient status. • Reposition the SpO₂ sensor. • Replace the SpO₂ sensor.
• Incompatible cable • Incompatible SpO₂ cable	• DF • MF	Masimo SpO ₂ micro-module has detected that an incompatible or unrecognized interconnect cable has been connected.	• Connect a Masimo compatible interconnect cable.
• No cable • No SpO₂ cable	• DF • MF	Interconnect cable is not connected to the Masimo SpO ₂ micro-module.	• Check the connection between the interconnect cable and SpO₂ micro-module.
• No probe • No SpO₂ probe	• DF • MF	Sensor is not connected to the device.	• Check the connection between the sensor and the device.
• No adhesive SpO₂ probe	• MF	Adhesive sensor is not connected to the SpO ₂ micro-module.	• Check the connection between the sensor and the SpO₂ micro-module.
• Check probe • Check SpO₂ probe	• DF • MF	There is no detectable SpO₂ signal, the sensor is faulty or is detached from the patient. With Nellcor SpO₂ micro-module this message also appears when the saturation updates exceed 30 seconds, the pulse rate is lost, or the pulse timeout condition occurs.	• Check the sensor and connections. • Check the patient status.

Message	Location	Possible causes	Suggested actions
- Faulty probe - SpO₂ faulty probe - Faulty adhesive SpO₂ probe	- DF - MF	The sensor has failed. The adhesive sensor has failed.	- Replace the sensor. - Replace the adhesive sensor.
- Faulty cable - SpO₂ faulty cable	- DF - MF	Masimo SpO ₂ micro-module has detected a defective interconnect cable.	Replace the interconnect cable.
- Incompatible probe - Incompatible SpO₂ probe - Incompatible adhesive SpO₂ probe	- DF - MF	The sensor is not compatible or it is not recognized. Adhesive sensor is not compatible or it is not recognized.	- Replace the sensor with a compatible one. - If the problem persists, contact authorized service personnel.
Probe initializing	DF	Masimo SpO ₂ micro-module has detected that the sensor is initializing.	SpO₂ monitoring will begin after initialization is complete.
Pulse search	DF	The measurement is starting normally. Defective or damaged sensor or cable. Sensor is off of the patient. Detection of a repeatable pulse has stopped. Pulse is not recognized by the algorithm due to a low amplitude signal.	- Wait for waveforms and parameter values to display. - Check the sensor and cable. - Reposition or replace sensor.
Artifact	DF	Artifact detected.	- Check sensor contact. - Reposition or replace sensor. - Request the patient to remain still.
Motion detected	DF	Patient movement detected.	Reposition sensor.
Low signal quality	DF	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.
Low Perfusion	DF	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	DF	The quality of the signal is questionable.	Check the sensor placement and the patient status.
- Check device - SpO₂ malfunction	- DF - MF	SpO₂ micro-module malfunction. No SpO₂ data detected.	If the problem persists, contact authorized service personnel.

Message	Location	Possible causes	Suggested actions
• Identical SpO2 device	• MF	Two or more SpO ₂ devices are connected to the system.	• Remove all but one SpO₂ device.
• Replace cable • Replace SpO2 cable	• DF • MF	Masimo SpO ₂ micro-module has detected that the interconnect cable has expired.	• Replace the interconnect cable.
• Expiring cable	• DF	Masimo SpO ₂ micro-module has detected that the interconnect cable is near its expiration date.	• Replace the interconnect cable.
• Replace probe • Replace SpO2 probe • Replace adhesive SpO2 probe	• DF • MF	Masimo SpO₂ micro-module has detected that the sensor has expired. Masimo SpO₂ micro-module has detected that the adhesive sensor has expired.	• Replace the sensor.
• Expiring probe	• DF	Masimo SpO ₂ micro-module has detected that the sensor or adhesive sensor is near its expiration date.	• Replace the sensor or adhesive sensor.
• SpO2 device failure: Call service	• MF	SpO ₂ micro-module startup or initialization failure.	• Reconnect the SpO₂ micro-module. • Replace the SpO₂ micro-module. • If the problem persists, contact authorized service personnel.
• Move SpO2 device to a cooler location	• MF	Surface temperature of the SpO ₂ micro-module is too high.	• Check the SpO₂ micro-module placement and ensure that it is not covered by anything that might lead to overheating. • Replace the SpO₂ micro-module.
• SpO2 device overheated Shutting down	• MF	The surface temperature of the SpO ₂ micro-module is too high and the device turns the SpO ₂ micro-module off.	• Check the SpO₂ micro-module placement and ensure that it is not covered by anything that might lead to overheating. • Replace the SpO₂ micro-module.
• Insufficient power for SpO2 device	• MF	There is not enough power for the SpO ₂ micro-module.	• Connect the acquisition platform to a host or use mains power. • Charge the device battery.
• STP module error	• MF	SpO ₂ module has encountered a communication problem.	• If the problem persists, contact authorized service personnel.
• Identical STP modules	• MF	Two or more STP modules are connected to the same monitor.	• Remove the identical STP modules.
• SpO2 measurement removed	• MF	SpO ₂ micro-module is disconnected.	• Connect an SpO₂ micro-module. • If the problem persists, contact authorized service personnel.

Messages related to SPI 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

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.
• NIBP cuff inflated	• DF	There may be some disturbances in the plethysmogram.	• See description of the measurement.
• 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.
• 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	• DF	Technical fault.	• Restart the device. • Contact authorized service personnel.
• NIBP malfunction	• 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.
• NIBP cuff loose	• MF		
• Cuff occlusion	• DF	Occlusion during measurement or overpressured cuff.	• Check the cuff.
• NIBP cuff occlusion	• MF		
• Cuff overpressure	• DF	NIBP cuff has exceeded the maximum cuff pressure during an NIBP measurement.	• Check NIBP cuff and hoses.
• NIBP cuff overpressure	• MF		
• 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 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.
• Select cuff size	• DF	Cuff size has not been selected.	• Select a valid cuff size from NIBP menu.
• NIBP alarm limits changed	• MF	The alarm limits have changed due to cuff size or user mode change.	• Check that the cuff size is correct. • Check that the new alarm limits are correct.
• NIBP cycling stopped	• MF	Automatic NIBP mode is stopped because of a loose cuff or cuff hose, or because there is a module communication failure, or because the cuff size has changed to not selected.	• Check the cuff and cuff hose. • Restart the Automatic NIBP mode.

Message	Location	Possible causes	Suggested actions
• NIBP STAT stopped	• MF	Continuous for 5 Min mode is stopped because of a loose cuff or cuff hose, or because there is a module communication failure, or because the cuff size has changed to infant or not selected.	• Check the cuff and cuff hose. • Restart the Continuous for 5 Min mode.
• NIBP over range • NIBP under range	• MF	At least one measurement value (systolic, diastolic, or mean) is outside the NIBP display range.	• Start a new measurement.
• NIBP air leakage	• MF	Air leakage in cuff or hose.	• Check the cuff and hose connection.
• Zeroing	• DF	Zeroing is in progress.	• Wait until zeroing is completed.
• Zeroed	• DF	Zeroing is completed.	• No action required.
• Calibrating	• DF	Calibration is in progress.	• Wait until the message disappears before starting a measurement.
• Calibrated	• DF	Channel calibrated successfully.	• No action required.
• Calibration error	• DF	Calibration has failed.	• If the problem persists, contact qualified service personnel.
• Incompatible NIBP	• MF	The current NIBP firmware is incompatible with the device software.	• Contact qualified service personnel.
• Calibrate NIBP	• MF	NIBP needs calibration.	• Contact qualified service personnel.

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
• 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.

Message	Location	Possible causes	Suggested actions
• 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.
• 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.
• 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.
• 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.
• 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.
• 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.

Message	Location	Possible causes	Suggested actions
• 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.
• Fem Sys high • Fem Sys low • Fem Mean high • Fem Mean low • Fem Dia high • Fem Dia low	• MF	Measurement values are equal to or outside the set alarm limits.	• Check patient status. • Adjust alarm limits if necessary.
• FemV Sys high • FemV Sys low • FemV Mean high • FemV Mean low • FemV Dia high • FemV Dia low	• MF	Measurement values are equal to or outside the set alarm limits.	• Check patient status. • Adjust alarm limits if necessary.

Message	Location	Possible causes	Suggested actions
• 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 • IBP3 Mean high • IBP3 Mean low • IBP4 Mean high • IBP4 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.

Message	Location	Possible causes	Suggested actions
• ABP X sensor disconnected • Art X sensor disconnected • CVP X sensor disconnected • ICP X sensor disconnected • LAP X sensor disconnected • PA X sensor disconnected • RAP X sensor disconnected • RVP X sensor disconnected • UAC X sensor disconnected • UVC X sensor disconnected • Fem X sensor disconnected • FemV X sensor disconnected • IBP1 X sensor disconnected • IBP2 X sensor disconnected • IBP3 X sensor disconnected • IBP4 X sensor disconnected • IBP8 X sensor disconnected Where X = 1, 2, 3, 4 or 8	• MF	• IBP connector: The cable is disconnected from Hub. • E-module: The transducer detected a disconnection or the cable is disconnected from the E-module. • Micro-module connectors: The transducer detected a disconnection.	• Check the patient status. • Check connections. • Acknowledge the alarm if you are intentionally disconnecting the invasive pressure line.
• 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.
• 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.
• 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.

Message	Location	Possible causes	Suggested actions
• Over range > 320 mmHg • Over range > 43 kPa	• DF		• If the problem persists, contact authorized service personnel.
• P1 under range • P2 under range • P8 under range	• MF	Measurement is under range, or the sensor is faulty.	• 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	Transducer has not been zeroed correctly.	
• STP measurements removed	• MF	Lost TruSignal SpO ₂ , Temperature, IBP measurement.	• Restart device. • If the problem persists, contact authorized service personnel.
• ABP disconnect • Art disconnect • UAC disconnect • Fem disconnect	• MF	Invasive pressure line is disconnected.	• Check patient status. • Check connections. • If pressure drops because of zeroing, perform the zeroing process.
• Disconnected	• DF	Invasive pressure line is disconnected.	• Check patient status. • Check connections. • If pressure drops because of zeroing, perform the zeroing process.
• Identical P8 modules	• MF	E-modules: There are two or more identical IP modules mapping to the same channel in the system.	• Remove identical IP modules mapping to the same channel.
• Pressure measurement removed	• MF	The acquisition device has been removed.	• Reconnect if necessary.
• Check device	• DF	The TruSignal Pressure micro-module has malfunctioned.	• Reconnect the TruSignal Pressure micro-module. • Check the patient status. • Check connections. • If the problem persists, contact qualified service personnel.
• P3 pressure malfunction • P4 pressure malfunction	• MF	The TruSignal Pressure micro-module has malfunctioned.	• Reconnect the TruSignal Pressure micro-module. • Check the patient status. • Check connections. • If the problem persists, contact qualified service personnel.

Message	Location	Possible causes	Suggested actions
• sensor failed	• DF	Faulty or disconnected sensor or transducer.	• Check cable and transducer connections. • Replace the transducer.
• ABP X sensor failed • Art X sensor failed • CVP X sensor failed • ICP X sensor failed • LAP X sensor failed • PA X sensor failed • RAP X sensor failed • RVP X sensor failed • UAC X sensor failed • UVC X sensor failed • Fem X sensor failed • FemV X sensor failed • IBP3 X sensor failed • IBP4 X sensor failed Where X = 3 or 4	• MF	Faulty or disconnected sensor or transducer.	• Check cable and transducer connections. • Replace the transducer.
• Device overheating	• DF	The TruSignal Pressure micro-module surface temperature is too high.	• Check the TruSignal Pressure micro-module placement and ensure that it is not covered by anything that might lead to overheating. • If the problem persists, replace the TruSignal Pressure micro module.
• Move pressure device 3/4 to a cooler location	• MF	The TruSignal Pressure micro-module has malfunctioned.	• Reconnect the TruSignal Pressure micro-module. • Check the patient status. • Check connections. • If the problem persists, contact qualified service personnel.
• Pressure device overheated. Shutting it down	• MF	The Tru-Signal Pressure micro-module is turned off because its surface temperature is too high.	• Check the TruSignal Pressure micro-module placement and ensure that it is not covered by anything that might lead to overheating. • If the problem persists, replace the TruSignal Pressure micro-module.
• Pressure device failure: Call service	• MF	Faulty TruSignal Pressure micro-module.	• Reconnect the TruSignal Pressure micro-module. • Replace the TruSignal Pressure micro-module. • If the problem persists, contact qualified service personnel.

Message	Location	Possible causes	Suggested actions
• Identical pressure devices	• MF	There are two or more TruSignal Pressure micro-modules connected.	• Remove all but one TruSignal Pressure micro-module.
• Pressure device initializing	• MF	New software is being downloaded to the TruSignal Pressure micro-module.	• Wait. The message will clear when the download is complete.
• 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.
• Calibrated	• Menu	Channel calibrated successfully.	• Wait until the message disappears before starting a measurement.
• Zeroing	• DF	IBP channel is currently being zeroed.	• No action required. Message is automatically removed and replaced with the zeroing results after completion.
• 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.
• 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.
• Zero adj > 100 mmHg	• DF	IBP channel zeroed to over 100 mmHg pressure.	• Repeat the transducer zeroing. • Replace the sensor. • Replace the transducer. • Rezero the pressure channel.
• Zeroed	• DF	Zeroing was successful.	• No action required. Message is automatically removed after 10 seconds.
• Pressure Sensed	• DF	Pressure pulsation has been sensed during zeroing.	• Open the venting stopcock to air. • Rezero.

Message	Location	Possible causes	Suggested actions
Artifact	DF	If Smart BP is enabled, this is normal behavior when zeroing, flushing, or sampling is performed. If Smart BP is not enabled, this message indicates that the measurement is disturbed by artifact. Systolic and diastolic numerics are also invalidated if an artifact event is detected while Smart BP is enabled.	- Check the patient status. - Check cable contact. - Minimize tubing length. - Rezero the transducer.

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 TruSignal SpO ₂ , Temperature, IBP measurement.	- Restart device. - 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 cardiac output 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
• CO measurement removed	• MF	E-COP or E-PiCCO module has been removed.	• Reconnect the module if necessary.
• CO module error	• MF	Communication between monitor and module contain errors.	• Reconnect the module. • If the problem persists, contact authorized service personnel.
• Identical CO modules	• MF	There are two or more CO modules in the system.	• Remove all but one CO module.
• Confirm CO	• DF, MF	The CO measurement is stopped within 30 minutes since it started, or when the measurement data has not been confirmed.	• Perform a new measurement.
• Service CO 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.
• Incompatible COP	• MF	Incompatible E-COP module is connected.	• Connect a compatible E-COP module.

Messages related to continuous cardiac output 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
• CCI high • CCI low	• MF	Measurement values are equal to or outside the alarm limits.	• Check the patient status. • Adjust alarm limits if necessary.
• CCO high • CCO low	• MF	Measurement values are equal to or outside the alarm limits.	• Check the patient status. • Adjust alarm limits if necessary.
• CO measurement removed	• MF	E-COP or E-PiCCO module has been removed.	• Reconnect the module if necessary.
• Identical CO modules	• MF	There are two or more CO modules in the system.	• Remove all but one CO module.
• Re-calibrate CCO	• DF • MF	The CCO calibration was performed more than 8 hours ago or the alarm was acknowledged more than 4 hours ago.	• Perform calibration.
• Calibrating	• DF	Calibration is in progress.	• No action required.

Message	Location	Possible causes	Suggested actions
• CCO meas. fail	• DF	Calibration has failed.	- Perform new calibration. - If the problem persists, contact authorized service personnel.
• Not calibrated	• DF	The module and cable are connected, but the CCO measurement has not been calibrated.	Perform calibration.
Confirm calibration Confirm CCO Calibration	- DF - MF	Measurement data has not been confirmed before trying to exit the Continuous Cardiac Output / CCO > Calibrate menu. If more than 30 minutes has passed since the start of the measurement, this message resets automatically.	Select Confirm CO & Calibrate.
• No CCO catheter	• MF	The catheter is disconnected from the cable, or the cable is disconnected from the module.	Check connections.
• Service CO 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.

Messages related to PRAM cardiac output 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
CI high CI low	• MF	Measurement values are equal to or outside the alarm limits.	- Check the patient status. - Adjust alarm limits if necessary.
CO high CO low	• MF	Measurement values are equal to or outside the alarm limits.	- Check the patient status. - Adjust alarm limits if necessary.

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
• Apnea • Apnea (CO2) • APN	• WF • MF • DF	No breathing detected.	• Check patient status. • Check the ventilator and breathing status.
• Apnea (Anes CO2)	• MF	No breathing detected.	• Check patient status. • Check the equipment connections.
• EtCO2 high • EtCO2 low • EtO2 high • EtO2 low • EtHal high • EtEnf high • EtIso high • EtSev high • EtDes high • EtHal high • 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.
• 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.
• FiN2O high • FiN2O low	• MF	Measurement values are equal to or outside the alarm limits.	• Check patient status.
• Gas module standby	• MF	Acquisition module has shut down the gas pump.	• No action required.
• Standby	• DF		• To exit the standby mode, touch any field of screen. • If needed, you can also turn on the pump from CO₂ menu.

Message	Location	Possible causes	Suggested actions
- Gas module standby. Touch to activate. - Gas module standby. Start from CO2 menu.	WF		
Sample line blocked	MF, WF, DF	The gas sampling line is blocked or the water trap is occluded.	Change sampling line and water trap.
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 disconnected - Line disconnected	- MF - DF	The sample line is disconnected.	Check the sample line connection and reconnect as needed.
Insufficient power for CO2 device	MF	There is not enough power for the gas module.	Remove other connected devices if possible.
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		
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.
Replace water trap	MF	Water trap is partially blocked.	Replace the water trap.
Gas measurements removed	MF	Acquisition module has been removed.	Connect the module if you want to restart the measurement.
CO2 measurements removed	MF	The Microstream CO ₂ micro-module is disconnected.	Connect the Microstream CO₂ micro-module if you want to restart the measurement.
Identical gas modules	MF	There are two or more identical gas modules in the system.	Remove all but one gas modules.
Identical CO2 device	MF	There is more than one Microstream CO ₂ micro-module in the system.	Remove all but one Microstream CO₂ micro-module.
- Select age - Select age for CO2	- DF - MF	The age of the patient must be selected before starting the measurement with the Microstream CO ₂ micro-module.	Select the age of the patient and start the measurement.
- Check flow - Check gas flow	- DF - MF	The sample flow rate is lower or higher than the nominal flow due to an obstruction in the gas exhaust or leak.	- Check the measurement setup and gas exhaust. - If the pump has shut down, disconnect and then reconnect the accessory to restart the pump.
Calibrating	DF	Calibration of the Microstream CO ₂ micro-module is in progress.	No action required.

Message	Location	Possible causes	Suggested actions
• Zeroing	• DF • MF	Zeroing is in progress.	• Wait until the zeroing is completed and the message disappears.
• Sensor overheating • Move CO2 sensor to a cooler location	• DF • MF	The internal temperature of Microstream CO ₂ micro-module is too high.	• Check the Microstream CO₂ micro-module placement and ensure that it is not covered by anything that might lead to overheating. • If the problem persists, replace the module or device. • Contact qualified service personnel.
• CO2 sensor overheated Shutting down	• MF	The Microstream CO ₂ micro-module sensor temperature is too high and the measurement device is turned off.	• Check the Microstream CO₂ micro-module placement and ensure that it is not covered by anything that might lead to overheating. • If the problem persists, replace the device. • Contact qualified service personnel.
• 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.
• 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.
• Check sensor	• DF	There is a problem with the Microstream CO ₂ micro-module.	• If the problem persists, replace the Microstream CO₂ micro-module. • Contact qualified service personnel.
• Service CO2 sensor	• MF	There is a problem with the Microstream CO ₂ micro-module.	• If the problem persists, replace the Microstream CO₂ micro-module. • Contact qualified service personnel.
• CO2 over scale	• WF	Gas signal exceeds the maximum waveform field.	• Check patient status. • Select a larger scale for waveform.

Message	Location	Possible causes	Suggested actions
• CO2 device failure: Call service	• MF	Microstream CO ₂ micro-module startup or initialization failure.	• Reconnect the CO₂ micro-module. • Replace the CO₂ micro-module. • Contact qualified service personnel.
• Check device • CO2 device malfunction	• DF • MF	Microstream CO₂ micro-module startup or runtime failure. Microstream CO₂ micro-module is in the software download mode.	• Reconnect the Microstream CO₂ micro-module. • Replace the Microstream CO₂ micro-module. • Contact qualified service personnel.
• Calibration required	• DF	Microstream CO ₂ micro-module needs calibration.	• Contact qualified service personnel.
• Warming up	• DF	The Microstream CO ₂ micro-module is warming up.	• Wait until the warm-up is completed and the message disappears.
• Over range	• DF • MF	The gas value is outside the specified range. The CO₂ value is outside the measurable range and cannot be measured.	• If the problem persists, replace the Microstream CO₂ micro-module. • Contact qualified service personnel.
• Purging	• DF	External device needs checking.	• Check the external device. • If the problem persists, contact qualified service personnel.
• CO2 measurement purging	• MF	There is a blockage in the sample line of the Microstream CO ₂ micro-module.	• Remove the blockage. • Replace the sample line.
• 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 device detects 3 breaths during the last minute.
• Calibrating gas sensor	• WF	Due to the module warm-up, O ₂ , CO ₂ , N ₂ O and anesthetic agent measurements are not available immediately after the module has been connected.	• Wait until the warm-up has been completed.
• Agent Mixture	• MF	Mixture of halogenated agents is detected.	• Check the ventilator and agent vaporizer settings.
• CO2 inaccurate	• MF	For E-sC(Ai)O and N-CAiO module: CO₂ inaccurate and FiO₂ ≤ 100% For E-miniC module: EtCO₂ value > 20%.	• Check gas levels. • Check patient status.
• O2 inaccurate	• MF	O ₂ inaccurate and FiO ₂ ≤ 100%.	• Check gas levels. • 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.

Message	Location	Possible causes	Suggested actions
• 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.
• 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 O_2 flush ($\text{O}_2 +, 100\% \text{O}_2$). • Empty the vaporizer and refill from an unopened container.
• Ext:Apnea	• MF	No breathing detected.	• Check the patient status. • Check the external device tubing and breathing circuit for leaks or disconnections. • Check the external device.
• EtN2O high • EtN2O low	• MF	Measurement values are equal to or outside the alarm limits.	• Check the patient status.
• Zero error	• MF	Zeroing has failed.	• Re-zero. • If the problem persists, contact qualified service personnel.
• Calibration error	• DF	External device calibration failed.	• Contact qualified service personnel.
• No ext device	• DF	No data is received from the external device.	• Check the external device. • Check the instructions for use of external device.
• Check ext device	• DF	External device should be checked.	• Check the external device. • If the problem persists, contact qualified service personnel.
• Service Mode	• DF	External device needs checking.	• Contact qualified service personnel.
• Interface Failed	• DF	External device and Unity Network Interface Device should be checked.	• Check the external device. • If the problem persists, contact qualified service personnel.
• Service ext device	• DF	External device needs checking.	• Contact qualified service personnel.
• Calibrate system	• DF	External device needs calibration.	• Check the external device. • If the problem persists, contact qualified service personnel.
• Ext:Hardware error • Hardware Error	• MF • DF	External device is faulty.	• Replace the external device.
• Ext not supported	• DF	External device is not supported.	• See the Unity Network Interface Device User's Manual for supported devices. • If the problem persists, contact qualified service personnel.
• Barometric sensor fail	• MF	Fail to read value from barometric sensor.	• Restart the device. • If the problem persists, contact qualified 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 • PEEP low	• 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 device has been disconnected from the device.	• 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.
• No ext device • Vent: No ext device	• DF • MF	External device is not detected by Unity Network Interface Device.	• Check the external device. • If the problem persists, contact authorized service personnel.
• Ext not supported • Vent: Ext not supported	• DF • MF	External device is not supported.	• See the Unity Network Interface Device User's Manual for supported devices. • If the problem persists, contact authorized service personnel.
• Connecting • Vent: Connecting	• DF • MF	External device is being connected to the device through Unity Network Interface Device.	No action required.
• Vent: Apnea	• MF	No breathing detected.	• Check the patient status. • Check the external device.
• Ventilator interface removed	• MF	The cable between the Unity Network Interface Device and the external device has been removed.	• Reconnect the cable if you want to restart the external device.
• Vent: Check ventilator	• MF	The external device needs to be checked.	• Check the external device. • If the problem persists, contact authorized service personnel.

Message	Location	Possible causes	Suggested actions
• Vent: Low battery	• MF	External device needs to be checked.	• Check the external device. • If the problem persists, contact authorized service personnel.
• Vent: In Alarm	• MF	External device needs to be checked.	• Check the patient status. • Check the ventilator tubing and patient connection. • Check the external device.
• Vent: Disconnect	• MF	External device needs to be checked.	• Check the patient status. • Check the ventilator tubing and patient connection. • Check the external device. • If the problem persists, contact authorized service personnel.

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 causes	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.

Message	Location	Possible causes	Suggested actions
• 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		
• 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.
• Demo data	• DF, WF	Entropy simulator is connected instead of the Entropy sensor.	• Disconnect the Entropy simulator.
• Incompatible Entropy	• MF	Incompatible E-Entropy module is connected.	• Connect a compatible E-Entropy module.

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.
• 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.

Message	Location	Possible causes	Suggested actions
• 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.
• Incompatible NMT	• MF	Incompatible E-NMT module is connected.	• Connect a compatible E-NMT module.
• Artifact	• DF	Artifact detected.	• Check electrode placement • Start new TOF measurement.

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 causes	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.
• 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.
• 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 measurement removed	• MF	The module or BISx is disconnected.	• Connect the module or BISx to start the measurement.
• 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.
• BIS DSC error • DSC error	• MF • DF	The BISx is not communicating or operating properly.	• Test the BISx. • Replace the BISx unit.
• 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.

Message	Location	Possible causes	Suggested actions
• 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		
• No sensor	• WF, DF	The sensor is not connected to the digital signal processing unit BISx.	Check the sensor connection to BISx and PIC (patient interface cable).
• No BIS sensor	• MF		
• Poor signal	• WF, DF	The BIS cannot be calculated because the SQI is below 50.	Check electrode connections.
• 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		
• 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.
• Incompatible BIS	• MF	Incompatible E-BIS module is connected.	Connect a compatible E-BIS module.

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.

Message	Location	Possible causes	Suggested actions
• 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 does not recognized by device	• 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 X = snapshot sequence number Displays for 5 seconds	• 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 device 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.

Message	Location	Possible causes	Suggested actions
• 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.
• Hub Battery empty	• MF	The device is battery powered and less than 5 min of monitoring time is available with battery.	• Charge the battery by using the docking station on main power.
• Dock Battery empty	• MF	The device is battery powered and less than 10 min of monitoring time is available with battery.	• Charge the battery by connecting the Dock to the mains power.
• Hub Battery low • Dock 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 device on main power.
• Hub Battery temperature high • Dock 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.
• Hub Condition battery • Dock Condition battery	• MF	Battery is not working properly.	• Connect AC main to condition battery. • If the problem persists, contact authorized service personnel.
• CS Gateway communication failure	• MF	An error occurred when trying to search for patient on the Carescape 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.
• Hub frame temperature high • Dock frame temperature high	• MF	The temperature inside the frame is over 70°C/158 °F.	• Turn off the device, wait for it cool down. • Make sure there is sufficient ventilation. • Check and clean device ventilation holes.

Message	Location	Possible causes	Suggested actions
• Identical IP address noticed	• MF	Two or more devices on the network have the same IP address.	• Contact authorized service personnel.
• Identical unit&bed name noticed	• MF	Two or more devices in the network have the same unit and bed name.	• Disconnect the device that has the identical unit and bed name. • Change the unit and bed name of the duplicate device 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 device with alarm notification enabled is disconnected from the network.	• Re-establish the connection.
• Motion Sensor Start Failed	• MF	The motion sensor for alarm gesture start failed for 10 times continuously.	• Restart the device. • If the problem persists, contact authorized service personnel.
• Network: HL7	• MF	When network connection between HL7 TCP Client application and device is made.	• No action required.
• Network down: HL7	• MF	No HL7 TCP Client is configured to connect to device on the network.	• Try to re-establish the connection. • If the problem persists, contact authorized service personnel.
• 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 Hub battery backup • No Dock 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 device.	• 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.

Message	Location	Possible causes	Suggested actions
• 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 Hub battery • Replace Dock battery	• MF	Battery is not working properly.	• Replace the battery.
• Restart the monitor.	• MF	The device should be restarted.	• Restart the device.
• 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.
• 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.
• Continue/Discharge	• MF	The device restart has occurred.	• Check the patient status. • Continue monitoring by pressing Continue Current , or discharge the patient by pressing Discharge Patient .
• Power Failure	• MF	The device has lost communication with the power management controller.	• Restart the device. • If the problem persists, contact authorized service personnel.

Message	Location	Possible causes	Suggested actions
Voltage out of range	MF	One of the internal supply voltage is out of the specification. The message stays on screen as long as the condition is valid.	- Restart the device. - If the problem persists, contact authorized service personnel.
Faulty Micro-module connector #x Where x = Micro-module connector number	MF	The device is detecting a fault on the Micro-module connector.	Contact qualified service personnel.
Unknown device in Micro-module connector #x Where x = Micro-module connector number	MF	- An unauthorized device connected to one of the Micro-module connectors is detected. - Faulty Micro-module.	- Disconnect the unauthorized device. - Replace the faulty Micro-module.
Faulty device in Micro-module connector #x Where x = Micro-module connector number	MF	The device is detecting a failure in the Micro-module connected to connector #x, caused by: - An over current condition - Repeated over temperature faults - Repeated communication failures	- Disconnect the Micro-module from the device and reconnect it. - Replace the Micro-module Cable. - For the Masimo SpO2 micro-module, remove and replace the patient cable.
Faulty Micro-module connected	MF	One of the connected Micro-modules has a communication failure.	Identify and replace the Micro-module causing the communication failure.
SW update in progress on Micro-module connector #x Where x = Micro-module connector number	MF	Software update in progress. One of the connected Micro-modules is updating software from the device.	- Wait until the software update to the Micro-module is successfully completed and the message disappears from the device screen. This may take up to 1 minute. - Do not disconnect the Micro-module from the device before the software update is completed.
SW download failed on Micro-module connector #x Where x = Micro-module connector number	MF	Software update to a Micro-module failed.	- Replace the Micro-module. - If the problem persists, contact authorized service personnel.
Call service Micro-module secure data corrupt	MF	Data in secure storage corrupt.	Contact qualified service personnel.
Call service Micro-module write secured data error	MF	Error occurred writing data to secured storage.	Contact qualified service personnel.
Call service Micro-module initiate security failure	MF	Initialization of platform security library returned an invalid directory error code.	Contact qualified service personnel.

Message	Location	Possible causes	Suggested actions
• Call service Micro-module system error	• MF	Micro-module communication error, and Micro-module communication is disabled.	• Restart the device. • If the problem persists, contact authorized service personnel.

Abbreviations

List of abbreviations

The abbreviations that appear in the device 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
CI	cardiac index
CO	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
CPAP+PSV	continuous positive airway pressure plus pressure supported ventilation
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

FiO2	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
PCV-VG	Pressure Control Ventilation – Volume Guaranteed
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
PEEPe	extrinsic positive end expiratory pressure (ICU, NICU, ED software packages)
PEEPe+PEEPi	total positive end expiratory pressure (ICU, NICU, ED software packages)

PEEPi	intrinsic positive end expiratory pressure (ICU, NICU, ED software packages)
PEEPtot	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
PSVPro	pressure supported ventilation with apnea protection
Psupport	support pressure
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
SIMV VCV	synchronized intermittent mandatory ventilation & volume controlled ventilation
SIMV PCV	synchronized intermittent mandatory ventilation & pressure controlled ventilation
SIMV PCV-VG	synchronized intermittent mandatory ventilation & pressure controlled ventilation – volume guaranteed
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
TcCO2	transcutaneous carbon dioxide
TcO2	transcutaneous oxygen
TCO2	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
VCV	volume control ventilation
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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