

Super Module

HS-700 Series

Ver.06

Operation Manual



- Before using this device, read this operation manual thoroughly.
- Keep this manual near the device for future reference.

This operation manual is for the HS-700 Version 06.

△CAUTION

FEDERAL LAW RESTRICTS THIS DEVICE TO SALE BY OR ON
THE ORDER OF A PHYSICIAN.

- * The company and product names used in this manual are trademarks or registered trademarks.
- * If this manual has pages missing or out of order, contact Fukuda Denshi for replacement.
- * Only a physician or persons instructed by physicians are allowed to use this device.
- * The information contained in this document is subject to change without notice due to improvement in the device.

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Preface

Thank you for purchasing this product.

Before using this product, read the following precautions to make sure the product is used correctly and safely.

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Safety Precautions

- Read the “Safety Precautions” thoroughly before use to ensure correct and safe use of the product.
- Be sure to follow the precautions indicated below, as these are important messages related to safety.



DANGER Failure to follow this message may cause immediate threat of death or serious injury, or complete failure of the equipment.



WARNING Failure to follow this message may result in death or serious injury, or complete failure of the equipment.



CAUTION Failure to follow this message may cause injury or failure to the equipment.



NOTE A note is not related to product safety, but provides information about the correct use and operating procedures to prevent incorrect operation and malfunction of the equipment.

Graphic Symbols

Refer following for the meaning of the symbols indicated on the equipment.

Symbols indicated on the equipment

Symbol	Description
	Caution; refer to accompanying documents Indicates the need to refer to related accompanying documents before operation.
	Equipotential Terminal Indicates the terminal to equalize the potential difference when interconnecting the devices.
	Inhibition The operation is inhibited. Refer to the instruction.
	Antenna Terminal Indicates the terminal to connect the antenna.
	Protective Earth Indicates the protective earth inside the equipment.
	Alternating Current (Main Power Input Indicator)
	Direct Current
	Battery Charge (Battery Charge Indicator)
	Power ON This indicates that the main power switch is in the ON position.
	Power OFF This indicates that the main power switch is in the OFF position.
	Electrostatic Sensitive Part Directly touching this connector part with hands should be avoided.

Symbol	Description
	Type CF Applied Part with Defibrillation-Proof Indicates the degree of protection against electric shock is Type CF Applied Part with defibrillation-proof.
	Type BF Applied Part with Defibrillation-Proof Indicates the degree of protection against electric shock is Type BF Applied Part with defibrillation-proof.
	Type BF Applied Part Indicates the degree of protection against electric shock is Type BF Applied Part.
	Signal Output Part
	GAS Output Part
	Signal Input Part
	Manufactured Date
	TCP/IP Network Connector Connects to TCP/IP network.
	RS-232C Connector Connects the related device.
	Eject Indicates the switch to remove the recorder paper cassette.

Precautions for Safe Operation of Medical Electrical Equipment

⚠ CAUTION	<p>Read the following precautions thoroughly to correctly operate the device.</p> <ul style="list-style-type: none">● Users should have a thorough knowledge of the operation before using this system.● Pay attention to the following when installing and storing the equipment.<ul style="list-style-type: none">• Do not install or store in an area where the equipment will be subject to splashing water.• Do not install or store in an area where the environmental conditions, such as atmospheric pressure, temperature, humidity, ventilation, sunlight, dust, sodium, sulfur, will adversely affect the system.• Place the equipment on a stable surface where there is no inclination, vibration, or shock (including during transportation).• Do not install or store in an area where there are chemical or gasses stored.• Verify the power frequency, voltage and allowable current (or power consumption).• Ensure the grounding is proper by connecting the accompanying power cable to the hospital grade outlet.● Before operating the system, verify the following items.<ul style="list-style-type: none">• Verify the power voltage.• Check the cable connection and polarity to ensure proper operation of the equipment.• Make sure the power system has adequate earth ground.• Ensure that all cables are firmly and safely connected.• Pay special attention when the device is used in conjunction with other equipment as it may cause erroneous judgment and danger.• Ensure all patient connections are proper and secure.● During operation of the system, verify the following items.<ul style="list-style-type: none">• Always observe the system and patient to ensure safe operation of the equipment.• If any abnormality is found on the equipment or patient, take appropriate measures such as ceasing operation of the equipment in the safest way for the patient.• Do not allow the patient to come in contact with the device.● After using the system, verify the following items.<ul style="list-style-type: none">• Unplug all the cables from the patient before turning off the power.• When unplugging the cables, do not apply excessive force by pulling on the cord. Pull by the connector part of the cable.• Clean the accessories and cables, and keep them together in one place.• Keep the unit clean to ensure proper operation of the next use.● If the equipment is damaged and in need of repair, user should not attempt service. Label the unit "OUT OF ORDER" and contact Fukuda Denshi.● Do not remodel the equipment.● Maintenance Check<ul style="list-style-type: none">• Make sure to periodically check the equipment, accessories and cables.• Before reusing the device that has been left unused for a while, make sure that the device works normally and safely.● When using the electrosurgical knives or defibrillator with this equipment, verify proper attachment of patient ground plate, ECG electrode type for the electrosurgical knives, and paste volume, output energy for the defibrillator. Also, verify that proper ground is selected.
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Precautions about the Maintenance

Safety Inspection and Maintenance

For safe operation of the equipment, regular inspection and maintenance is required. Once a year, check all cables, devices, and accessories for damage, earth impedance, earth and leakage currents, and all alarm functions. Also, ensure that all safety labels are legible. Maintain a record of these safety inspections.

Immediate maintenance has to be carried out if ;

- the equipment was subjected to extreme mechanical stress, e.g. after a heavy fall.
- the equipment was subjected to liquid spill.
- the monitoring function is interrupted or disturbed.
- parts of the equipment enclosure are cracked, removed, or lost.
- any connector or cable shows signs of deterioration.



Refer to "5. Maintenance" for details.



WARNING

Never open the housing while the equipment is in operation or connected to hospital grade outlet as it may result in electric shock.

Maintenance, Modifications, and Repairs

Fukuda Denshi is liable for the safety, reliability, and performance of its equipment only if;

- Maintenance, modifications, and repairs are carried out by authorized personnel.
- Components are used in accordance with Fukuda Denshi operating instructions.

A full technical description of the HS-700 series is available from your local Fukuda Denshi representative.

Precautions about the Pacemaker

 WARNING	<ul style="list-style-type: none">● Minute ventilation rate-adaptive implantable pacemakers can occasionally interact with certain cardiac monitoring and diagnostic equipment, causing the pacemakers to pace at their maximum programmed rate. The cardiac monitoring and diagnostic equipment may possibly send wrong information. If such event occurs, please disconnect the cardiac monitoring and diagnostic equipment, or follow the procedures described in the operation manual of the pacemaker. (For more details, contact FUKUDA DENSHI personnel, your institution's professionals, or your pacemaker distributors.)● Reference “Minute Ventilation Rate-Adaptive Pacemakers” FDA alerts health professionals that minute ventilation rate-adaptive implantable pacemakers can occasionally interact with certain cardiac monitoring and diagnostic equipment, causing pacemakers to pace at their maximum programmed rate. [October 14, 1998 (Letter: www.fda.gov/cdrh/safety.html) – FDA]● Rate meters may continue to count the pacemaker rate during occurrences of cardiac arrest or some arrhythmias. Do not rely entirely upon rate meter alarms. Keep pacemaker patients under close surveillance. See “11 Technical Information” for disclosure of the pacemaker pulse rejection capability of this equipment.
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Non-Explosion Proof

 DANGER	Never operate the equipment in the presence of flammable anesthetics, high concentration of oxygen, or inside hyperbaric chamber. Also, do not operate the equipment in an environment in which there is a risk of explosion. Explosion or fire may result.
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Defibrillation Safety

 WARNING	<ul style="list-style-type: none">● When defibrillating, keep away from the electrodes or medicament applied to the patient chest. If this is not possible, remove the electrodes or medicament before defibrillating. If the defibrillator paddles directly contact the electrodes or medicament, electrical shock may result by the discharged energy.● When defibrillating, make sure that the electrodes, sensor cables, or relay cables are firmly connected to the device. Contacting the metal part of the disconnected cable may result in electrical shock by the discharged energy.● When defibrillating, do not touch the patient and the metal part of the device or cables. Electric shock may result by the discharged energy.
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Precautions about the Mason-Likar Lead Configuration

●ECG Monitoring by the Mason-Likar Lead Configuration



The Mason-Likar lead configuration which places the limb leads on the torso may generate waveforms different from the standard 12-lead ECG. The waveforms may also differ depending on the patient's supine or standing (sitting) position. Therefore, verify the waveform difference which may be caused by the lead configuration or patient's body position before monitoring.

●Electrode Attachment Site



The waveform difference with the standard 12-lead ECG can be reduced by placing the R and L electrodes at the right and left infraclavicular fossa, as near as possible to the arm where myoelectric influence will not occur.

Electrosurgery Safety



The monitoring system contains protection against interference generated by electrosurgical instruments. However, operating conditions, surgery site with respect to the location of ECG electrodes, or the type of instrument used, may cause noise on the ECG. The noise is generated at the tip of an electrical knife and is difficult to completely eliminate because of the frequency components of the ECG. To reduce electrosurgical interference, take the following precautions:

Location

Locate the electrosurgical unit as far as possible from this unit and the patient cable. This will help reduce interference on the ECG through the monitor or cables.

Power Supply

Connect the electrosurgical unit to a power supply that is different from that of the monitor. This will help prevent interference through the power cable.

Electrode Placement

The amount of interference is considerably different depending on the electrode position and surgery site. Place the ECG electrodes as far away as possible from the surgery site and the ground plate. Do not place electrodes in the path between the surgery site and the ground plate. If the electrodes are placed in this path, the amount of interference will be quite large. Position (+) and (-) electrodes as close as possible to each other.

Ground Plate

When using electrosurgical instruments, make sure the contact between the patient and the ground plate is secure. If the connection is incomplete, the patient may suffer a burn at the electrode site.

Precautions about Magnetic Resonance Imaging



- Do not operate this equipment in magnetic resonance imaging (MRI) environments.
- When conducting MRI test, remove the electrodes and sensors connected to the patient (test subject).

The local heating caused by the induced electromotive force may cause burn injury to the patient (subject). For details, refer to the operation manual for the MRI testing device.

Precautions about Connections to Peripheral Devices

In the interest of safe and sufficient performance of this equipment, the connection of other manufacturers' equipment to the monitor is not authorized, unless the connection is explicitly approved by Fukuda Denshi. It is the user's responsibility to contact Fukuda Denshi to determine the compatibility and warranty status of any connection made to another manufacturer's equipment.

⚠ WARNING	For the connector with  mark, only the peripheral devices specified by Fukuda Denshi should be connected with the given procedure. Use of an unspecified device may cause electric shock to the patient and/or operator due to excessive leakage current.
⚠ CAUTION	All the peripheral device connectors on the HS-700 series are isolated from the power supply, but the peripheral devices are not isolated. To prevent danger of electric shock, always position the peripheral devices away from the patient.

When connecting peripheral devices, it is the user's responsibility to verify that the overall system complies with IEC 60601-1-1, "Collateral Standard: Safety Requirements for Medical Electrical Systems".

Precautions about the Fuse

⚠ DANGER	If the fuse burns out, contact Fukuda Denshi Service Representative. Do not continue using it as internal damage to the equipment may be considered.
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Accessories and Optional Accessories

⚠ WARNING	Use only the cables specified by Fukuda Denshi. <ul style="list-style-type: none">• Use of other cables may result in increase in emission or decrease in immunity.• We are not liable of the performance if product other than specified is used.
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Precautions about the HS-700

DANGER

When connecting to other device, contact Fukuda Denshi service representative.
Danger such as electric shock may result to the patient and operator.

WARNING

- Do not connect unit or cable not authorized by Fukuda Denshi to any I/O connector. If done so by mistake, the HS-700 cannot deliver its maximum performance and the connected units may be damaged, resulting in a safety hazard.
- Use only the accompanying 3-way AC power cable. Use of other cables may result in electric shock to the patient and the operator.
- The power cable must be connected to hospital grade outlet. When connecting, do not use multitap.
- When using multiple ME equipment simultaneously, perform equipotential grounding to prevent potential difference between the equipment. Even a small potential difference may result in electric shock to the patient and the operator.
- If the HS-700 series is used under an environment not fulfilling the specified condition, not only that the equipment cannot deliver its maximum performance, the equipment may be damaged and safety cannot be ensured. If using the equipment under condition other than specified, contact our service representative.
- Objective and constant arrhythmia detection is possible through the fixed algorithm incorporated in this monitor.
However, excessive waveform morphology change, motion artifact, or the inability to determine the waveform pattern may cause an error, or fail to make adequate detection. Therefore, physicians should make final decisions using manual recording, alarm recording and recall waveform for evaluation.
- When measuring the SpO₂ of patient with high fever or peripheral circulatory insufficiency, check the sensor attachment periodically and change the attachment site. The temperature of attachment site will rise 2 to 3°C due to the sensor heat which may result in burn injury.
- For the following case, accurate measurement may not be possible.
 - Patient with excessive abnormal hemoglobin (COHb, MetHb)
 - Patient with the pigment injected to the blood
 - Patient receiving CPR treatment
 - When a sensor is applied to a limb with NIBP cuff, arterial catheter, or intracatheter
 - When measuring at site with venous pulse
 - Patient with body motion
 - Patient with small pulse
- Before the NIBP measurement, make sure the patient type (Adult / Child / Neonate) is properly selected. Otherwise, correct measurement cannot be performed, and congestion or other injury may result.
- Use only the specified accessories.
- For HS-710E, 720E, 702E, always consider the circumference of the intubation tube when using the airway adapter. If inappropriate airway adapter is used for a patient with low ventilation, CO₂ may mix in to the inspired air resulting in incorrect measurement, or apnea detection may become difficult.
- Analog signal is a delay output. (about 35ms for ECG, BP)
When connecting to a device using vital signs as trigger signals (ex. IABP), make sure the delay time fulfills the specifications of the connected device.
- The delay time may differ depending on the waveform shape or artifact interference.
- Be cautious not to touch the cooling fan. Fingers may be entangled in the fan causing serious injury.
- When the air filter is washed with neutral detergent, dry it completely before reattaching. If the moisture is remained on the air filter, it may damage the equipment.

 WARNING

- The air filter must be attached. If the equipment is used with the air filter detached, it may damage the equipment.

 CAUTION

- Systems
 - This equipment is intended to be used for only one patient.
 - Use only the accessories specified for this device. Otherwise, proper function cannot be executed.
 - For quality improvement, specifications are subject to change without prior notice.
 - When the product is used in regions whose voltage is other than 220-240V, a cable appropriate to the regulations and voltage of the country in which the product is being used shall be used.
- ECG Monitoring
 - Use only the specified relay cables, lead cables, and electrodes.
 - The conductive parts of electrodes and associated connectors for applied parts, including the neutral electrode, should not contact other conductive parts including earth.
 - The indication for continuous use of the electrode is about one day.
 - Replace the electrode if the skin contact gets loosen due to perspiring, etc.
 - When an electrode is attached at the same location for a long time, some patients may develop a skin irritation. Check the patient's skin condition periodically and change the electrode site as required.
 - There are some cases when QRS is not automatically detected although the amplitude is above the threshold level.
 - QRS may not be automatically detected for the following ECG waveforms.
 - The amplitude is low and extremely wide.
 - Contains large amount of artifacts such as EMG or excessive body movement.
 - Contains excessive noise from electrosurgery.
 - There are some cases when pacemaker pulse can not be detected depending on the pacemaker type, pulse voltage, pulse width, electrode lead type (unipolar, bipolar), or electrode placement which causes the pacemaker pulse amplitude to decrease and disables pacemaker pulse detection.
 - If signals similar to a pacemaker pulse are present, such as electric blanket noise or excessive AC frequency noise, these may be erroneously detected and displayed as a pacemaker pulse.
 - If signals similar to a pacemaker pulse are present, such as electric blanket noise or excessive AC frequency noise, these may be erroneously detected and displayed as a pacemaker pulse.
 - When continuously detecting AC noise artifact as pacemaker pulses, QRS detection stops and heart rate is extremely degraded. Also arrhythmia cannot be detected.
- Arrhythmia Analysis
 - For stable arrhythmia detection and ECG monitoring, verify proper electrode placement, lead, waveform size, and filter mode selection. If not properly selected, it may cause erroneous detection.
- Respiration Monitoring
 - When the following relay cables are used, respiration cannot be measured.
 - Relay Cable CI-700E_3 (FA) (Electrosurgery-proof, 3-electrode)
 - Relay Cable CI-700E_4 (FA) (Electrosurgery-proof, 4-electrode)
 - Relay Cable CI-700E_5 (FA) (Electrosurgery-proof, 5-electrode)
 - When a defibrillator is used during respiration monitoring, a large offset voltage will be placed on the ECG electrodes, which may cause interruption of monitoring for a few seconds.
- SpO₂ Monitoring
 - If the nail is rough, dirty, or manicured, accurate measurement will not be possible. Change the finger or clean the nail before attaching the probe and sensor.
 - If irritation such as skin reddening or skin fit appears with the sensor use, change the attachment site or stop using the sensor.
 - When fixing the sensor with a tape, do not wind the tape too tight. At the same time, check the blood flow constantly so that congestion is not generated at the peripheral.
 - Even a short duration of attachment may inhibit the blood flow and generate compression necrosis and burn injury.
 - Change the sensor attachment site constantly (every 4 hours). As the temperature of sensor attachment site normally rises 2 to 3°C, compression necrosis and burn injury may generate.
 - As skin for neonate / low birth weight infant is immature, change the sensor attachment site more frequently depending on the condition.

⚠ CAUTION	<ul style="list-style-type: none"> • Direct sunlight to the sensor area can cause a measurement error. Place a black or dark cloth over the sensor. • When not performing the measurement, unplug the relay cable and sensor from the SpO₂ input connector. Otherwise, the measurement data may be erroneously displayed by the ambient light. ● NIBP Monitoring • Pay attention when measuring the NIBP of patient with bleeding disorders or hyper coagulation. The cuff inflation may cause petechia or circulatory failure by the blood clot. • When measuring the NIBP, make sure to display the NIBP numeric data box on the home display. Otherwise, the measurement result will not be displayed although the NIBP Start/Stop key is pressed. ● BP Monitoring • The zero balance procedure is required for the following case. <ul style="list-style-type: none"> • When starting the measurement. • When the position of the heart has changed due to body movement. • When measuring for a long period of time and there is a possibility of measurement error due to change in ambient temperature, etc. • When the connector is connected / disconnected, or transducer is replaced. ● CO₂ Monitoring (HS-710E, 720E, 702E) • Perform calibration after 20 minutes when the main power of the Super Module is turned ON. • Do not disconnect the sampling tube during calibration. If disconnected, calibration will cease. • Conduct CO₂ calibration for the following case. <ul style="list-style-type: none"> • When 6 months has elapsed from the last calibration date. • When EtCO₂ measurement is not stable or accuracy is degraded compared with other measuring device. • When the patient monitor was not used for a while, or when EtCO₂ was not measured for a while. • If the HC-500 (CO₂ Module) is simultaneously used, the CO₂ measurement priority will be according to the setting on the patient monitor. With the default setting, the HC-500 will be prioritized. ● CO₂ Monitoring (HS-720C, 702C: RESPIRONICS® Capnostat 5) • If the HC-500 (CO₂ Module) is simultaneously used, the CO₂ measurement priority will be according to the setting on the patient monitor. With the default setting, the HC-500 will be prioritized. • The disposable airway adapter should be opened just before use. Do not sterilize it. • Do not reuse the disposable airway adapter. • The airway adapter should be attached with the thicker side facing to the patient. If attached oppositely, it may damage the CO₂ sensor or airway adapter. • Do not sterilize the airway adapter using autoclave method. ● Maintenance • Clean the equipment frequently so stains can be removed easily. • To prevent injury, it is recommended to wear gloves when cleaning the equipment. • Do not allow liquids such as alcohol or cleaning solution enter the equipment or connectors. • Do not use organic solvents, thinner, toluene and benzene to avoid damaging the resin case. • Do not polish the housing with abrasive or chemical cleaner. • When sterilizing the entire room using a spray solution, pay close attention not to have liquids get into the equipment or connectors. • Use only neutral detergent to clean the housing. Do not use chemical cloth, scrub brush, abrasive, polishing powder, hot water, volatile solvent and chemicals (cleanser, thinner, toluene, benzine, benzol, and synthetic detergent for house and furniture), or sharp-edged tools. The surface resin coating may be damaged, resulting in discoloration, scratches, and other problems. • Do not open the housing. • Do not allow alcohol or other liquids to enter the equipment. • If you accidentally wet the device, dry it completely and verify it operates safely before usage. <p>Replace the components periodically as specified.</p>
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Precautions about the Ventilator Monitoring

 WARNING	<ul style="list-style-type: none">● If the DS-7300 system does not generate an alarm even though the ventilator is generating an alarm, or if any other malfunction occurs, immediately check the ventilator, DS-7300 system, cable, and replace the cable if necessary. If the malfunction persists, stop using the device.● The alarm generation on the DS-7300 system is not assured if the alarm other than the following generates at the ventilator.<ul style="list-style-type: none">• SV-300 airway pressure upper limit alarm, high continuous pressure alarm, O₂ concentration lower limit alarm, expiratory minute volume upper/lower limit alarm, apnea alarm, gas supply alarm, air supply alarm, O₂ supply alarm, battery alarm, limited battery alarm, no battery alarm, overrange alarm• Servo-i airway pressure upper limit alarm, high continuous pressure alarm, O₂ concentration lower limit alarm, expiratory minute volume upper/lower limit alarm, apnea alarm, gas supply alarm, O₂ supply alarm, battery alarm, no battery alarm, limited battery alarm, overrange alarm, expiratory cassette disconnected alarm, backup ventilation alarm, regulation pressure limited alarm, respiratory rate alarm, PEEP low alarm, EtCO₂ upper limit alarm, EtCO₂ lower limit alarm• Servo-s airway pressure upper limit alarm, high continuous pressure alarm, O₂ concentration lower limit alarm, expiratory minute volume upper/lower limit alarm, apnea alarm, gas supply alarm, air supply alarm, O₂ supply alarm, backup ventilation alarm, respiratory rate alarm, PEEP low alarm● The DS-7300 system will not correspond to the following alarms generated on the Evita 4 / Evita XL / Evita 2 dura.<ul style="list-style-type: none">• O₂ monitoring disabled alarm, CO₂ alarm disabled alarm, Oximeter alarm disabled alarm, Neo. volume measurement inoperable alarm, Minute volume alarm disabled alarm, Minute volume alarm low off alarm, Tidal volume alarm high off alarm, Apnea alarm off alarm, Nebulizer active alarm● There is a communication delay of 3 seconds between the DS-7300 system and the Evita ventilator. Therefore, if the alarm generated at the ventilator is resolved within 3 seconds, the ventilator alarm may not be generated at the DS-7300 system.
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 CAUTION	<ul style="list-style-type: none">● The ventilator operation should be performed by well-trained and authorized personnel.● For connecting the DS-7300 system and ventilator, use only the specified connection cable.● Verify that the DS-7300 system and the ventilator are properly connected.● When connecting the cable, verify that the main power of the DS-7300 system and the ventilator is OFF.● When connecting the PURITAN-BENNETT ventilator, follow the precautions below.<ul style="list-style-type: none">• The serial port (RS-232C) of the ventilator should be set as follows. Refer to the service representative of the ventilator manufacturer.<table><tr><td>Baud Rate</td><td>:</td><td>9600bit/s</td></tr><tr><td>Data Bit</td><td>:</td><td>8bit</td></tr><tr><td>Parity Bit</td><td>:</td><td>none</td></tr><tr><td>(Stop Bit)</td><td>:</td><td>(1bit)</td></tr></table>• The DS-7300 system detects the "ventilator alarm" when the nurse call port on the ventilator outputs the alarm signal. For details of ventilator setup and alarm signal output condition from the nurse call port, refer to the service representative of the ventilator manufacturer.● When connecting the Evita 4 / Evita XL / Evita 2 dura ventilator, the serial port (RS-232C) setup of the ventilator should be as follows. Refer to the service representative of the ventilator manufacturer.<table><tr><td>Protocol</td><td>:</td><td>Medibus</td></tr><tr><td>Baud Rate</td><td>:</td><td>19200bit/s</td></tr><tr><td>Data Bit</td><td>:</td><td>8bit</td></tr><tr><td>Parity Bit</td><td>:</td><td>Even</td></tr><tr><td>Stop Bit</td><td>:</td><td>1bit</td></tr></table>	Baud Rate	:	9600bit/s	Data Bit	:	8bit	Parity Bit	:	none	(Stop Bit)	:	(1bit)	Protocol	:	Medibus	Baud Rate	:	19200bit/s	Data Bit	:	8bit	Parity Bit	:	Even	Stop Bit	:	1bit
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Stop Bit	:	1bit																										

Precautions for Use of SpO₂ Sensor

 DANGER	<p>Burn Risk in Using SpO₂ Sensor</p> <p>In SpO₂ monitoring, always use the sensor/relay cable specified by Fukuda Denshi. If any other sensor/relay cable is used, a high temperature rise of the sensor may place the patient in danger of burns.</p> <p>If there are any questions regarding the sensor/relay cable use for SpO₂ measurements of this device, please contact Fukuda Denshi service representative.</p>
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Precautions for Use of NIBP Cuff

 CAUTION	This product contains natural rubber latex which may cause allergic reactions. (FDA: Medical Alert on Latex Products, "Allergic Reactions to Latex-Containing Medical Devices", Food & Drug Administration, 9200 Corporate Blvd., Rockville, MD 20850, 1991.)
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Disposing of Equipment, Accessories, or Components

 CAUTION	When disposing of the equipment, accessories, or components, use an industrial waste distributor. Do not dispose of as ordinary waste.
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Precautions about Transportation

For transporting this device, pack with specified packing materials.



Refer to "6. Technical Information Specification / Performance" for environmental condition during transportation.

Precautions about Data Backup

 CAUTION	To protect the data during voltage dip, short interruptions and voltage variations on power supply input lines or during short duration of power turned OFF, this monitor performs 5-minute (approx.) data backup using the secondary battery. The data may not be protected if the power is turned off within 30 minutes from power on.
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To Prepare for Emergency Use

Accessories / Optional Accessories

- (1) The ECG electrodes are consumables. Always prepare extra supplies of electrodes.
- (2) Check if any wire break is present on the patient cable once a week.

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1. General Description	Describes the outline of this module.
2. Basic Operation	Describes the procedure for power supply connection and recorder operation.
3. Preparation	Describes the procedure to measure each parameter and to connect external equipment.
4. Installation	Describes the operating environment of this module.
5. Maintenance	Describes the maintenance and troubleshooting of this module.
6. Technical Information	List the specification and pin assignment of the external connector.
7. Accessories	Lists the accessories and optional accessories for this module.

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1. General Description

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2. Basic Operation	
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Chapter 1

General Description

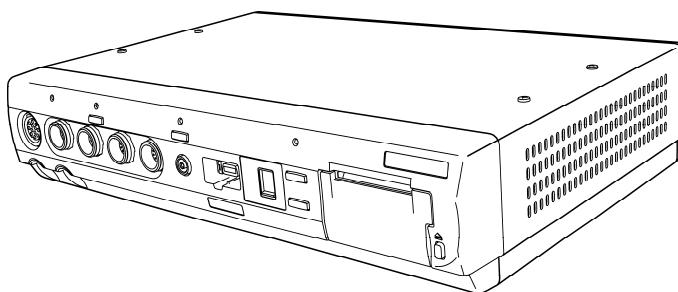
This chapter explains the general description of this equipment.

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General Description

The HS-700 series Super Module is used by connecting to the DS-7300 Bedside Monitor. The HS-700 is capable of measuring ECG, respiration, NIBP, SpO₂, temperature, BP, and CO. Depending on the model type, CO₂, O₂, N₂O, anesthetic agent measurement and recording is also possible.

The HS-700 acquires physiological signal from patient, and filters and measures the data. The result will be displayed on the main unit (DS-7300). All controls are performed on the main unit.



<HS-720E>

The SpO₂ measurement is performed using the NELLCOR® unit.

The HS-700 series incorporates 4 multiparameter connectors. Parameters from temperature (max. 8), BP (max.8), CO (1) can be freely combined according to the monitoring purpose.

Model Type	Basic Measurement		CO ₂ Measurement* ¹	Recording
	Fixed	Multiparameter		
HS-710	ECG RESP×1 NIBP×1 SpO ₂ ×1	4 ports TEMP×8 BP×8 Cardiac Output×1	×	×
HS-710E			○	×
HS-720			×	○
HS-720E			○	○
HS-720C			△	○
HS-702C	ECG RESP×1 NIBP×1 SpO ₂ ×1 BP×2	2 ports TEMP×4 BP×4 Cardiac Output×1	△	○
HS-702E			○	○

*¹CO₂ measurement

△: Mainstream Method
(Optional RESPIRONICS® sensor can be connected)
○: Microstream Method (Oridion®)

Features

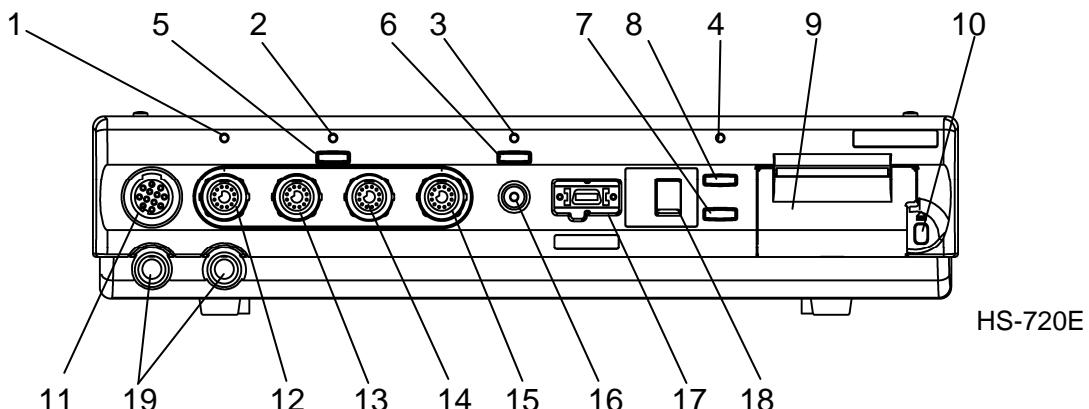
- The HS-700 is equipped with multiparameter connectors enabling flexible monitoring of parameters according to the patient requirement.
- The HS-700 is equipped with BP zero balance switch and NIBP start/stop switch.
- The HS-700 incorporates analog signal (ECG, BP waveform) output connector.
- Two types of CO₂ measurement method can be selected by the Super Module types. One is the microstream method (Oridion[®]) which is less influenced by the anesthetic gas (HS-710E, HS-720E, HS-702E), and the other is the mainstream method (RESPIRONICS[®]) which allows long stable measurement (HS-720C, HS-702C).
- By connecting a ventilator via serial connector on this unit or CJM-01SR0.6 multiport relay cable, ventilator data can be displayed on the monitor.
The following products can be connected.
 - Servo Ventilator 900C/900D/900E, 300/300A, Servo-i/Servo-s
 - PURITAN-BENNETT Ventilator 7200ae/7200e, 740/760, 840
 - Evita 4, Evita XL, Evita 2 dura
- By connecting an oximeter, SvO₂, CO, etc, can be monitored. The following device can be connected.
 - Oximeter / CCO Measurement Device; Vigilance, Vigilance CEDV, VigilanceII, Vigileo
 - SO₂/CO Computer; OXIMETRIX3
 - CCO/CO Computer; Q-vue
 - CCO/SO₂ Monitor; Q2 Computer
- By connecting the Poet IQ 8500A series analyzer (Criticare Systems Inc.), CO₂ concentration, anesthetic gas concentration, O₂ concentration, N₂O concentration can be measured. The anesthetic gas that can be measured are halothane, isoflurane, sevoflurane, desflurane, and enflurane.
- The upgrading of the software can be easily performed by transferring the program from the CF card to the flash memory.

Names of Parts and Their Functions

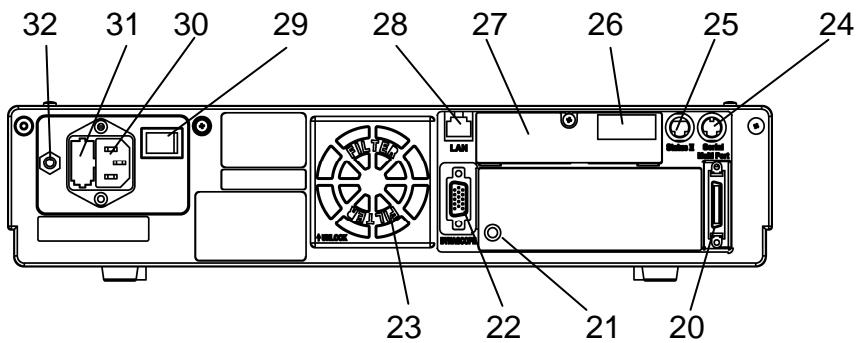
WARNING	Do not connect unit or cable not authorized by Fukuda Denshi to any I/O connector. If done so by mistake, the device cannot deliver its maximum performance and the connected units may be damaged, resulting in a safety hazard.
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HS-710, 710E, 720, 720E, 720C

【Front Side】



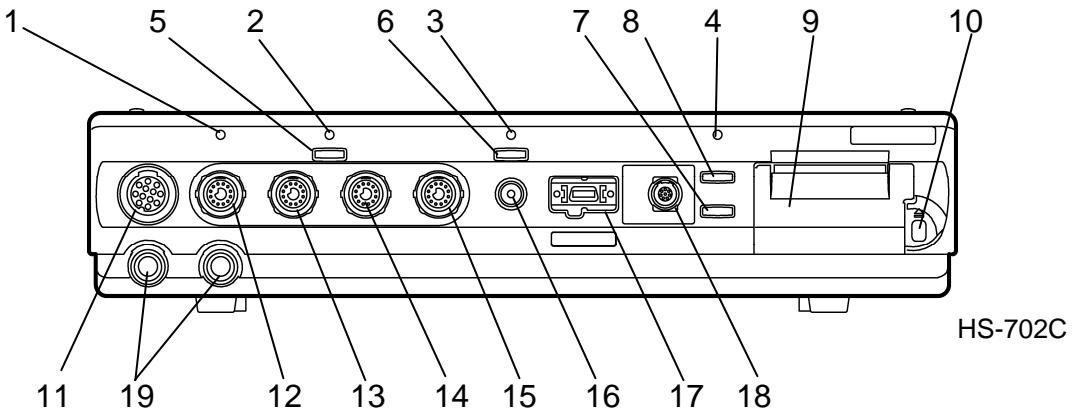
1. Power Supply Indicator : Indicates the power supply status.
2. BP Zero Balance Indicator : Lights during BP zero balancing.
3. NIBP Measurement Indicator : Lights during NIBP measurement.
4. Recorder Status Indicator : Indicates recorder status.
5. BP Zero Balance Switch : Starts BP zero balance.
6. NIBP Start/Stop Switch : Starts/stops NIBP measurement.
7. Paper Feed Switch : Feeds the paper.
8. Start Recording Switch : Starts/stops the recording.
9. Paper Cassette : Stores recording paper.
10. Paper Cassette Eject Button : Press here to remove the paper cassette.
*No. 4, 7 to10 are equipped on HS-720, HS-720E, HS-720C, only.
11. ECG Input Connector : Connects ECG relay cable.
12. Multiparameter Amplifier Input Connector 1 : Connects the relay cable for monitoring parameter.
13. Multiparameter Amplifier Input Connector 2 : Connects the relay cable for monitoring parameter.
14. Multiparameter Amplifier Input Connector 3 : Connects the relay cable for monitoring parameter.
15. Multiparameter Amplifier Input Connector 4 : Connects the relay cable for monitoring parameter.
16. NIBP Cuff Connector : Connects the NIBP cuff.
17. SpO₂ Input Connector : Connects the SpO₂ sensor cable.
18. The function differs according to the Super Module model type.
HS-710E, 720E
18. CO₂ Measurement Connector : Connects the filter line or nasal filter.
HS-720C
18. Serial Communication Connector (RGM) : Connects the CO₂ sensor (Capnostat 5)
19. Analog Output Connector : Connects the specified equipment.

【Rear Side】

- | | |
|-----------------------------------|--|
| 20. Multiport Relay Box Connector | : Connects the multiport relay cable (CJM-01SR0.6). |
| 21. Exhaust Connector | : Connects gas exhaust system.
*For HS-710E, 720E only. |
| 22. Main Unit Connector | : Connects to the main unit (DS-7300). |
| 23. Cooling Fan | : Inhale port for cooling fan. |
| 24. Serial Connector | : Connects the specified equipment. |
| 25. Status I/O Connector | : Connects the specified equipment. |
| 26. NIBP Measurement Indicator | : Displays NIBP data. |
| 27. Maintenance Cover | : Used for maintenance. |
| 28. LAN Connector | : Connects the specified LAN equipment. |
| 29. Power Supply Switch | : Turns ON/OFF the power. |
| 30. Power Supply Connector | : Connects the power supply cable. |
| 31. Fuse Holder | : Stores the fuse. |
| 32. Equipotential Ground Terminal | : Used for equipotential ground connection. |

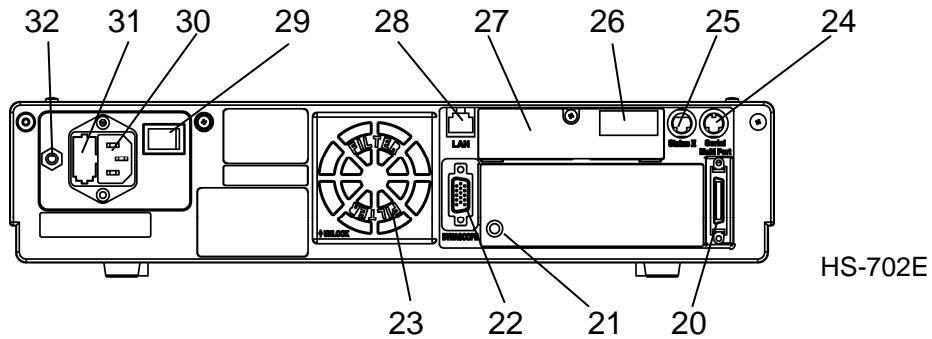
HS-702C, 702E

[Front Side]



1. Power Supply Indicator : Indicates the power supply status.
2. BP Zero Balance Indicator : Lights during BP zero balancing.
3. NIBP Measurement Indicator : Lights during NIBP measurement.
4. Recorder Status Indicator : Indicates recorder status.
5. BP Zero Balance Switch : Starts BP zero balance.
6. NIBP Start/Stop Switch : Starts/stops NIBP measurement.
7. Paper Feed Switch : Feeds the paper.
8. Start Recording Switch : Starts/stops the recording.
9. Paper Cassette : Stores recording paper.
10. Paper Cassette Eject Button : Press here to remove the paper cassette.
11. ECG Input Connector : Connects ECG relay cable.
12. BP Input Connector 1 : Connects BP interface cable.
13. BP Input Connector 2 : Connects BP interface cable.
14. Multiparameter Amplifier Input Connector 1 : Connects the relay cable according to the monitoring purpose.
15. Multiparameter Amplifier Input Connector 2 : Connects the relay cable according to the monitoring purpose.
16. NIBP Cuff Connector : Connects the NIBP cuff.
17. SpO₂ Input Connector : Connects the SpO₂ sensor cable.
18. The function differs according to the Super Module model type.
 HS-702E
 18. CO₂ Measurement Connector : Connects the filter line or nasal filter.
 HS-702C
 18. Serial Communication Connector (RGM) : Connects the CO₂ sensor (Capnostat 5).
19. Analog Output Connector : Connects the specified equipment.

【Rear Side】



- | | |
|--|--|
| 20. Multiport Relay Box Connector | : Connects the multiport relay cable (CJM-01SR0.6). |
| 21. CO ₂ Exhaust Connector
*For HS-702E only | : Connects the gas exhaust system. |
| 22. Main Unit Connector | : Connects to the main unit (DS-7300).
(Connects to the IB-7300 Input Box if used.) |
| 23. Cooling Fan | : Inhale port for cooling fan. |
| 24. Serial Connector | : Connects the specified equipment. |
| 25. Status I/O Connector | : Connects the specified equipment. |
| 26. NIBP Measurement Indicator | : Displays NIBP data. |
| 27. Maintenance Cover | : Used for maintenance. |
| 28. LAN Connector | : Connects the specified LAN equipment. |
| 29. Power Supply Switch | : Turns ON/OFF the power. |
| 30. Power Supply Connector | : Connects the power supply cable. |
| 31. Fuse Holder | : Stores the fuse. |
| 32. Equipotential Ground Terminal | : Used for equipotential ground connection. |

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Chapter 2

Basic Operation

This chapter describes the basic operation for monitoring.

2

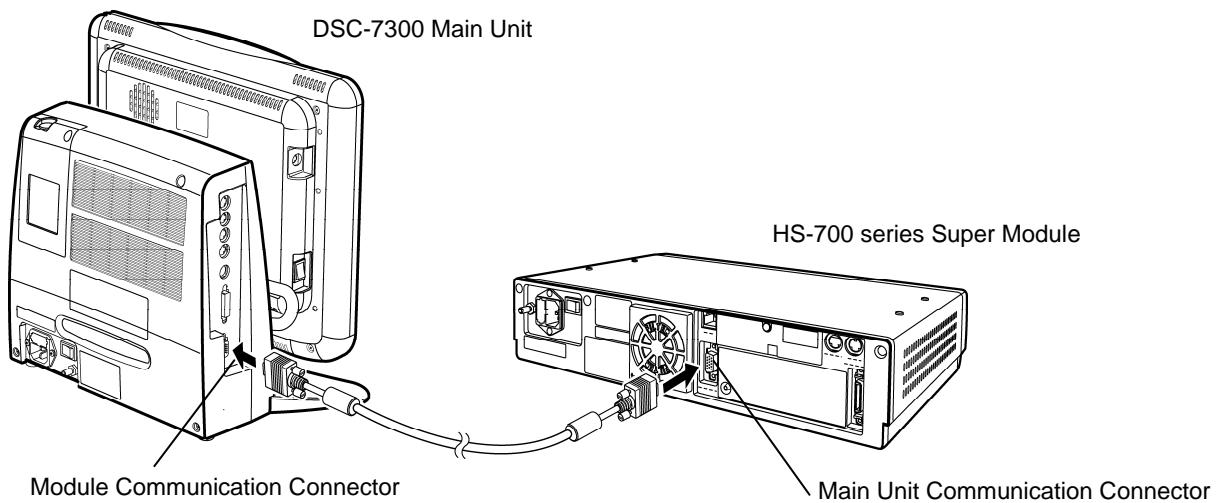
Basic Operation

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Monitor Connection and Power ON

Connection with the DS-7300

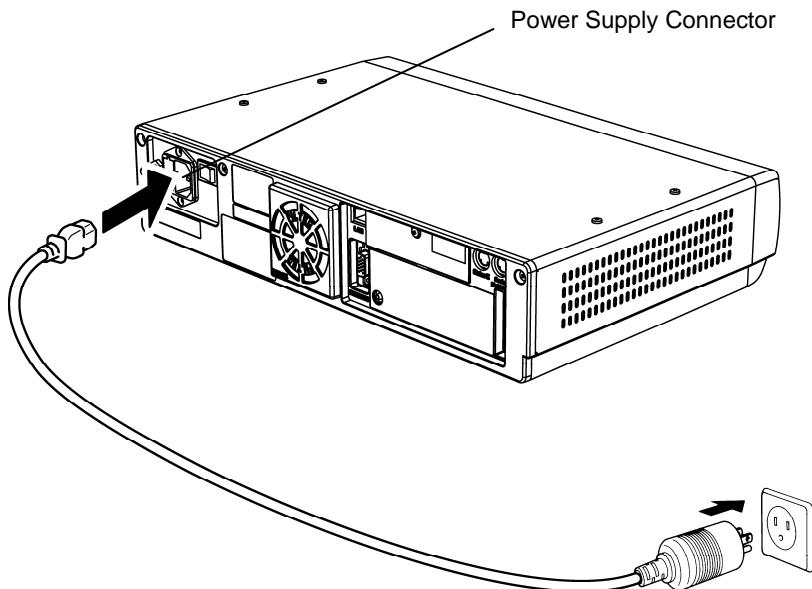
Connect the accessory module connection cable (CJ-732) to the rear side of the Super Module and the other end to the DSC-7300 Bedside Monitor.



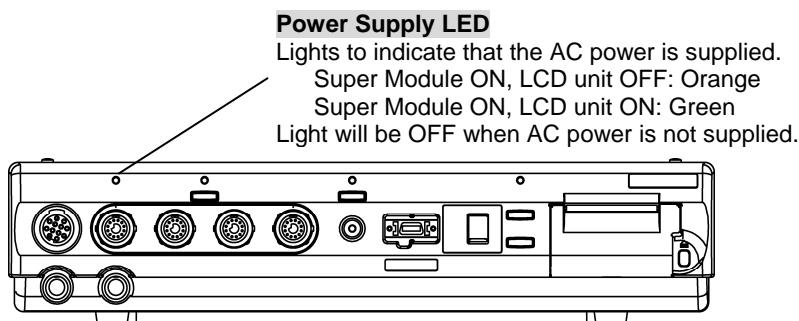
Power Cable Connection

Connect the accessory power cable (CS-24) to the power supply connector on the rear side of the Super Module.

Connect the other end of the power cable to the 3-way outlet with ground terminal.



When the power cable is connected and the power is turned ON, the main power supply indicator on the front side of the Super Module will light to notify that the AC power is supplied.

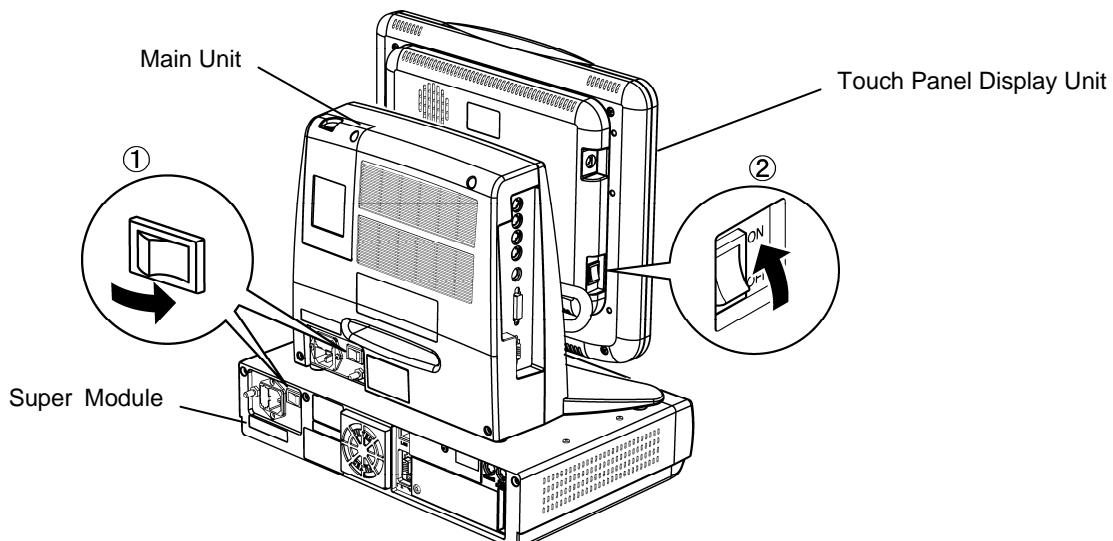


WARNING	<ul style="list-style-type: none"> ● Use only the accompanying 3-way AC power cable. Use of other cables may result in electric shock to the patient and the operator. ● The power cable must be connected to hospital grade outlet. When connecting, do not use multitap. ● When using multiple ME equipment simultaneously, perform equipotential grounding to prevent potential difference between the equipment. Even a small potential difference may result in electric shock to the patient and the operator.
----------------	---

NOTE	Equipotential Grounding When connecting multiple devices, electrical potential difference may be generated between the devices. This may result in electric shock to the patient connected to these devices. Pay special attention for use in the operating room, ICU, CCU, Cardiac Catheter Laboratory, and Cardiovascular X-ray room. To avoid such electrical potential difference, use the accessory ground cable to connect each device's equipotential terminal to the same ground terminal. This is called equipotential grounding.
-------------	--

To Turn On the Power Switch

First, (1) turn ON the power supply switch of the main unit and the Super Module, then (2) turn ON the power supply switch of the display unit. The monitoring screen will be displayed. The power supply LED will light in green when the power is turned ON.

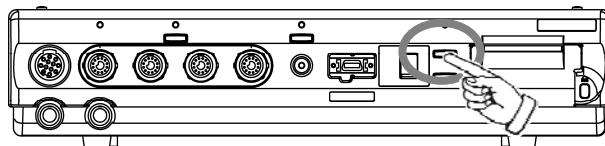


CAUTION	When the power of the LC-7315T/LC-7319T Display Unit is turned OFF, the power of the Super Module and Input Box will be also turned OFF.
----------------	--



For procedure to connect the display unit, refer to the operation manual of the bedside monitor.
For procedure to connect the ECG lead cable, NIBP cuff, and other parameter cables, refer to "3. Preparation"

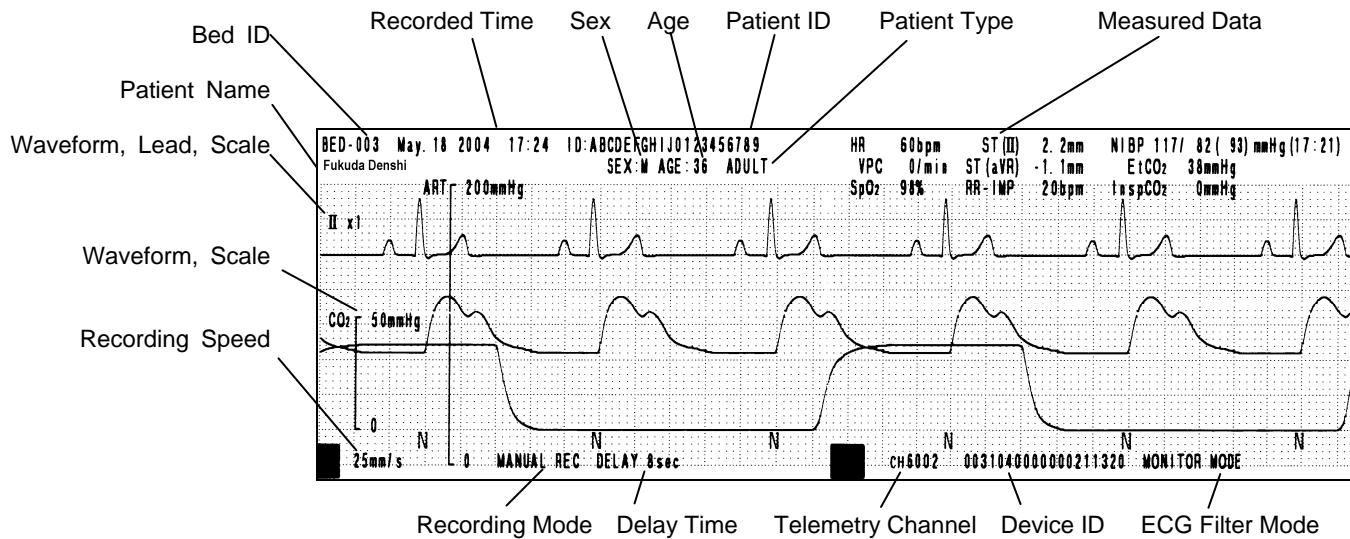
Start / Stop of Waveform Recording



Pressing the Start Recording Switch will start the waveform recording. Up to 3 waveforms can be recorded.

Pressing the Start Recording Switch during recording will stop the recording.

【Example of Recording】



Recording setup is performed on the bedside monitor. Refer to the operation manual of the bedside monitor.

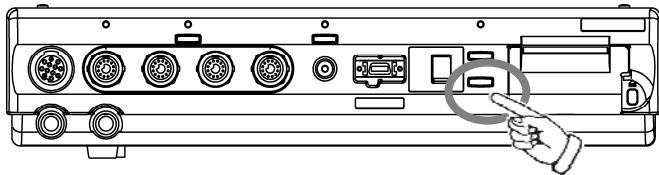
Reference

The "Device ID" is a value indicating the setup of the device.

Refer to P6-8 "6. Technical Information Specification / Performance The Printed Device ID" for details.

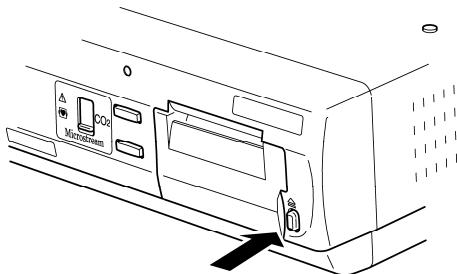
Paper Feed

Pressing the paper feed switch will feed the paper to the top.

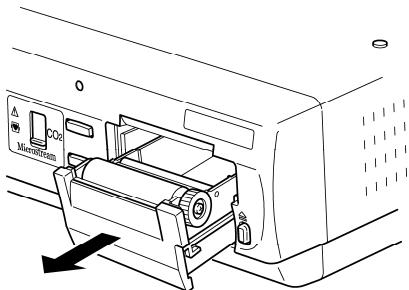


To Replace the Recording Paper

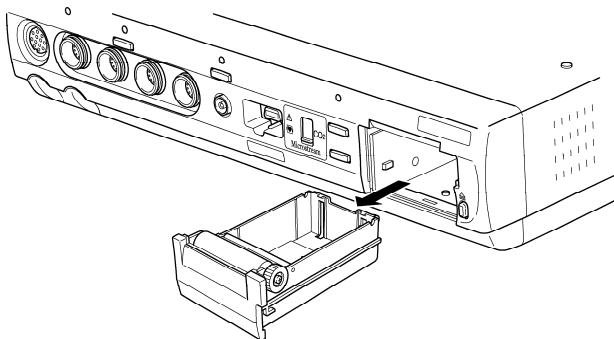
- 1 Press the eject button located at the right side of the recorder cassette.



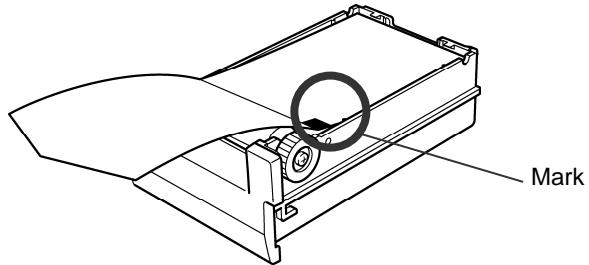
- 2 The cassette will come out.



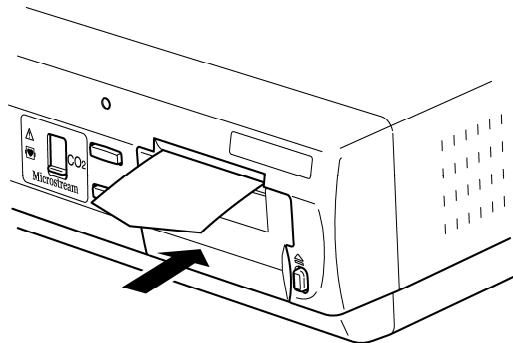
- 3 Pull out the cassette from the Super Module.



4 Set the recording paper so that the printed mark on each paper comes to the right side.



5 Place the cassette back into the Super Module. Push in until it locks into place with a click sound.



Chapter 3

Preparation

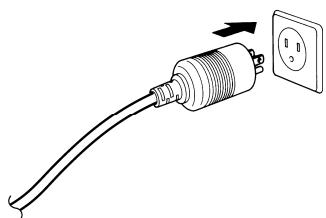
The measurement method of each parameter and connecting procedure of external equipment will be explained.

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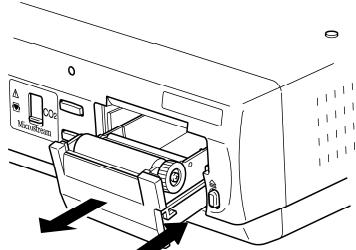
To Acquire ECG Waveform

Before turning ON the power

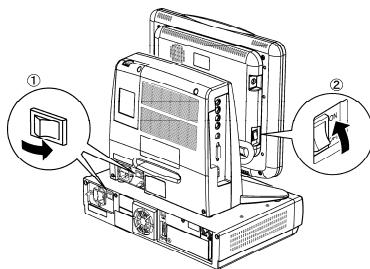
1. Check the grounding.



2. Check the recording paper.



3. Turn ON the power.



Properly use the 3-way AC plug to ground the monitor.
The grounding is required
to prevent AC noise.

Open the recorder cassette, and
check that there is enough amount
of paper installed.

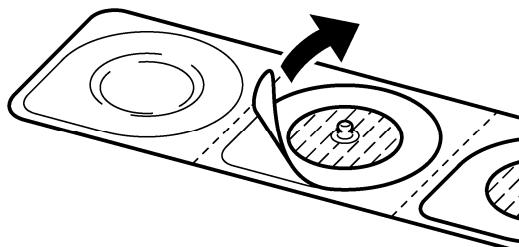
Turn ON the power switch
and check if the power lamp
is lighted.

Before Attaching the Electrodes

1 Clean the electrode sites with an alcohol swab or other skin preparation. If necessary, shave the electrode sites to remove excessive hair.



2 Peel off the backing of disposable electrode.



Pay attention not to touch the electrode jelly.

Lead Cable Types

There are various combinations of lead cable connecting type and electrode material.
Contact our service representative for details and select the appropriate electrode.

【for 3-electrode】	ECG Relay Cable (defibrillation-proof)	CI-700D-3 (FA)
	ECG Relay Cable (electrosurgery-proof)	CI-700E-3 (FA)
	ECG Lead Cable (hook type)	3380.0648.13
【for 4-electrode】	ECG Relay Cable (defibrillation-proof)	CI-700D-4 (FA)
	ECG Relay Cable (electrosurgery-proof)	CI-700E-4 (FA)
	ECG Lead Cable (hook type)	500398800
【for 5-electrode】	ECG Relay Cable (defibrillation-proof)	CI-700D-5 (FA)
	ECG Relay Cable (electrosurgery-proof)	CI-700E-5 (FA)
	ECG Lead Cable	3380.0661.13 (for limb, 60cm)
	ECG Lead Cable	3380.0661.15 (for limb, 90/150cm)
【for 10-electrode】	ECG Relay Cable (defibrillation-proof)	500403000
	ECG Lead Cable	500403200 (for chest, 90cm)
	ECG Lead Cable	3380.0661.13 (for limb, 60cm)
	ECG Lead Cable	3380.0661.15 (for limb, 90/150cm)

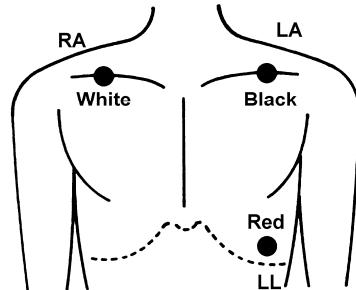
Electrode Placement

There are 3-electrode, 4-electrode, 5-electrode, 10-electrode application depending on the cable type. Using the 4-electrode, 5-electrode or 10-electrode application allows simultaneous monitoring of 2 ECG waveforms, and high accuracy of arrhythmia analysis can be attained. Also, the displayed lead type can be changed.

For 3-electrode lead (1 waveform monitoring)

Lead Type I / II / III

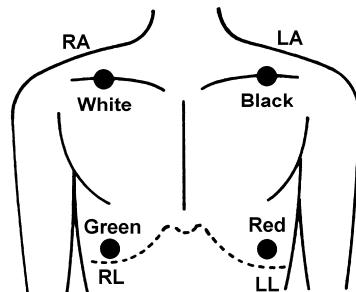
Symbol	Color	Electrode Site
RA	White	On the right infraclavicular fossa
LA	Black	On the left infraclavicular fossa
LL	Red	On the left midclavicular line, near the suprasternal line.



For 4-electrode lead (Max. simultaneous 6 waveforms monitoring)

Lead Type I / II / III / aVR / aVL / aVF

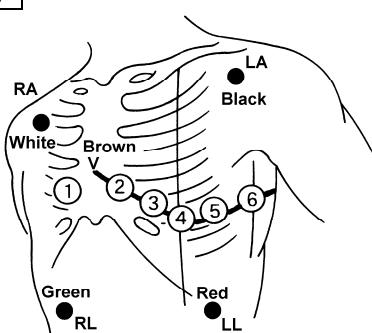
Symbol	Color	Electrode Site
RA	White	On the right infraclavicular fossa
LA	Black	On the left infraclavicular fossa
LL	Red	On the left midclavicular line, near the suprasternal line.
RL	Green	On the right midclavicular line at the same height as LL.



For 5-electrode lead (Max. simultaneous 7 waveforms monitoring)

Lead Type I / II / III / aVR / aVL / aVF / V

Symbol	Color	Electrode Site
RA	White	On the right infraclavicular fossa
LA	Black	On the left infraclavicular fossa
LL	Red	On the left midclavicular line, near the suprasternal line.
RL	Green	On the right midclavicular line at the same height as F.
V	Brown	Chest Lead (V1–V6)

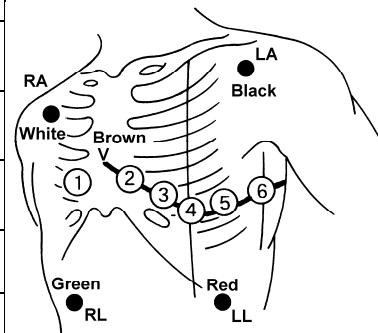


For 10-electrode lead (Max. simultaneous 12 waveforms monitoring)

Lead Type

I	/	II	/	III	/	aVR	/	aVL	/	aVF	/	V1	/	V2	/	V3
V4	/	V5	/	V6												

Symbol	Color	Electrode Site
RA	White	On the right infraclavicular fossa
LA	Black	On the left infraclavicular fossa
LL	Red	On the left midclavicular line, near the suprasternal line.
RL	Green	On the right midclavicular line at the same height as F.
V	Brown	The fourth intercostal space at the right sternal border.
V2	Yellow/Brown	The fourth intercostal space at the left sternal border.
V3	Green/Brown	On the midway between V2 and V4.
V4	Blue/Brown	The fifth intercostal space on the left midclavicular line.
V5	Orange/Brown	On the left anterior axillary line at the same horizontal level as V4.
V6	Violet/Brown	On the left midaxillary line at the same horizontal level as V4 and V5.



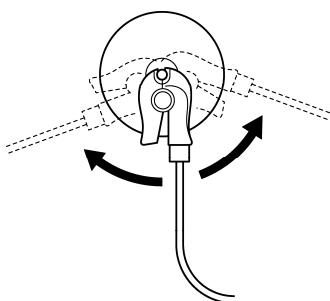
Connection to the Super Module



- Use only the specified relay cables, lead cables, and electrodes.
- The conductive parts of electrodes and associated connectors for applied parts, including the neutral electrode, should not contact other conductive parts including earth.

1 Connect the lead cable to the electrode.

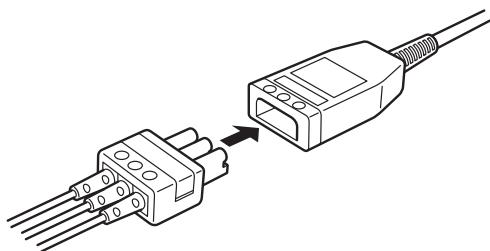
Clip on the lead cable end to the electrode convex part.



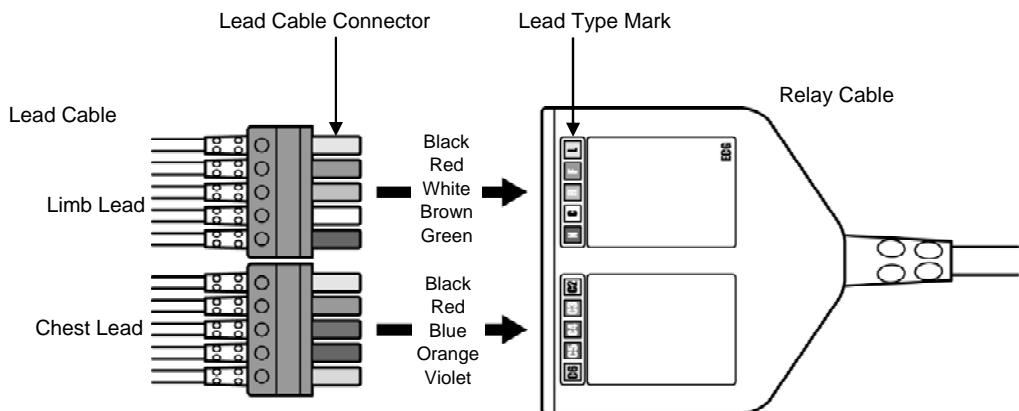
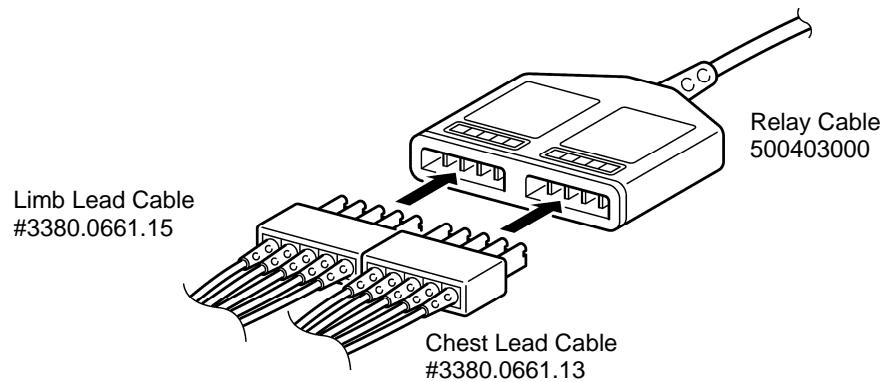
- The indication for continuous use of the electrode is about one day.
- Replace the electrode if the skin contact gets loosen due to perspiring, etc.
- When an electrode is attached at the same location for a long time, some patients may develop a skin irritation. Check the patient's skin condition periodically and change the electrode site as required.

2 Connect the lead cable to the relay cable.

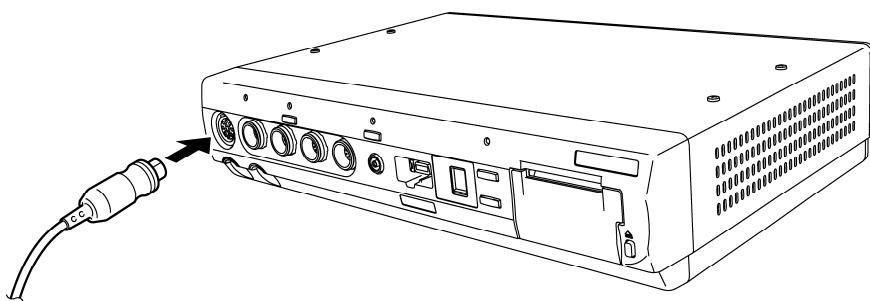
【Example of 3-electrode lead cable: #3380.0648.13】



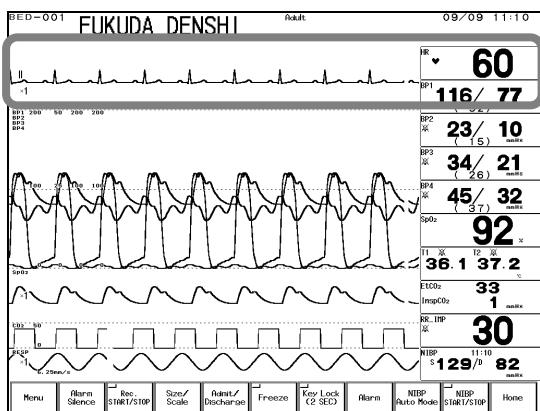
【Example of 10-electrode lead cable】



3 Plug in the relay cable to the ECG input connector (green) of the Super Module.



4 Verify that the ECG waveform is displayed on the monitor.



Adjust the waveform size and position, set the lead, AC filter, filter mode, etc. on the bedside monitor as necessary.

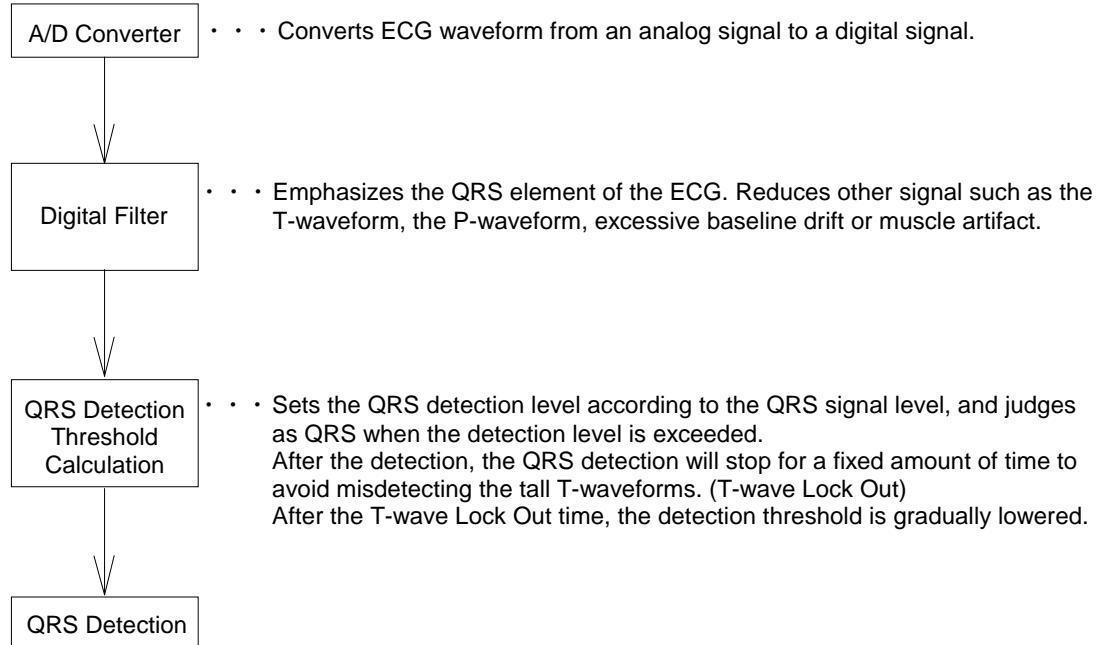
3

To Acquire ECG Waveform

QRS Detection

The QRS on the ECG waveform can be automatically detected. When the automatically determined detection threshold level is exceeded, it will be judged as QRS. However, if the QRS amplitude is extremely small or has an irregular pattern, QRS may not be detected.

Automatic QRS Detection Algorithm

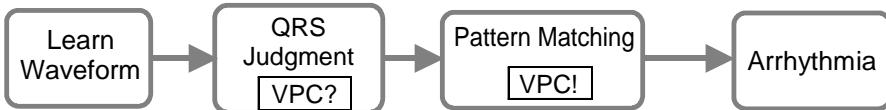


The detection threshold level differs according to the ECG waveform size selection on the patient monitor.

CAUTION	<ul style="list-style-type: none">There are some cases when QRS is not automatically detected although the amplitude is above the threshold level.QRS may not be automatically detected for the following ECG waveforms.<ul style="list-style-type: none">The amplitude is low and extremely wide.Contains large amount of artifacts such as EMG or excessive body movement.Contains excessive noise from electrosurgery.
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Arrhythmia Analysis

Arrhythmia Analysis Flow



The arrhythmia detection algorithm learns the normal waveform of the patient and compares the waveform (QRS pattern) and RR interval for each heartbeat to determine the VPC.

It compares the parameters such as QRS amplitude, QRS width, QRS polarity, RR interval, and selects abnormal QRS. Then the QRS with suspected VPC is pattern matched to distinguish the noise and VPC. This will finally determine the VPC and generate the arrhythmia alarm.

3

To Acquire ECG Waveform

WARNING	Arrhythmia detection is objective and constant. However, excessive waveform morphology change, motion artifact, or the inability to determine the waveform pattern may cause an error, or fail to make adequate detection. Therefore, physicians should make final decisions using manual recording, alarm recording and recall waveform for evaluation.
CAUTION	For proper arrhythmia detection and ECG monitoring, verify proper electrode placement, lead selection, and waveform size. Set the filter mode if necessary. Improper electrode placement, lead selection, and waveform size can cause errors in detection.

●QRS Classification

Each QRS will be classified to the following pattern.

N (Normal)	Normal QRS beat
V (VPC)	Ventricular Extrasystole
S (SVPC)	Supraventricular Extrasystole
P (Pacing Beat)	Pacing beat
F (Fusion Beat)	Fusion beat of pacing and spontaneous beat
? (Undetermined Beat)	Learning arrhythmia, or beat not matching the pattern

●Arrhythmia Type

With the above QRS judgment, the following 12 types of arrhythmia alarm can be generated.

Type	Meaning	Detection Criteria
ASYSTOLE	Cardiac Arrest	Cardiac arrest is detected for more than preprogrammed time.
VF	Ventricular Fibrillation	A random, rapid electrical activity of the heart is detected.
VT	Ventricular Tachycardia	9 or more continuous ventricular beats are detected. (HR: 140bpm / 120bpm or over)
SLOW_VT		9 or more continuous ventricular beats are detected. (HR: under 140bpm / 120bpm)
TACHY	Tachycardia	HR is over the upper alarm limit.
BRADY	Bradycardia	HR is below the lower alarm limit.
RUN	Consecutive VPC	Continuous VPC exceeding the preprogrammed value is detected.
COUPLET	Couplet Ventricular Extrasystole	2 continuous beats of VPC is detected.
PAUSE		Cardiac arrest exceeding the preprogrammed value is detected.

Type	Meaning	Detection Criteria
BIGEMINY	Ventricular Bigeminy	3 or more continuous QRS pattern of V-N is detected.
TRIGEMINY	Ventricular Trigeminy	3 or more continuous QRS pattern of V-N-N is detected.
FREQUENT	Frequent VPC	VPC exceeding the preprogrammed value is detected within 1 minute.

Filter Selection

● Filter Mode Setup

The waveform frequency characteristic can be selected from Monitor Mode, ESIS Mode, or Diagnosis Mode according to the monitoring purpose.

1. Monitor Mode Frequency Characteristic Adult / Child: 0.5–40Hz Neonate: 1.6–40Hz

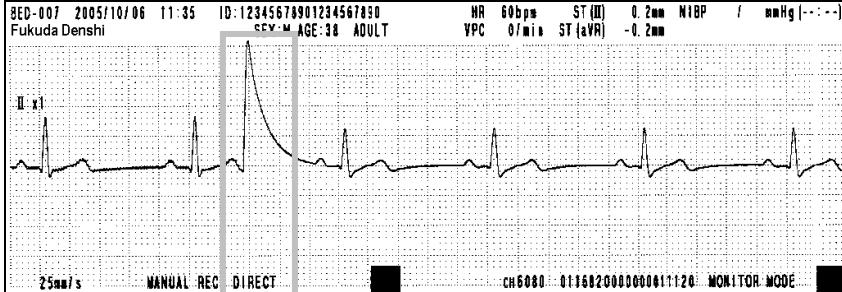
This is the standard mode for ECG monitoring. The upper frequency is set to 40Hz to reduce artifact caused by EMG, etc.

2. ESIS Mode Frequency Characteristic Adult / Child: 1.6–15Hz Neonate: 1.6–15Hz

By selecting this mode when using electrosurgical instrument or electric blanket, electrical noise can be largely reduced.

3. Diagnosis Mode Frequency Characteristic Adult / Child: 0.05–100Hz Neonate: 1.6–100Hz

Select this mode to monitor ECG without filter influence. However, this mode is susceptible to artifact influence.

NOTE	<p>When the filter setup is changed, a notch will appear on the ECG waveform due to the change in frequency characteristic. This will appear on the display, recording, and recall waveform.</p> 
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● AC Filter

If the ECG waveform is interfered with AC noise, the AC filter cuts off the frequency component (50Hz or 60Hz).

● Drift Filter

The drift filter reduces the ECG baseline drift.

[ON] or [OFF] can be selected on the ECG configuration menu on the patient monitor.

Electrosurgical Interference

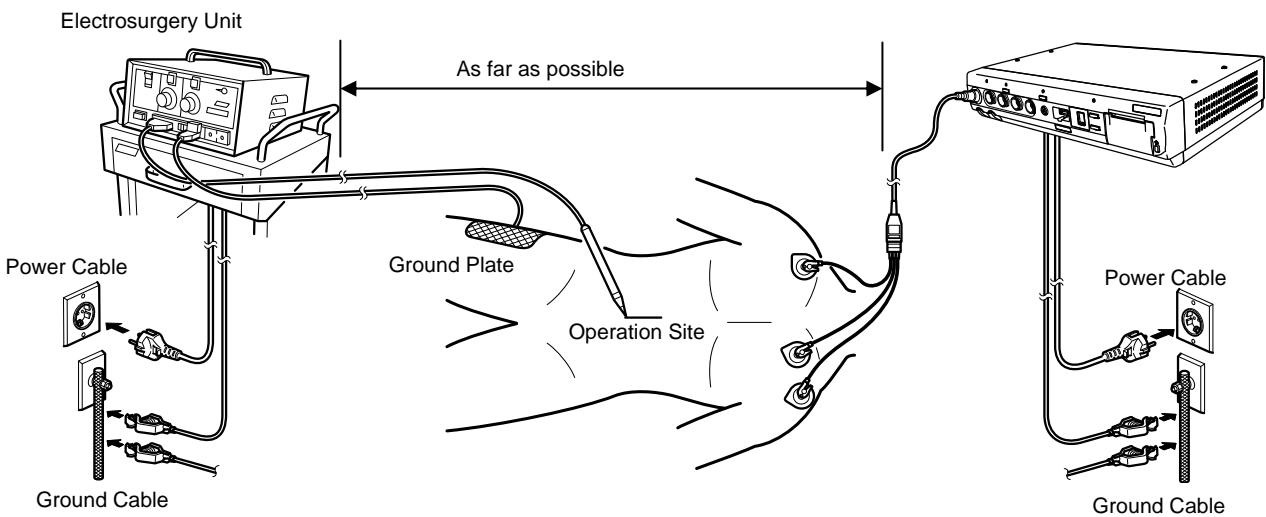
The HS-700 contains protection against the interference generated when using electrosurgery instruments. But still, noise may be generated in some conditions depending on the environment, location of the surgery on the patient, type of electrosurgical knives, and so forth. The artifact generated by the electric discharge at the tip of the surgical knife has frequency characteristics that closely correspond with that of the ECG. This makes it difficult to completely eliminate. To reduce the electrosurgical interference, please take the following precautions.

1. ECG Relay Cable

To reduce the noise of electrosurgery influence, use the ECG relay cable, CI-700E-3, CI-700E-4, CI-700E-5 (electrosurgery-proof relay cable).

2. Location

Locate the electrosurgical unit as far as possible from the patient monitor, input box or patient cables. This can help prevent the electrosurgical interference on the ECG through the HS-700 or the ECG patient cable.



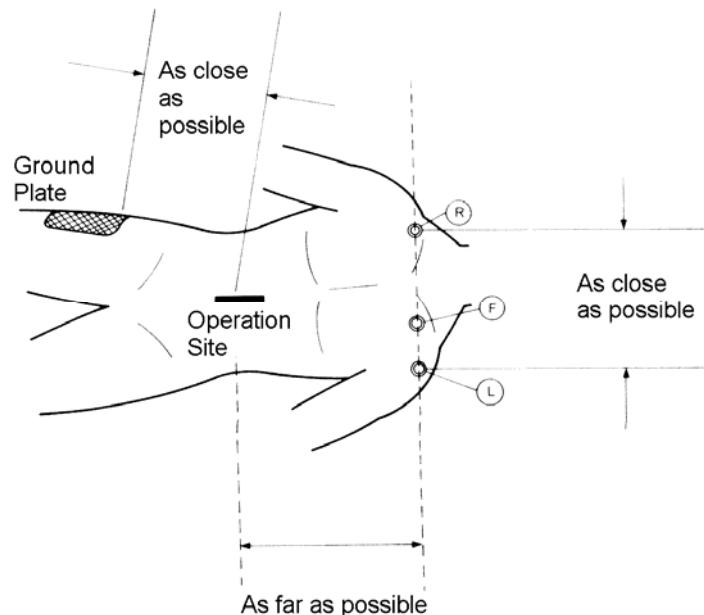
3. AC Power Source

Connect the electrosurgical unit to a power system that is different from that of the patient monitor. This can help prevent electrosurgical interference through the power line.

4. Electrode Placement

The amount of interference differs depending on the electrode placement and surgical location on the patient. Place the electrodes as far as possible from the area of surgery.

If the electrodes are placed in between the surgery location and the ground plate for the electrosurgical knife, the interference will be quite large. Try to place the electrodes outside this range as much as possible, and place the positive and negative electrodes as close as possible to each other.

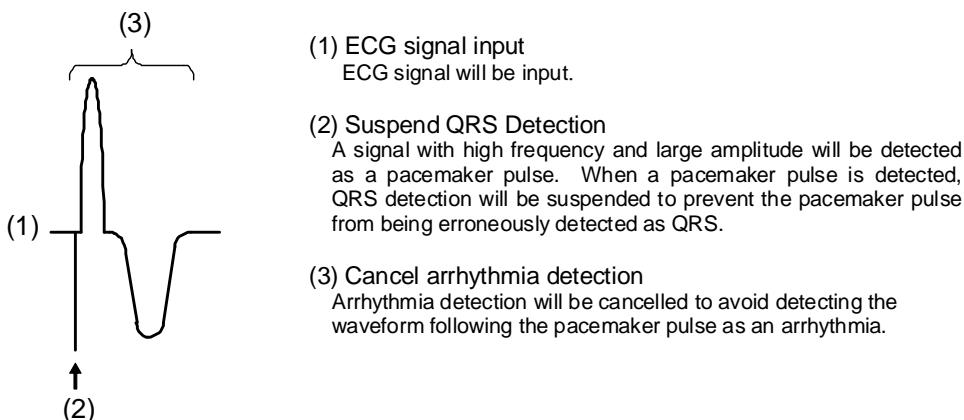


Patients with Pacemakers

When monitoring a patient with a pacemaker, select [Used] for pacemaker in the patient admit/discharge menu, and select [ON] for pacemaker pulse in the ECG configuration menu of the patient monitor. This will superimpose the pacemaker pulse waveform on the ECG waveform.

WARNING	Rate meters may continue to count the pacemaker rate during occurrences of cardiac arrest or some arrhythmias. Do not rely entirely upon rate meter alarms. Keep pacemaker patients under close surveillance. See "11 Technical Information" for disclosure of the pacemaker pulse rejection capability of this equipment.
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●Pacemaker Pulse Detection Algorithm



●Cautions for Pacemaker Pulse Detection

ECG Signal Input

- There are some cases when a pacemaker pulse cannot be detected. This depends on the pacemaker type, pulse voltage, pulse width, electrode lead type (unipolar, bipolar), and electrode placement.
- If there are signals similar to a pacemaker pulse, such as electric blanket noise or excessive AC frequency noise, these may be erroneously detected and displayed as a pacemaker pulse.

QRS Detection / Arrhythmia Detection

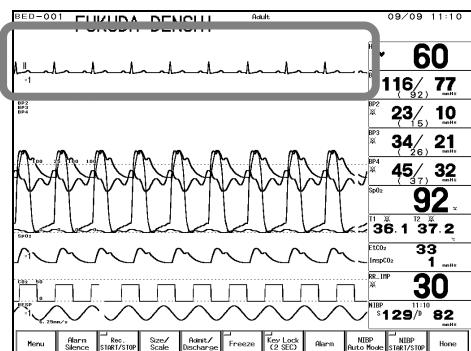
- When the waveform of the QRS and a pacemaker pulse (fusion beat) overlaps, QRS detection may be suspended to prevent erroneous detection.
- If the pacemaker pulse is continuously detected due to AC frequency interference, QRS detection will remain suspended which will reduce the heart rate. Also, arrhythmia cannot be detected for this case.

Respiration (Impedance Measurement)

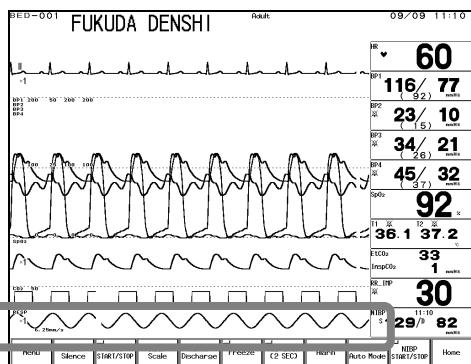
CAUTION

- When the following relay cables are used, respiration cannot be measured.
 - Relay Cable CI-700E_3 (Electrosurgery-proof, 3-electrode)
 - Relay Cable CI-700E_4 (Electrosurgery-proof, 4-electrode)
 - Relay Cable CI-700E_5 (Electrosurgery-proof, 5-electrode)
- When a defibrillator is used during respiration monitoring, a large offset voltage will be placed on the ECG electrodes, which may cause interruption of monitoring for a few seconds.

1 Verify that the ECG waveform is properly acquired.



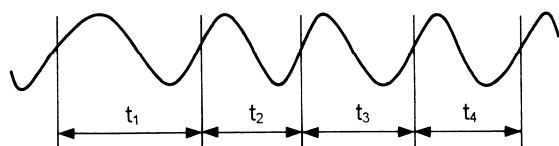
2 Verify that the respiration waveform and respiration rate is displayed on the home display.



Automatic Respiration Detection

The respiration is automatically detected.

The respiration rate (RR) is averaged over 15 seconds of measurements of the inspiration and expiration intervals.



$$RR = \left[\frac{\text{Total respiration interval time detected for 15sec.}}{\text{Qty of waveform detected for 15sec.}} \right]$$

Above value is converted to rate per minute.

Respiration Filter Selection

The following respiration filters can be selected.

- 0.15–2.5Hz (Neonate)
- 0.15–1.5Hz (Adult / Child)

Generally, neonates have lower amplitude and higher respiration rates as compared to adults. Select an appropriate filter for each patient to eliminate artifact and to display a proper waveform and measured value.

To Measure the SpO₂

(HS-710, 710E, 720, 720E, 720C, 702C, 702E)

The HS-700 series incorporates a SpO₂ measurement module manufactured by NELLCOR®.

1 Prepare an appropriate probe or sensor for the patient.

Sensor Types

Probe Type (Reusable type, for adult finger)



DS-100A

For adult with weight of 40kg and over.

This is for temporary use. When continuously using for long period of time, use the following single-use type.

Single Use Type



OXISENSORIII N-25 (for neonate toe)

For neonate with weight of 3kg and over.



OXISENSORIII I-20 (for pediatric toe)

For pediatric with weight of 3–20kg



OXISENSORIII D-20 (for pediatric finger)

For pediatric or adult with weight of 10–50kg



OXISENSORIII D-25 (for adult finger)

For adult with weight of 30kg and over.



MAX Fast (for adult forehead)

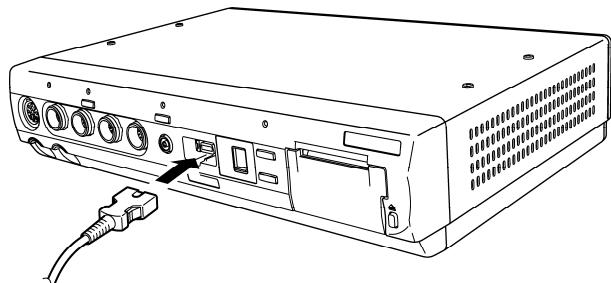
For adult with weight of 40kg and over.

With the use of new technology of NELLCOR®, OXIMAX, stable monitoring during body motion / low perfusion is possible.

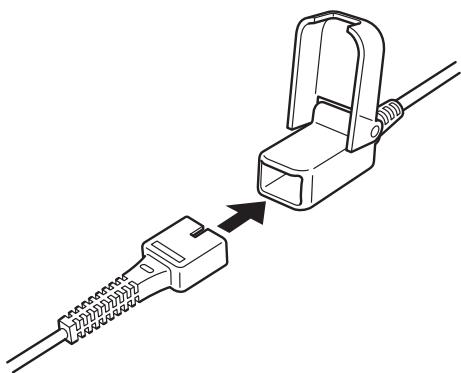
3

To Measure the SpO₂ (HS-710, 710E, 720, 720E, 720C, 702C, 702E)

2 Connect the sensor to the Super Module.



(1) Connect the SpO₂ relay cable (DOC-10) to the SpO₂ input connector on the Super Module.



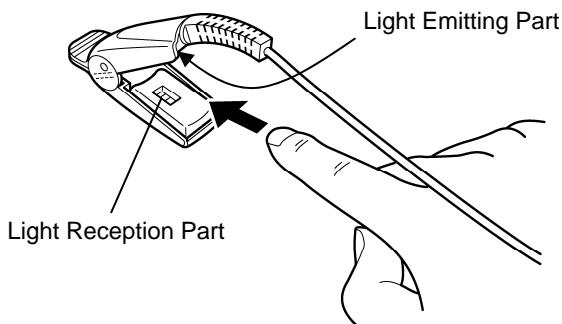
(2) Insert the sensor into the SpO₂ relay cable connector, and lock with the transparent part.

3 Attach the sensor to the patient.

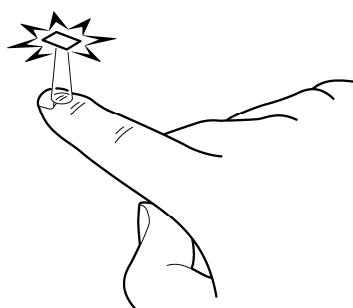


If the nail is rough, dirty, or manicured, accurate measurement will not be possible. Change the finger or clean the nail before attaching the probe and sensor.

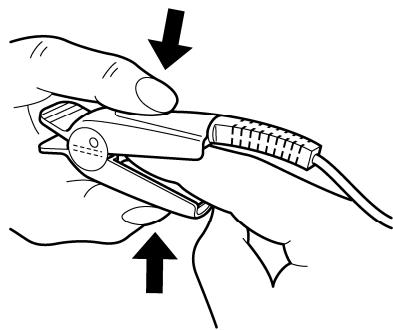
【Probe Type Sensor】



(1) Attach the probe as shown on left.
The probe cable should be on the nail side.



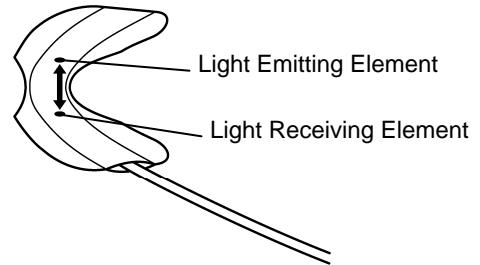
(2) Adjust the sensor so that the light-emitting part
(on cable side) touches the root of the nail,
and close the probe.



- (3) Press the probe lightly so that the finger and the rubber cover are appressed.
This is to stabilize the probe, and to avoid ambient light.

【Single-use Type】

- (1) Clean the attachment site with alcohol, etc.
- (2) Align the light emitting element and light receiving element of the sensor with the measuring site in between when attaching the sensor to patient.



- (3) Fixate the cable with surgical tape so that the sensor does not come off when a cable is pulled.

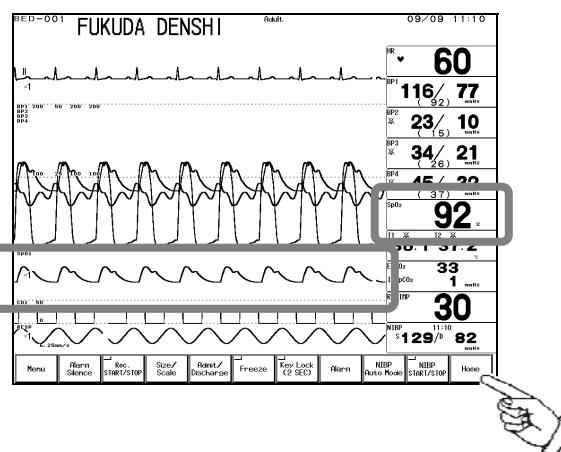


Attachment to the toe



Attachment to the finger

4 Verify that the SpO₂ value and waveform are displayed on the home display.



Adjust the waveform size, baseline position, etc. on the bedside monitor as necessary.



 WARNING	<ul style="list-style-type: none"> ● When measuring the SpO₂ of patient with high fever or peripheral circulatory insufficiency, check the sensor attachment periodically and change the attachment site. The temperature of attachment site will rise 2 to 3°C due to the sensor heat which may result in burn injury. ● For the following case, accurate measurement may not be possible. <ul style="list-style-type: none"> • Patient with excessive abnormal hemoglobin (COHb, MetHb) • Patient with the pigment injected to the blood • CP Patient receiving CPR treatment • When a sensor is applied to a limb with NIBP cuff, arterial catheter, or intracatheter • When measuring at site with venous pulse • Patient with body motion • Patient with small pulse
 CAUTION	<ul style="list-style-type: none"> ● If irritation such as skin reddening or skin fit appears with the sensor use, change the attachment site or stop using the sensor. ● When fixating the sensor with a tape, do not wind the tape too strong. At the same time, check the blood flow constantly so that congestion is not generated at the peripheral. ● When fixating the sensor with a tape, do not wind the tape too strong. At the same time, check the blood flow constantly so that congestion is not generated at the peripheral. ● Change the sensor attachment site constantly (every 4 hours). As the temperature of sensor attachment site normally rises 2 to 3°C, compression necrosis and burn injury may generate. ● As the skin of neonate / low birth weight infant is immature, change the sensor attachment site more frequently depending on the condition. ● Direct sunlight to the sensor area can cause a measurement error. Place a black or dark cloth over the sensor. ● When not performing the measurement, unplug the relay cable and sensor from the SpO₂ connector. Otherwise, the measurement data may be erroneously displayed by the ambient light.

HR/PR Source

The HR/PR source can be selected from ECG, SpO₂, BP, or Auto.

When SpO₂ is selected, the heartbeat tone will be synchronized with the pulse instead of the ECG.

The tone will vary in pitch with changes in saturation. The higher the saturation percentage, the higher the pitch.

SpO₂ SEC Alarm Function

This function is valid only when the SpO₂ alarm is set to ON.

When the SpO₂ value is unstable around the lower alarm limit, the frequently generated alarm may be bothersome. The SEC alarm function controls these frequent alarms.

This function generates the alarm only when the integral value (the accumulation of difference between the alarm limit and SpO₂ value at every second) reaches the preprogrammed SEC alarm threshold value.

If the SpO₂ value falls below the lower limit, the alarm will be generated after a preprogrammed time.

The SEC alarm value can be selected from **OFF**, **10**, **25**, **50**, **100**.

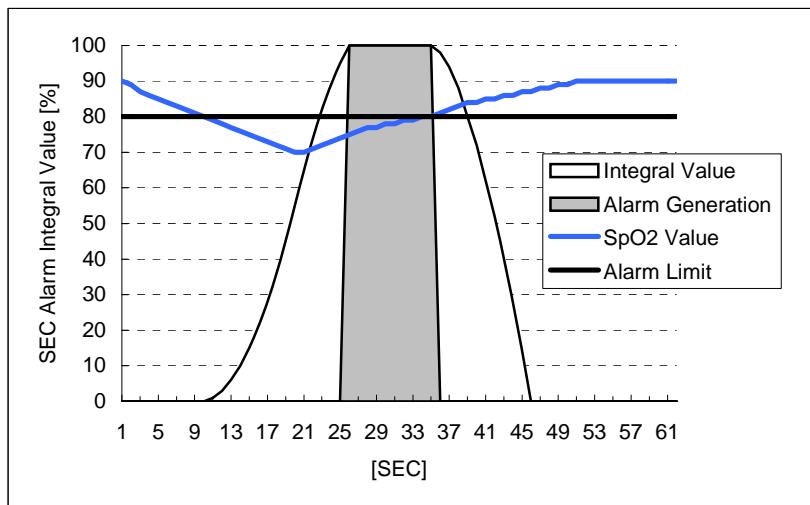
If **10** / **25** / **50** / **100** is selected, a circular SEC alarm indicator will be displayed inside the parameter key. As the integral value increases, the indicator will begin to fill, and when it is completely filled, an alarm will be generated.

If **OFF** is selected, this SEC alarm indicator will not be displayed.



SEC Alarm Indicator

The integral value of the SEC alarm is calculated as follows.



On this graph, the SEC alarm threshold value is set as 100.

The SpO₂ value begins to fall below the alarm limit at approximately 10 seconds. At the same time, the integral value begins to increase.

(Alarm limit) – (SpO₂ value) is accumulated each second.

At around 25 seconds, the integral value reaches 100 and the alarm is generated.

At approximately 36 seconds, the SpO₂ value returns to the level within the alarm limit, and at the same time, the integral value begins to decrease. $\{(\text{Alarm limit}) - (\text{SpO}_2 \text{ value})\} \times 2$ is subtracted each second.

NOTE	<ul style="list-style-type: none"> ● The SEC alarm function has a safety net for the case when the SpO₂ value frequently falls below the alarm limit but does not last long enough to reach the SEC alarm threshold. If the SpO₂ value falls below the limit 3 times or more during the last 60 seconds, an alarm will be generated even if the SEC alarm threshold is not reached. ● Whether to use the SEC alarm function and its threshold selection should be based on the patient's clinical indication pertinent and medical evaluation.
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Pulse Oximetry Measurement

The HS-700 measures pulse oximetry by means of an electro-optical sensor and a microprocessor-based computation circuit. Employing the principles of spectrophotometry, each sensor is equipped with light sources of two low-voltage light emitting diodes (or LED) and a photodetector (or photodiode). Each LED emits light of different wavelength; one emits red light (in the range of 660nm), and the other emits infrared light (in the range of 920nm). As the light from these LED passes through the body tissues, some of them will be absorbed. With the amount of light emitted by the LED, and the photodetector measurement, amount of both red and infrared light absorbed by the tissues can be determined.

Each heartbeat forces a "pulse" of oxygenated arterial blood to the SpO₂ sensor site at the periphery (generating the SpO₂ plethysmographic or pulsatile waveform display on the monitor). The oxygenated hemoglobin of arterial blood differs from deoxygenated hemoglobin in its relative absorption of both red and infrared light. Thus, measurement of both red and infrared absorption can be used to determine the percentage of functional hemoglobin saturated with oxygen.

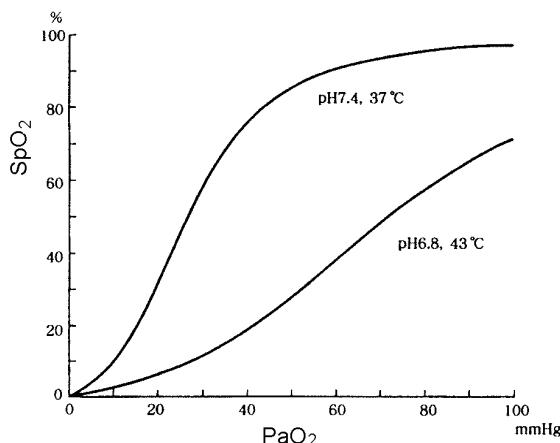
Light absorption measured when the pulsatile blood is absent reflects absorption of red and infrared light strictly by body tissues and non-pulsatile (venous) blood. This measurement can be considered as analogous to the "reference" use in a photospectrometer. Correcting for absorption of light of pulsatile blood against this "reference" and determining the ratio of the corrected absorption at each wavelength provides for the determination of arterial oxygen saturation (SpO₂).

Functional and Fractional Saturation

The HS-700 measures functional SpO₂ and may therefore produce measurements that differ from devices measuring fractional SpO₂. "Functional" SpO₂ is the amount of oxygenated hemoglobin expressed as a percentage of the total amount of hemoglobin capable of transporting oxygen. By utilizing the light of two different wavelengths, the HS-700 can analyze for both oxygenated and deoxygenated hemoglobin, and consequently, can determine the functional SpO₂. The HS-700 does not detect the presence of abnormal hemoglobin, such as carboxyhemoglobin or methemoglobin.

Measured Versus Calculated Saturation

When SpO₂ is calculated from a blood gas measurement of the partial pressure of arterial oxygen (PaO₂), the calculated value may differ from the HS-700 SpO₂ measurement. This is because the calculated SpO₂ may not have been corrected for the effects of variables that shift the relationship between PaO₂ and SpO₂: temperature, pH, the partial pressure of carbon dioxide(PaCO₂), and the concentrations of 2, 3-DPG and fetal hemoglobin.



To Measure the NIBP

Connection to the Super Module

1 Select the appropriate cuff type for the patient.

Select the appropriate cuff type for the patient.



Infant Cuff
CUF-7105
Width 8.5cm



Pediatric Cuff
CUF-7104
Width 10.5cm



Adult Cuff (small)
CUF-7103
Width 11cm

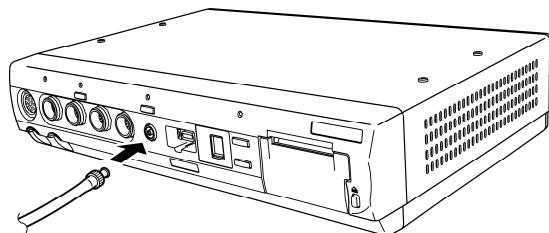
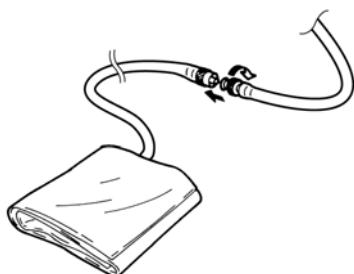


Adult Cuff (medium)
CUF-7102A
Width 14.5cm



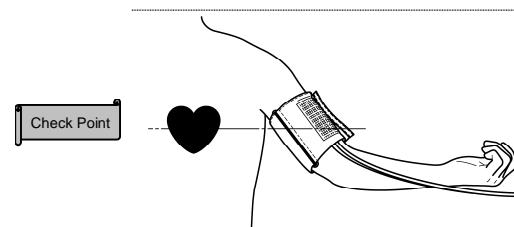
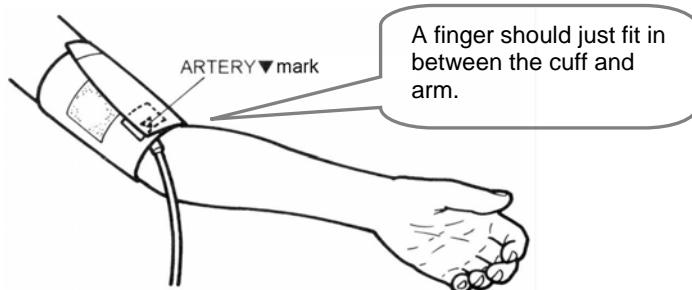
Adult Cuff (large)
CUF-7101
Width 17cm

2 Connect the cuff to the air hose, and then connect the air hose to the NIBP cuff connection connector on the Super Module.



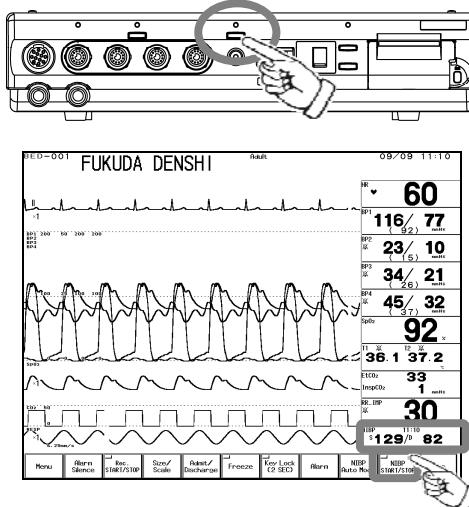
3 Apply cuff to the patient.

Position the ARTERY▼mark over the artery on the patient's arm and wrap the cuff around.



Align the cuff height and heart position to eliminate an error caused by the blood weight.
It is most appropriate to measure with the patient lying down and arms naturally extended.

4 Start the measurement.



Pressing the NIBP Start/Stop key on the Super Module, or on the bedside monitor will start inflating the cuff pressure and starts the measurement.

Upon completion, the measured data will be displayed on the bedside monitor.

Set the BP measurement unit, periodic measurement on the bedside monitor as necessary.

WARNING

Before the measurement, make sure the patient type (Adult / Child / Neonate) is properly selected. Otherwise, correct measurement cannot be performed, and congestion or other injury may result.

CAUTION

- Pay attention when measuring the NIBP of patient with bleeding disorders or hypercoagulation. The cuff inflation may cause petechia or circulatory failure by the blood clot.
- Do not apply the cuff to the arm or thigh where vein is secured. The blood may backflow causing the chemical injection to cease.
- If the air hose is twisted, or weighed down, the cuff air cannot be exhausted. Properly arrange the cuff and air hose.
- Check the condition of cuff-applied part on the patient during measurement so that the blood circulation will not be blocked over long period of time by the squashed or bent cuff hose.
- Check the patient's condition constantly while measuring over long period of time with interval of 2.5 minutes or less. Also, periodically check the blood circulation while performing periodic measurement over long period of time. Congestion may occur at the measuring site.
- The following factors may affect the NIBP value.
 - Body motion, arrhythmia, convulsion
 - Continuous noise such as cardiac massage
 - Periodic electromagnetic noise

NOTE

When the cuff is not applied to the patient, pay attention not to leave the cuff unattended. If periodic or continuous measurement is set, the cuff will automatically inflate and may cause the rubber bag inside the cuff to burst. When not performing the NIBP measurement, set the NIBP measurement interval OFF and disconnect the air hose from the NIBP connector.

Cuff Inflation Value

The initial inflation value and the measurement time for NIBP measurements are determined according to the selected patient type and the cuff size being used. Select the proper patient type (adult / child / neonate) and the appropriate cuff size.

The HS-700 NIBP system has an automatic safety exhaust function to release the cuff pressure. Initial inflate pressure, maximum pressure allowed, and maximum measurement time are determined for each patient type. When the cuff pressure reaches the value, or the measurement time exceeds the value, the system will automatically exhaust the cuff pressure.

Patient Type	Initial Inflate Pressure	Max. Pressure	Max. Measurement Time
Adult	180mmHg	300mmHg	120sec.
Child	140mmHg	220mmHg	90sec.
Neonate	120mmHg	165mmHg	60sec.

To Measure the CO₂

(HS-710E, 720E, 702E)

The Microstream® technology developed by Oridion Medical 1987 Ltd. is used for the CO₂ measurement by HS-710E, HS-720E, HS-702E.

CAUTION

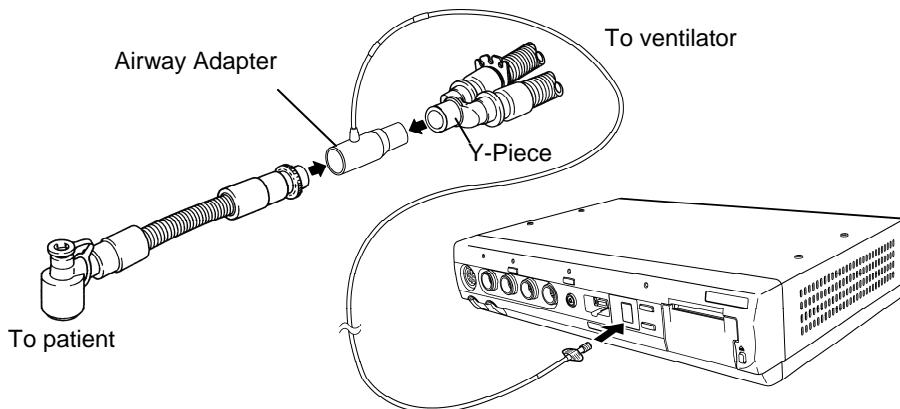
If the HC-500 (CO₂ Module) is simultaneously used, the CO₂ measurement priority will be according to the setting on the patient monitor. With the default setting, the HC-500 will be prioritized.

Patient Application and Display

Refer to "7. Accessories" for list of specified "Oridion Medical" airway adapters. These accessories may be purchased from Fukuda Denshi or any authorized "Oridion" distributors.

1 For intubated patient

- (1) Attach the airway adapter to respiration circuit.
- (2) Remove the protective cap on the airway adapter, and connect to the sampling tube. Connect the other end of the sampling tube to the CO₂ measurement connector on the Super Module. Verify that all the tubes are properly connected.

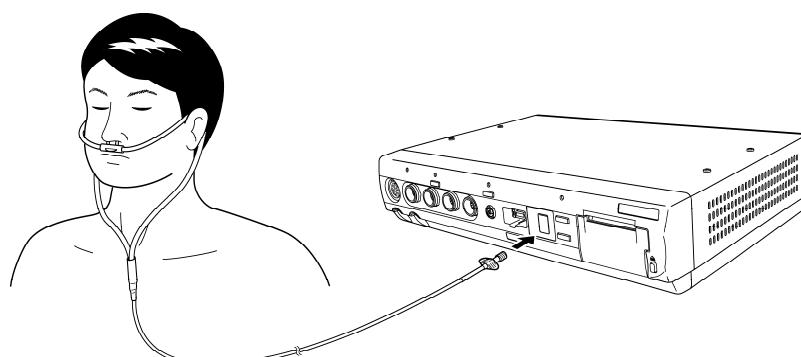


WARNING

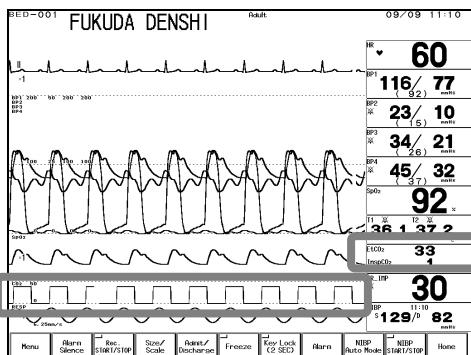
- Use only specified sampling tube and nasal prong manufactured by Oridion Medical 1987 Ltd. See "7. Accessories" (P7-5)
- Always consider the circumference of the intubation tube when using the airway adapter. If inappropriate airway adapter is used for a patient with low ventilation, CO₂ may mix in to the inspired air resulting in incorrect measurement, or apnea detection may become difficult.

2 For non-intubated patient using the nasal prong

- (1) Attach the nasal prong to the patient.
- (2) Connect the nasal prong to the CO₂ measurement connector on the Super Module. Verify that it is properly connected.



3 Verify that the CO₂ waveform and EtCO₂ measurement data is displayed on the patient monitor.



Stable measurement can be achieved after about 20 minutes from power ON.

Set the waveform scale, measurement unit, alarm, etc. on the bedside monitor as necessary.

NOTE

Connecting a sampling tube or nasal prong to the patient monitor will automatically start the sampling pump. To prevent the pump from deteriorating, disconnect the sampling tube and nasal prong from the patient monitor when not measuring the CO₂ concentration.

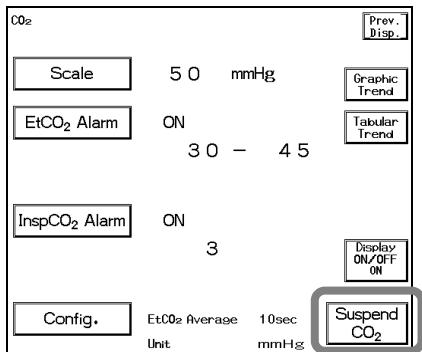
Suspending CO₂ Measurement

The CO₂ measurement can be temporarily suspended by stopping the CO₂ pump operation.

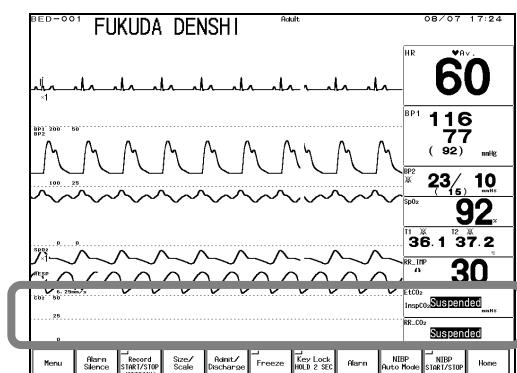


When performing expectoration treatment to the patient with a ventilator connected, make sure to suspend the CO₂ measurement before the treatment. Otherwise, water may enter into the pump causing the equipment to be damaged.

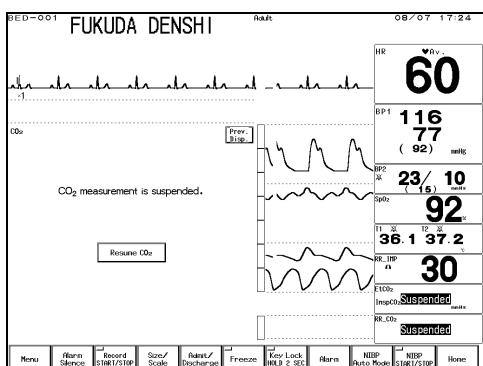
1 Press the **Suspend CO₂** key.



The pump operation will stop, CO₂ waveform and numeric data display will disappear, and "Suspended" will be displayed inside the CO₂, RR_CO₂ numeric data box.



- 2** If the CO₂ numeric data box (or RR_CO₂ numeric data box) is pressed when the CO₂ measurement is suspended, the following display will appear.



Press the **Resume CO₂** key to resume the CO₂ measurement.

For the following case, CO₂ measurement will automatically resume.

- When 15 minutes has elapsed since the measurement was suspended.
- When the patient is discharged.
- When the power was turned OFF for 5 minutes or more and turned ON again.

CAUTION

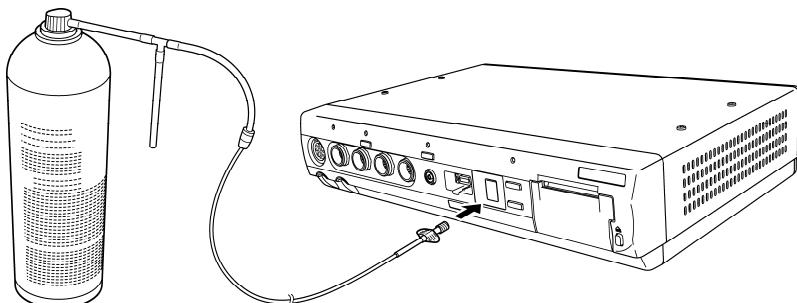
- When the CO₂ measurement is suspended, the CO₂ alarm generation and CO₂ data input to the tabular/graphic trend will also cease.
- If CO₂ is selected as the RR source, RR value will also not be displayed when the CO₂ measurement is suspended.

Procedure for Calibration

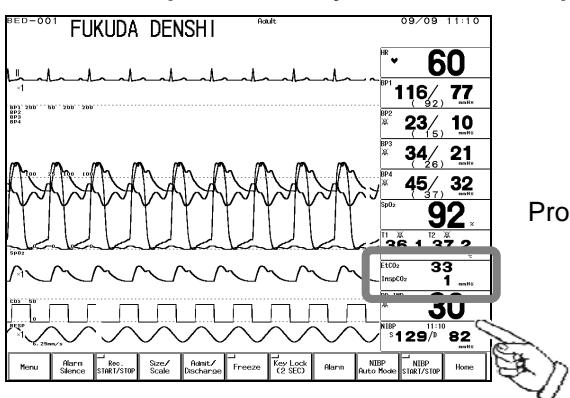
CAUTION

- Perform calibration after 20 minutes has elapsed since the Super Module is turned ON.
- Do not disconnect the sampling tube during calibration. Calibration will cease when the sampling tube is disconnected.

- 1** Connect the calibration gas cylinder to the Super Module.

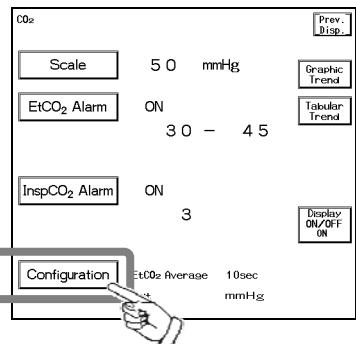


- 2** Press the CO₂ parameter key on the home display.



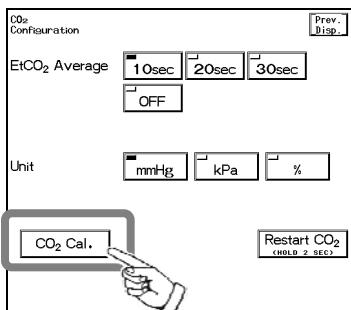
Proceed to the CO₂ setup menu.

3 Press the **Configuration key on the CO₂ setup menu.**

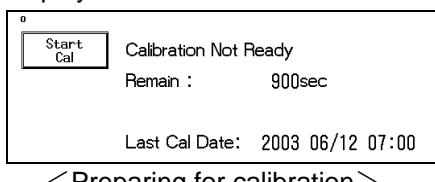


Proceed to the CO₂ configuration menu.

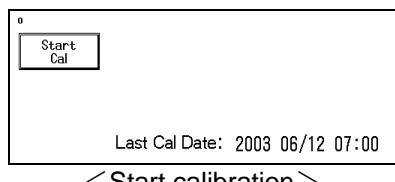
4 Press the **CO₂ Cal. key on the CO₂ configuration menu and display the calibration menu.**



Due to precision matter, CO₂ calibration can not be started until 20 minutes has elapsed after the power is turned ON. During this time, **Start Cal** key will be displayed in gray which indicates that the key is ineffective. The message, "Calibration not ready" and the remaining time for preparation will be displayed.



<Preparing for calibration>



<Start calibration>

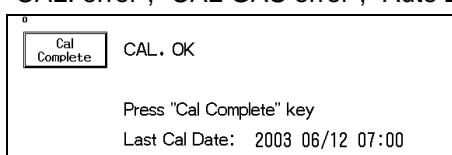
5 Press the **Start Cal key and conduct calibration according to the displayed messages.**

6 The message, "Feed CAL. GAS" will be displayed. Press the injection button and inject the calibration gas.

7 The message, "Calc. Gas can be removed" will be displayed. Stop pressing the injection button and cease the injection.

8 The message, "CAL. OK" will be displayed. "Last Cal. Date" will be updated to the current date.

If any of the following messages is displayed, start the procedure again from step 2.
"CAL. error", "CAL GAS error", "Auto Zero fail", "No stable gas flow", "CAL. failure"



Press "Cal Complete" key
Last Cal Date: 2003 06/12 07:00

9 Press the **Cal Complete key to end the calibration.**

CAUTION	<p>Conduct CO₂ calibration for the following case.</p> <ul style="list-style-type: none"> Initial calibration after 1,200 operating hours, then once a year or after 4,000 operating hours, whichever comes first. When EtCO₂ measurement is not stable or accuracy is degraded compared with other measuring device. When the patient monitor was not used for a while, or when EtCO₂ was not measured for a while.
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To Measure the CO₂

(HS-720C, 702C: Capnostat 5)

For the HS-720C and HS-702C, the CO₂ measurement is performed by the RESPIRONICS® Capnostat 5 sensor (Mainstream method).

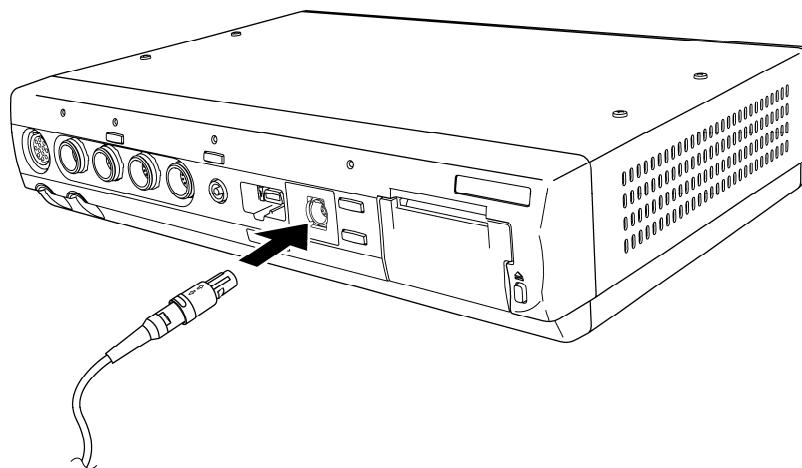
CAUTION

If the HC-500 (CO₂ Module) is simultaneously used, the CO₂ measurement priority will be according to the setting on the patient monitor. With the default setting, the HC-500 will be prioritized.

Patient Application and Display

1 Connect the CO₂ sensor (Capnostat 5) to the serial communication connector (RGM).

CO₂ sensor will automatically begin warming up.



The sensor requires a warming up process to achieve stable operating temperature. This process is performed automatically in any of the following situation:

- When the power of the monitor is turned on.
- When the CO₂ sensor is plugged into the Super Module.

During the warm up period, the message "CO₂ warm up" will be displayed on the monitor.
Warm up process will require 2 minutes or more.

When the warm up completes, the message will disappear.

2 Prepare an airway adapter suitable for the patient.

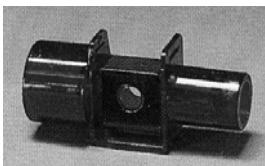
There are 4 types of airway adapters. Select the appropriate adapter according to the used endo-tracheal tube size.



Airway Adapter (Adult) 7007

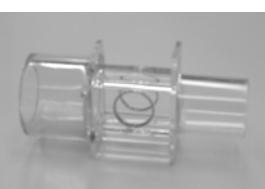
For patients using an endo-tracheal tube greater than 4.0 mm in diameter.

Reusable Type



Airway Adapter (Neonate) 7053

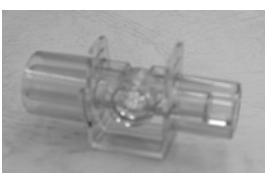
For patients using an endo-tracheal tube less than, or equal to 4.0 mm in diameter. Reusable Type



Airway Adapter (Disposable, Adult) 6063

For patients using an endo-tracheal tube greater than 4.0 mm in diameter.

Disposable Type



Airway Adapter (Disposable, Neonate) 6312

For patients using an endo-tracheal tube less than, or equal to 4.0 mm in diameter.

Disposable Type

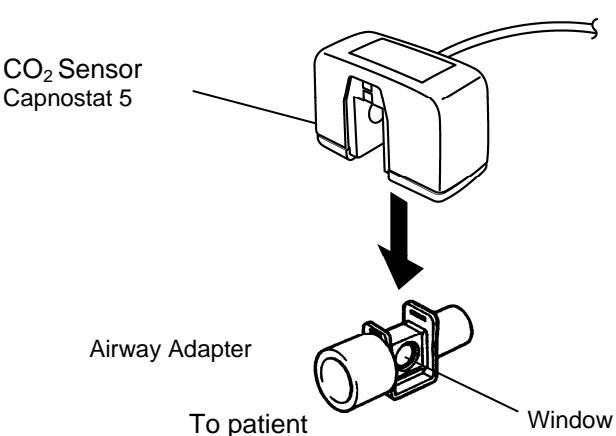
⚠ CAUTION

- The disposable airway adapter should be opened just before use. Do not sterilize it.
- Do not reuse the disposable airway adapter.

3 Verify that the warm up is complete, and attach the CO₂ sensor to the airway adapter until a “click” sound is heard.

⚠ CAUTION

The airway adapter should be attached with the thicker side facing to the patient. If attached oppositely, it may damage the CO₂ sensor or airway adapter.



4 Input the following data.

- O₂ Compensation

Input the oxygen concentration value to be applied to the patient.

- N₂O Compensation

Select ON if N₂O is supplied to the patient.

Select OFF if not supplied.

- Anesthetic Gas Compensation

Input the anesthetic gas concentration value if supplied.

If not supplied, input "0 (zero)".

- Atmospheric Pressure

Input the current atmospheric pressure.

NOTE	Set these items each time the condition changes.
------	--



For details of setup procedure, refer to "DS-7300 System Operation Manual".

5 Calibrate the airway adapter.

The airway adapter calibration must be performed before connecting to the respiration circuit.
Calibration must be also performed for the following case.

- When airway adapter is replaced
- When "CO₂ cal required" or "CO₂ adapter check" message is displayed on the monitor

Use a clean airway adapter.

When reusing, wash the adapter, wipe the window with a swab after air dry, and sterilize (EOG, etc.) before use.

NOTE	During the calibration, the measurement data will be displayed as "—". The measurement data during calibration may be included in the trend data causing discontinuity.
------	--

6 On the CO₂ menu of the patient monitor, press the **Cal Airway Adpt.** key.

The calibration process will start.

During calibration, "Zeroing CO₂" message will be displayed.

Upon completion of calibration, a tone will be generated and "Cal complete" message will be displayed.

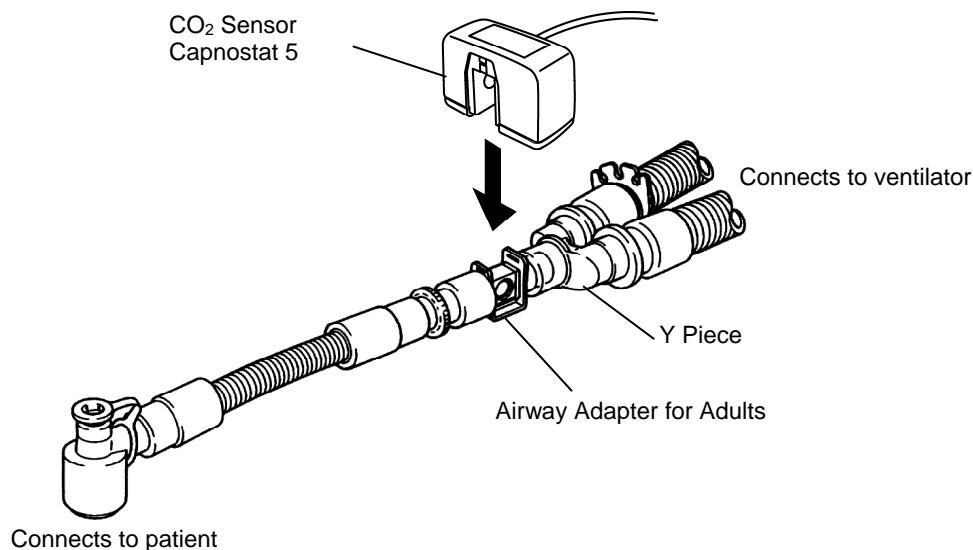
If the calibration fails, an error tone will be generated and "Cal error" message will be displayed.

In such case, start the calibration process again.

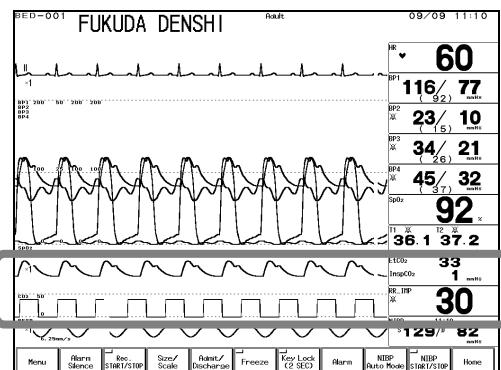
NOTE	Calibration cannot be performed if respiration is detected within 20 seconds before calibration. In such case, wait for next 20 seconds and perform calibration again.
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- 7 Verify that the airway adapter calibration is properly completed, and attach the airway adapter to the patient's respiration circuit. Then, attach the CO₂ sensor to the airway adapter.**

Attach the airway adapter between the patient's circuit wye and intubation tube. The CO₂ sensor should be facing upward.



- 8 Verify that the CO₂ waveform, EtCO₂ value, InspCO₂ value are displayed on the monitor.**



Adjust the scale, set the measurement unit, alarm, etc. as necessary.

CO₂ Measurement Principle

This unit (HS-720C, 702C) measures carbon dioxide and respiratory rate with a unique solid-state sensor called the Capnostat 5. The sensor is placed onto an airway adapter and the airway adapter is placed in the patient's airway circuit - - typically between the ventilator elbow and the patient wye. Infrared light is generated in one leg of the "U" shaped sensor and then beamed through the windows of the airway adapter to a detector in the other leg of the sensor. Carbon dioxide, flowing in the airway adapter as a result of respiration, absorbs some of this light energy. The monitor relates the amount of detected energy to the amount of CO₂ in the sample cell (the airway adapter). This results in a Capnogram display and numeric values for CO₂ and respiration rate.

To Measure the BP

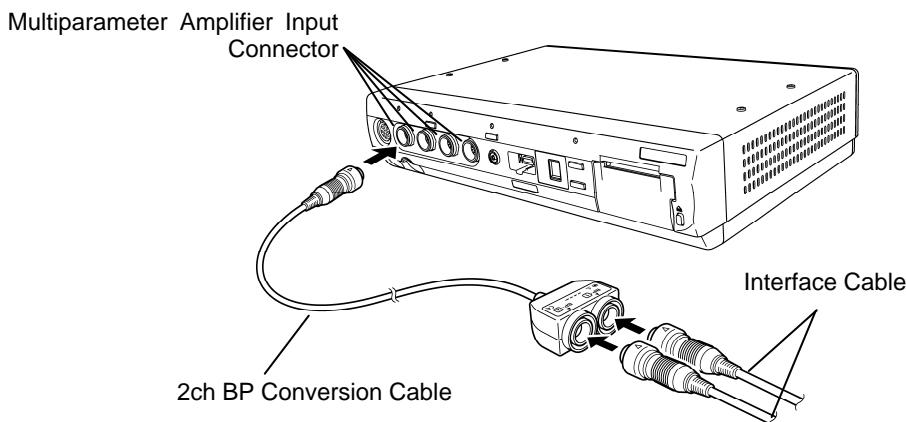
The BP measurement is performed through the multiparameter amplifier input connector. For HS-702C and 702E, interface cable can be directly connected to BP input connector. Using the 2ch BP interface cable allows monitoring of up to 8 channels of BP. (6 channels for HS-702C, 702E)

Connection to the Super Module

1 Connect the BP Interface Cable to the Super Module.

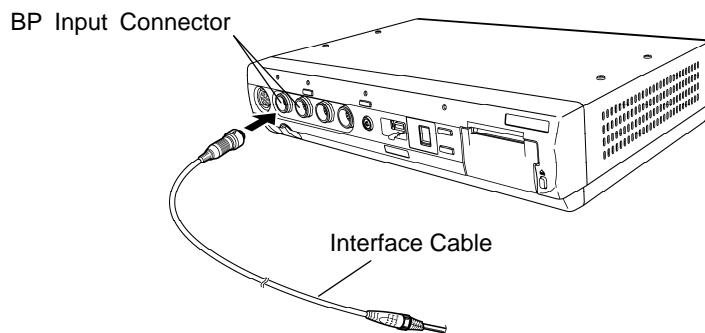
【For HS-710, 710E, 720, 720E, 720C】

Connect the interface cable to the multiparameter amplifier input connector (light blue) via CJ-7546 2ch BP Conversion Cable.

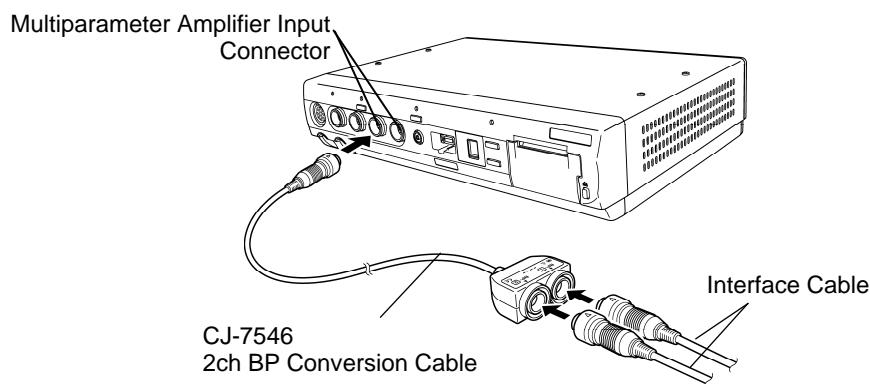


【For HS-702C, 702E】

Connect the interface cable to the BP input connector (orange).



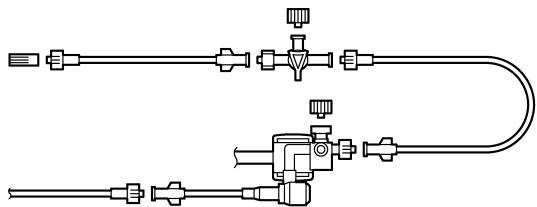
Or, connect the interface cable to the multiparameter amplifier input connector (light blue) via CJ-7546 2ch BP Conversion Cable.



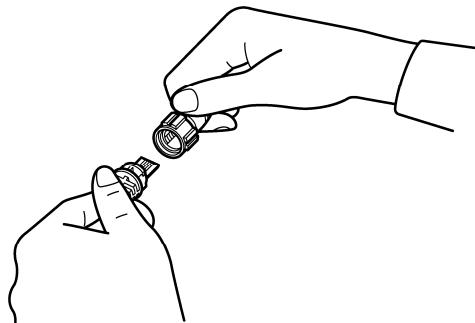
2 Assemble the BP measurement device.

The following procedure explains the case when BP transducer (COBE CDX series, No.041-575-504) is used.

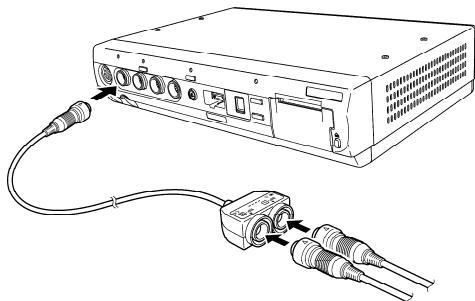
If using other transducers, refer to the operation manual for the corresponded transducer.



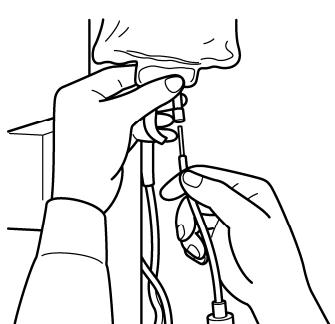
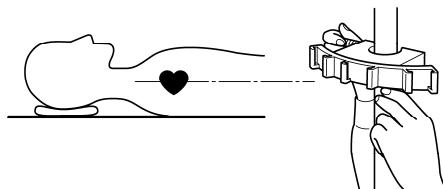
- (1) Inspect transducer packaging for damage prior to opening.
Verify that each connector is securely connected.



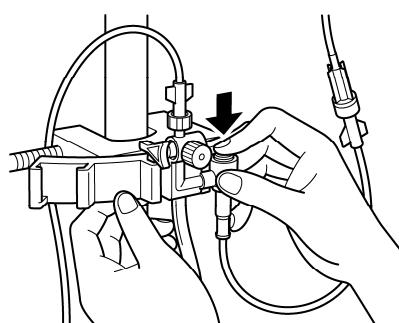
- (2) Connect the interface cable and 2ch BP conversion cable to the Super Module, and then to the transducer.



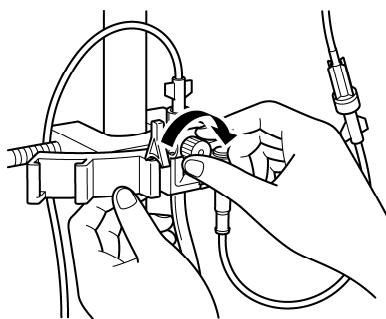
- (3) Align the bracket to patient's heart position (about 1/2 of the chest depth).



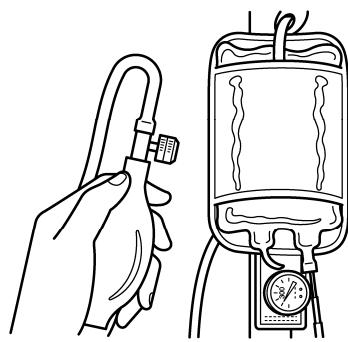
- (4) Inject 1000 units of heparin into saline bag, mix thoroughly and puncture the infusion line through the same hole. Set the saline bag to pressure bag, and hang from the infusion device. Fill saline to about 1/3 of the drip.



- (5) After loosening the zero-port plug, push the flash button to perform priming to remove air bubbles.

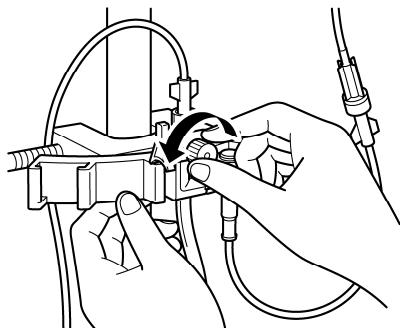


- (6) Verify that all air bubbles are removed, and tighten the zero-port plug.
Turn on the zero-port plug side of the open-air three-way valve.

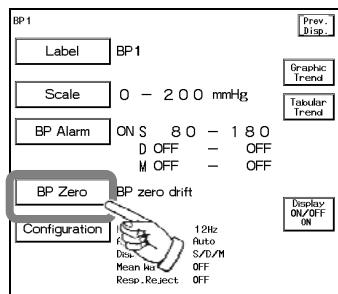
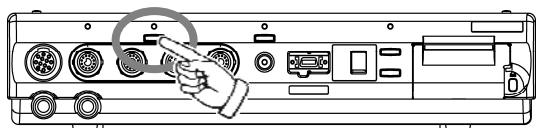


- (7) Inflate the pressure bag to 300mmHg.

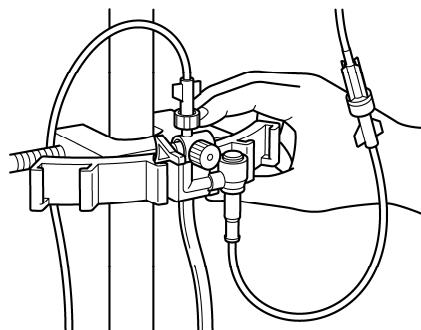
3 Perform zero balance.



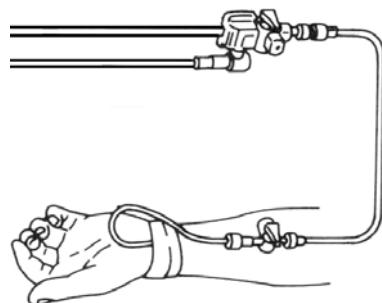
- (1) Loosen the zero-port plug on open-air three-way valve one-half turn.



- (2) Press the BP zero balance switch on the Super Module. Or, perform zero balance procedure on the bedside monitor.
The lamp will light during the zero balance procedure, and extinguishes when the procedure is complete.

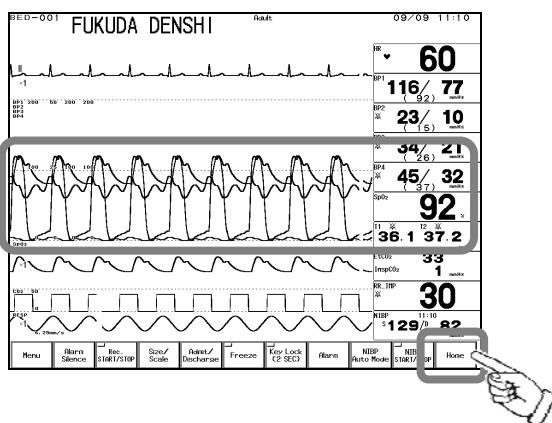


- (3) Turn off the zero-port plug side of the open-air three-way valve.



- (4) Connect the catheter to the end of monitoring line.
The preparation for measurement is complete.

4 Verify that BP waveform and numeric data is displayed on the monitor.



Adjust the waveform scale and baseline position, set the measurement unit, respiration filter, etc. on the bedside monitor as necessary.

CAUTION	<p>The zero balance procedure is required for the following case.</p> <ul style="list-style-type: none"> • When starting a measurement. • When the heart position has changed due to body movement. • When the transducer position has changed. • When measuring for a long period of time and there is a possibility of measurement error due to change in ambient temperature, etc. • When a connector is connected / disconnected, or a transducer is replaced.
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Label

Label each BP according to the measurement location.
The selectable BP labels are as follows.

ART	(Arterial Pressure)
LAP	(Left Atrial Pressure)
LVP	(Left Ventricular Pressure)
CVP	(Central Venous Pressure)
RAP	(Right Atrial Pressure)
PAP	(Pulmonary Artery Pressure)
UAP	(Umbilical Artery Pressure)
ICP	(Intra-cranial Pressure)
IAP	(Intra-aortic Balloon Pumping Pressure)
RVP	(Right Ventricular Pressure)
BP1–BP8	(Default)

NOTE	<p><u>Default BP Label</u></p> <p>If the Super Module and HB-500 BP Module are used simultaneously, the priority for the default BP label is higher for the Super Module. Then, the next priority will be in the order of the slot number of the input box.</p> <p>For example, if "BP1, 2" is used for the Super Module, and HB-500 are inserted in input box slot 1 and 2, "BP3, 4" will be assigned to the HB-500 in slot 1, and "BP5, 6" will be assigned to the HB-500 in slot 2.</p>
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Filter Selection

The cut-off frequency of 6, 8, 12, 40Hz can be selected as low-pass filter. If a high frequency artifact is interfered on the BP waveform, select 6Hz or 8Hz.

Respiration Rejection Filter

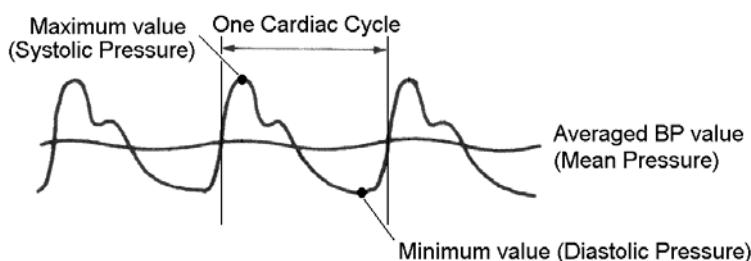
The BP waveform baseline drift caused by the respiration influence can be prevented by setting ON the respiration rejection filter.

Pulse Rate Measurement by the BP Waveform

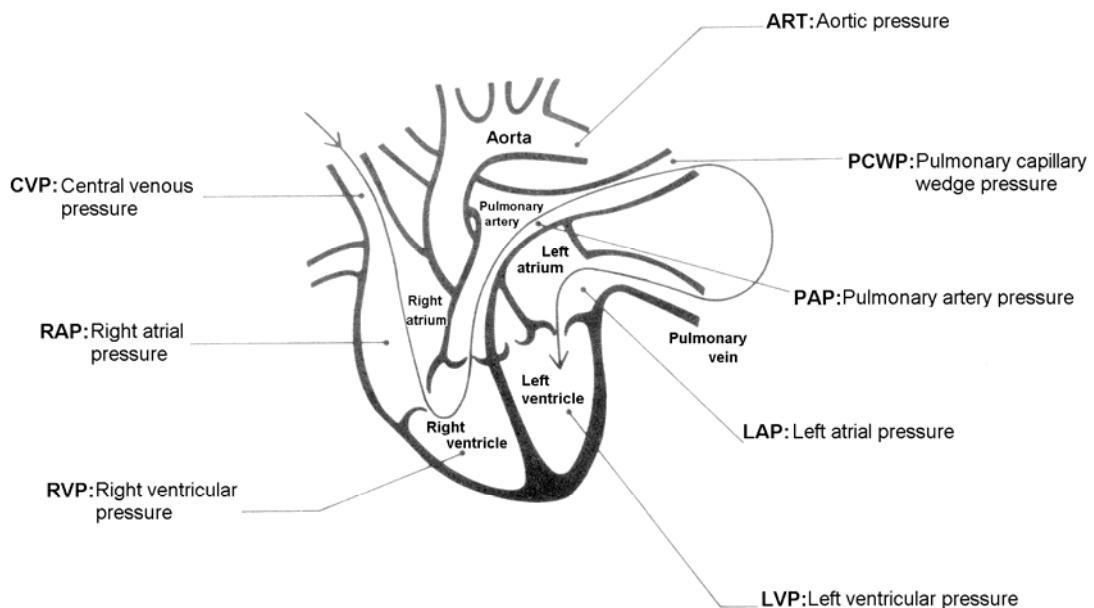
By selecting BP for the HR/PR source, the pulse rate can be measured from the waveform labeled as "ART".

Blood Pressure Calculations

The average pressure will be first measured. The pressure above this average will be determined to be in the systolic period, and the pressure below this average will be determined to be in the diastolic period. From the beginning of systolic period to the end of diastolic period will be one cardiac cycle. From this cardiac cycle, the maximum value (systolic pressure), minimum value (diastolic pressure) and mean value (mean pressure) for each cardiac cycle will be calculated.



Measurement Position



To Measure the Temperature

The temperature can be measured using the multiparameter amplifier input connector. By using the CJ-7414 2ch Temperature Relay Cable, up to 8 channels (4 channels for HS-702C, 702E) of temperature can be monitored.

1 Select an appropriate type of probe for the patient.

Probe Type

Reusable Type



Rectal Probe (adult) 401J



Rectal Probe (pediatric) 402J



Body Surface Probe 409J

Probe Cover (disposable)

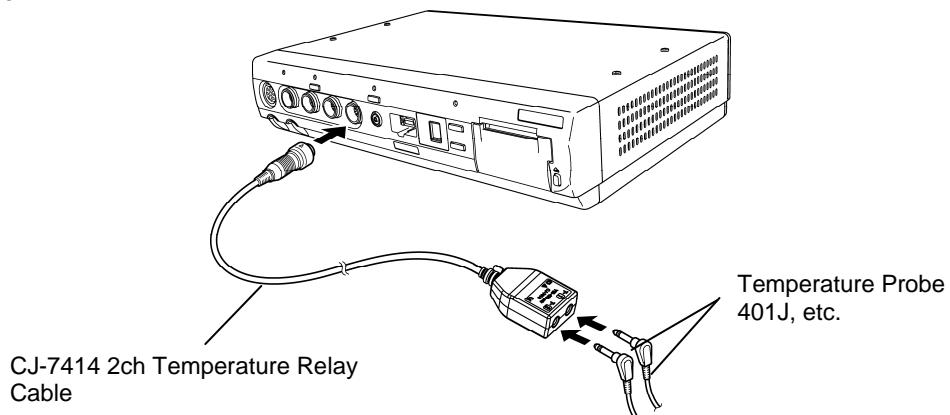


Probe Cover for 401J (10 covers)

3

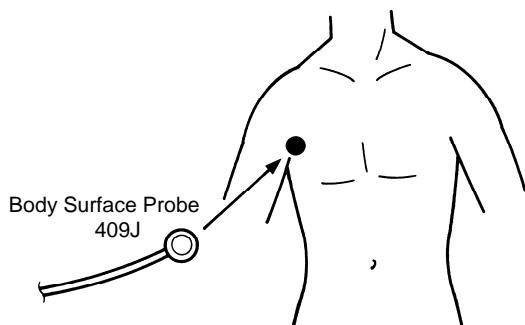
To Measure the Temperature

- 2** Connect the CJ-7414 2ch Temperature Relay Cable to the multiparameter amplifier input connector on the Super Module, and connect the temperature probe to the 2ch Temperature Relay Cable.



- 3** Attach the probe to the patient.

●Body Surface

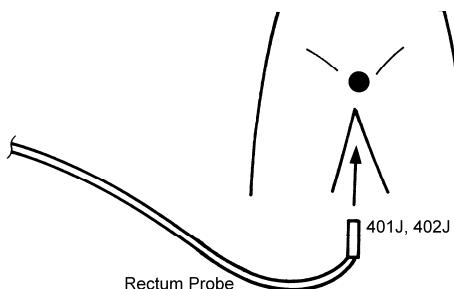


Attach the probe to the body surface, and secure with surgical tape.

NOTE

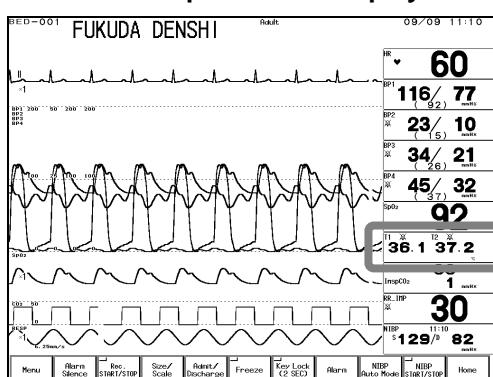
The probe location shown above is an example. Adjust the probe location according to the patient's condition.

●Rectum



- (1) Attach the probe cover to the probe end.
- (2) Insert the probe into the rectum about 3 to 7cm deep.
- (3) Secure the probe to inner thigh with surgical tape.

- 4** Check that the temperature is displayed on the patient monitor.



Set the measurement unit on the bedside monitor as necessary.

To Measure the Cardiac Output

The multiparameter amplifier connector is used for the cardiac output measurement.

Connection to the Super Module

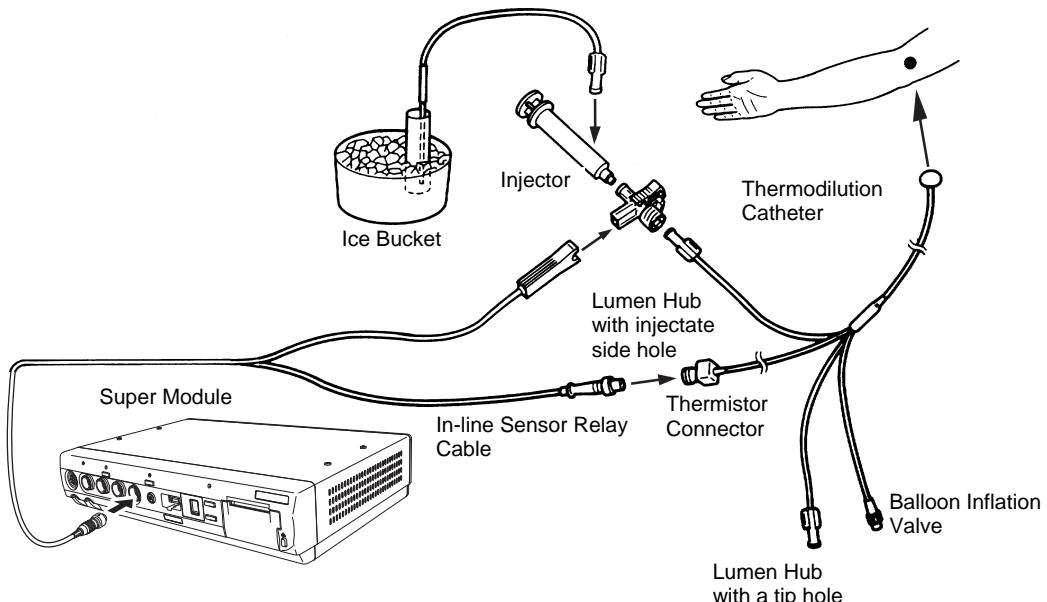
1 Select the catheter relay cable.

The usable catheter relay cable differs depending on the measurement method. Select the appropriate cable.

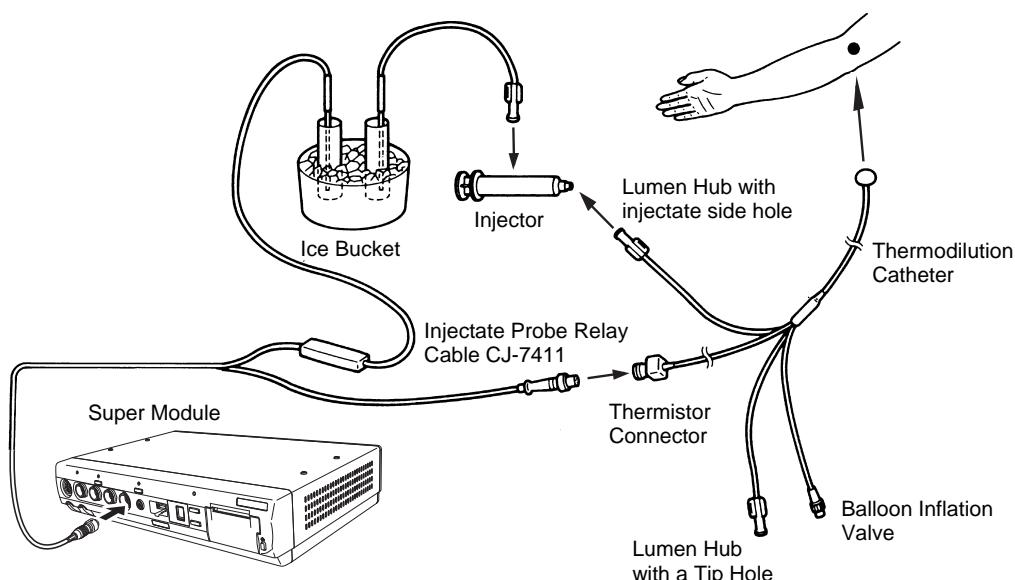
Measurement Method	Catheter Relay Cable
0°C / 24°C Temperature	CJ-7382
Flow-through Sensor	CJ-7413
In-line Sensor	CJ-7412
Injectate Temperature Probe	CJ-7411

2 Connect the catheter relay cable to the multiparameter amplifier input connector, and connect the catheter to the catheter relay cable.

【Example of In-line System】



【Example of Injectate Probe】



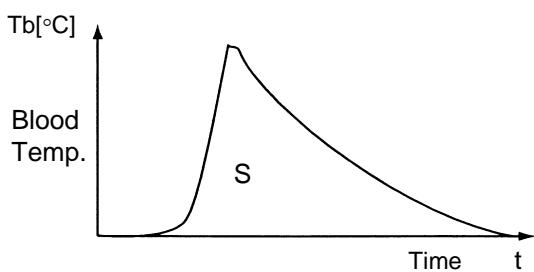
Cardiac Output Measurement Algorithm

Cardiac output is measured using the thermodilution method.

Thermodilution Method

The thermodilution catheter is inserted from the vein through the right atrium, right ventricle, to the pulmonary artery. From the side hole near the catheter tip, injectate is injected quickly to the right atrium. At this time, the heart contraction and heat diffusion mixes the injectate with blood, and causes blood temperature fall.

Variable initiated by these effects are measured as time function at the pulmonary artery, and the following thermodilution curve can be drawn. Cardiac output is calculated by applying this to the Stewart-Hamilton formula shown below.



$$CO = 60 \cdot Vi \cdot \frac{Si \cdot Ci}{Sb \cdot Cb} \cdot \frac{Ct(Tb - Ti)}{S} = CC \cdot \frac{Tb - Ti}{S}$$

CO : Cardiac Output [L/min]

Vi : Injectate Volume [L]

Tb : Blood Temperature [°C]

Ti : Injectate Temperature [°C]

Ct : Correction coefficient for injectate temperature rise inside catheter

60 : seconds

S : Area of thermodilution curve $\int_0^{\infty} \Delta Tb(t) dt$ [°C · sec]

$\Delta Tb(t)$: Temperature change of Tb after "t" seconds. [°C]

CC : Catheter Constant (Computation Constant: CC value)

Si : Specific Gravity of Injectate [g/cm³]

Sb : Specific Gravity of Blood [g/cm³]

Ci : Specific Heat of Injectate [cal/(g · °C)]

Cb : Specific Heat of Blood [cal/(g · °C)]

As shown above, cardiac output is directly proportional to the Injectate Volume (Vi) and the difference between Blood Temperature (Tb) and Injectate Temperature (Tb-Ti), and is inversely proportional to the area of the thermodilution curve (S).

●Hematocrit Value

Hematocrit value of 45% ($Si \cdot Ci / (Sb \cdot Cb)$) = 1.08 is programmed for this device.

NOTE

If the hematocrit value is different, an error may be caused in cardiac output measurement.

Ventilator Connection

By connecting the ventilator to the HS-700, ventilator waveform and numeric data can be displayed on the bedside monitor, and ventilator alarm can be notified.

Also, by connecting the bedside monitor to the network, the ventilator alarm can be notified to the central monitor via wireless or wired network.

When connecting to a ventilator, check the corresponded software version of the ventilator.

Ventilator	Corresponded Software Version
SV300	Not specified
Servo-i	v1.5 / v2.0 / v3.0
Servo-s	v2.0 / v3.0
PB7200	26300-85-V
PB740	M
PB760	H
PB840	K
Evita 4	04.14
Evita XL	05.10
Evita 2 dura	04.14

⚠ WARNING

- The ventilator alarm on this monitor should be used as supplementary function. Check the patient's condition, ventilator alarm sound and message occasionally.
- If the DS-7300 system does not generate an alarm even though the ventilator is generating an alarm, or if any other malfunction occurs, immediately check the ventilator, DS-7300 system, cable, and replace the cable if necessary. If the malfunction persists, stop using the device.
- The alarm generation on the DS-7300 system is not assured if the alarm other than the following generates at the ventilator.
 - SV-300
airway pressure upper limit alarm, high continuous pressure alarm, O₂ concentration lower limit alarm, expiratory minute volume upper/lower limit alarm, apnea alarm, gas supply alarm, air supply alarm, O₂ supply alarm, battery alarm, limited battery alarm, no battery alarm, overrange alarm
 - Servo-i
airway pressure upper limit alarm, high continuous pressure alarm, O₂ concentration lower limit alarm, expiratory minute volume upper/lower limit alarm, apnea alarm, gas supply alarm, O₂ supply alarm, battery alarm, no battery alarm, limited battery alarm, overrange alarm, expiratory cassette disconnected alarm, backup ventilation alarm, regulation pressure limited alarm, respiratory rate alarm, PEEP low alarm, EtCO₂ upper limit alarm, EtCO₂ lower limit alarm
 - Servo-s
airway pressure upper limit alarm, high continuous pressure alarm, O₂ concentration lower limit alarm, expiratory minute volume upper/lower limit alarm, apnea alarm, gas supply alarm, air supply alarm, O₂ supply alarm, backup ventilation alarm, respiratory rate alarm, PEEP low alarm
- The DS-7300 system will not correspond to the following alarms generated on the Evita 4 / Evita XL / Evita 2 dura.
 - O₂ monitoring disabled alarm, CO₂ alarm disabled alarm, Oximeter alarm disabled alarm, Neo. volume measurement inoperable alarm, Minute volume alarm disabled alarm, Minute volume alarm low off alarm, Tidal volume alarm high off alarm, Apnea alarm off alarm, Nebulizer active alarm
- There is a communication delay of 3 seconds between the DS-7300 system and the Evita ventilator. Therefore, if the alarm generated at the ventilator is resolved within 3 seconds, the ventilator alarm may not be generated at the DS-7300 system.

! CAUTION

- The ventilator operation should be performed by well-trained and authorized personnel.
- For connecting the DS-7300 system and ventilator, use only the specified connection cable.
- Verify that the DS-7300 system and the ventilator are properly connected
- When connecting the cable, verify that the main power of the DS-7300 system and the ventilator is OFF.

Ventilator Cable Connection

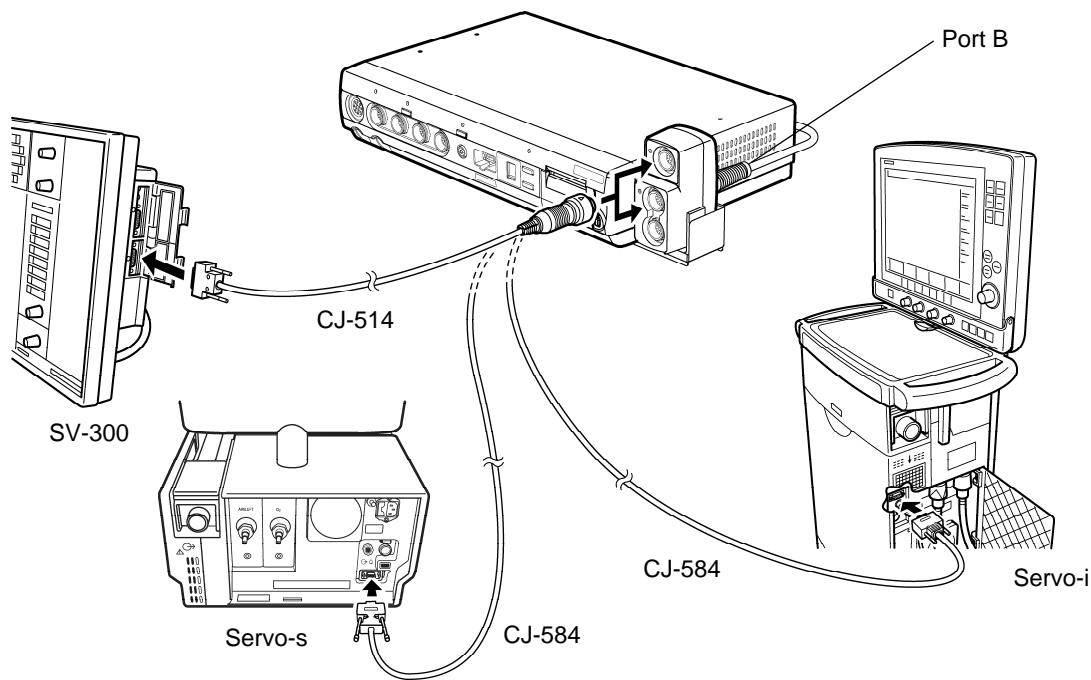
- 1** Connect the multiport relay cable to the multiport relay box connector on the HS-700. Connect the multiport relay cable and ventilator with optional ventilator cable.
Or, ventilator can be connected via ventilator cable connected to the serial connector on the HS-700.

Ventilator	Ventilator Cable	
	via multiport relay cable	via Super Module serial connector
Servo Ventilator 300/300A	CJ-514 (Qty 1)	CJ-501
Servo-i / Servo-s Ventilator	CJ-584 (Qty 1)	CJ-502
PURITAN-BENNETT Ventilator 7200ae/7200e	CJ-518, CJ-525A (Qty 1 each)	(Connection not possible)
PURITAN-BENNETT Ventilator 740/760	CJ-527, CJO-02RR4 (Qty 1 each)	CJ-504
PURITAN-BENNETT Ventilator 840	CJ-527, CJO-02RR4 (Qty 1 each)	CJ-504
Evita 4 / Evita XL / Evita 2 dura	CJ-583 (Qty 1)	CJ-502

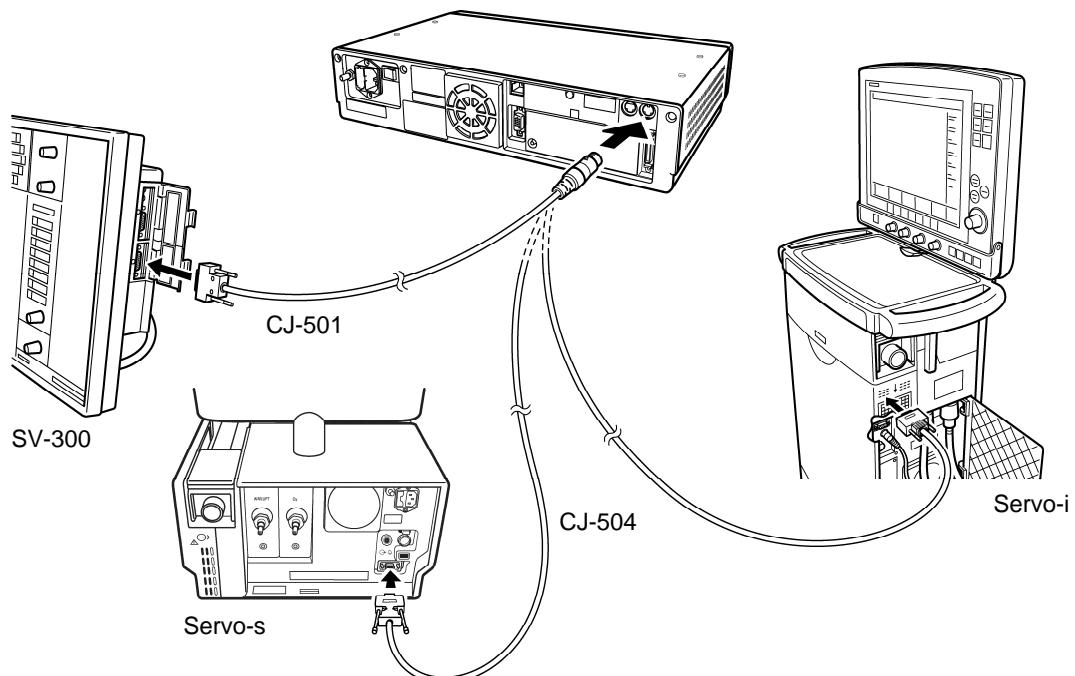
NOTE Only one ventilator can be connected to each DS-7300 system.

[Connecting SV-300, Servo-i/s via multiport relay cable]

The SV-300 and Servo-i/s can be connected to either port A or B of the multiport relay cable.

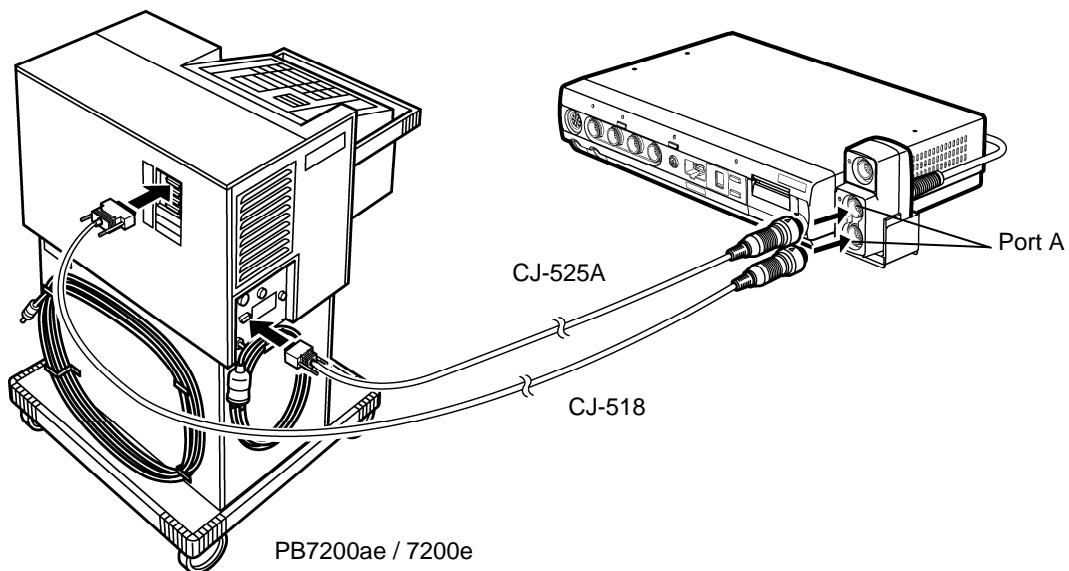


[Connecting Servo Ventilator via Super Module serial connector]



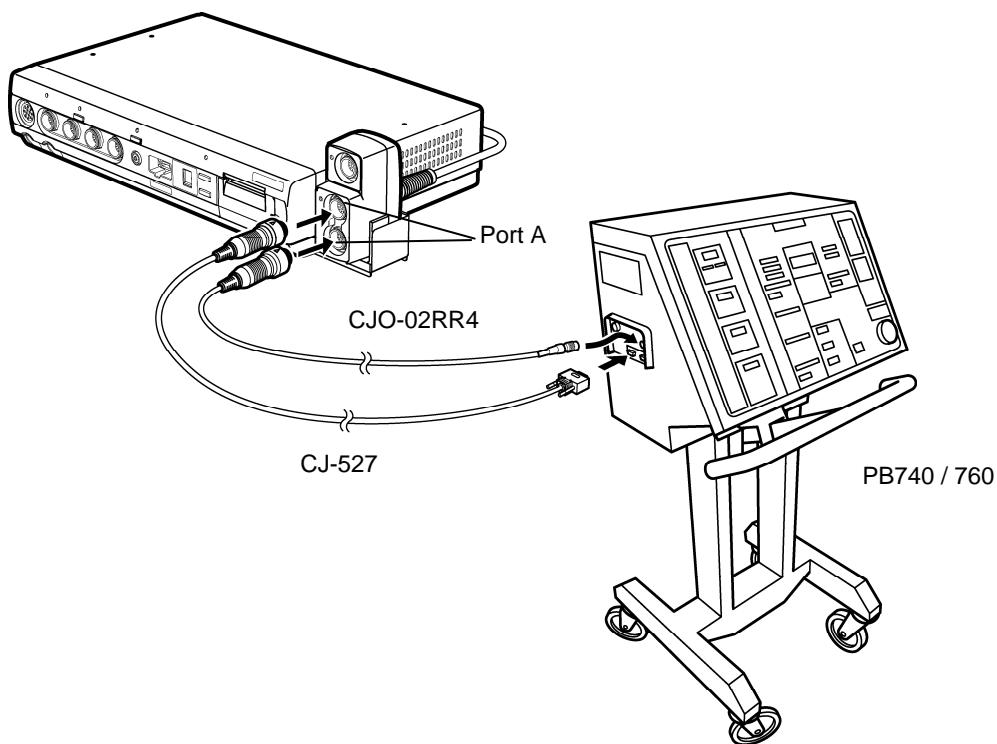
[Connecting PB7200ae/7200e Ventilator via multiport relay cable]

The PB7200ae/7200e can be connected to port A of the multiport relay cable.

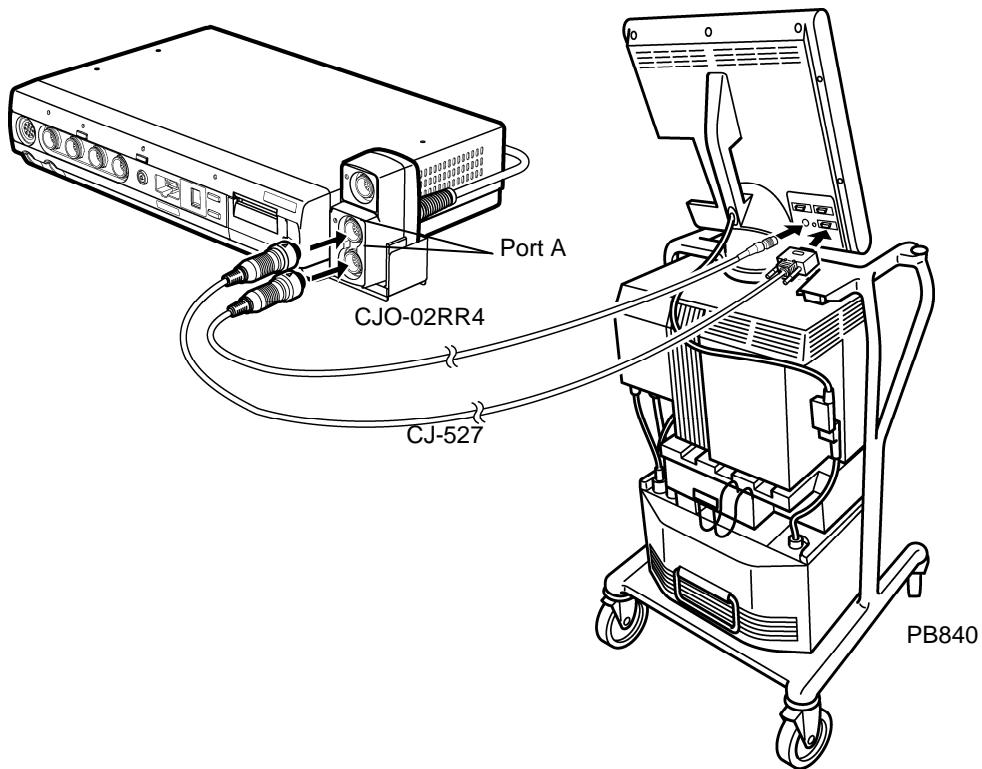


[Connecting PB740/760 Ventilator via multiport relay cable]

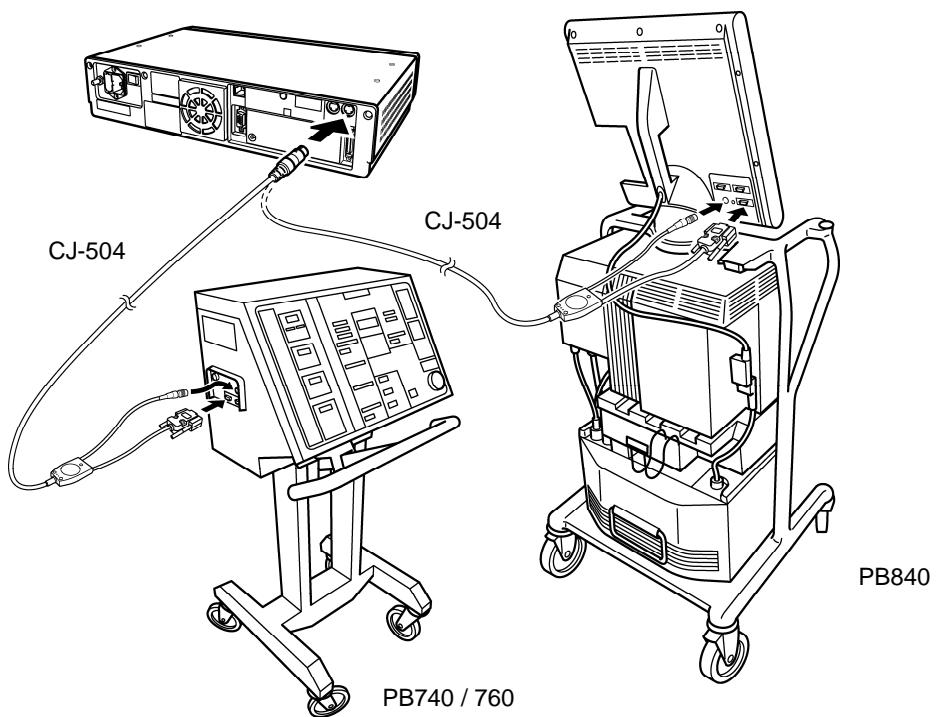
PB740/760 can be connected to port A of the multiport relay cable.



[Connecting PB840 Ventilator via multiport relay cable]
PB840 can be connected to port A of the multiport relay cable.



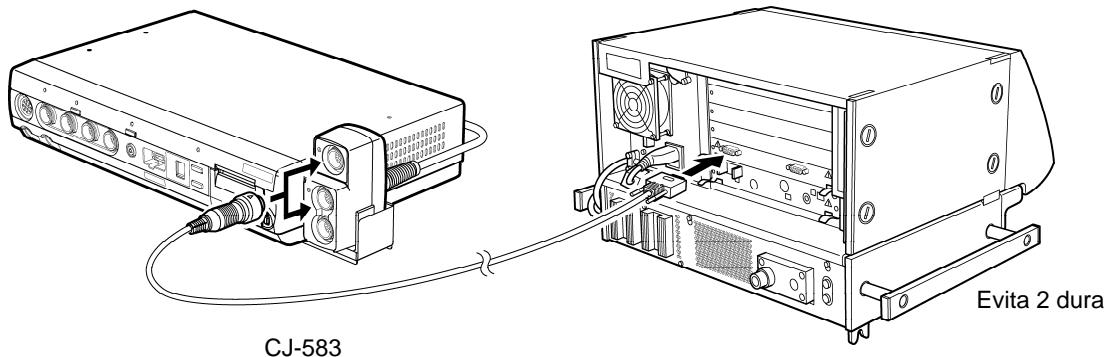
[Connecting PURITAN-BENNETT Ventilator via Super Module serial connector]



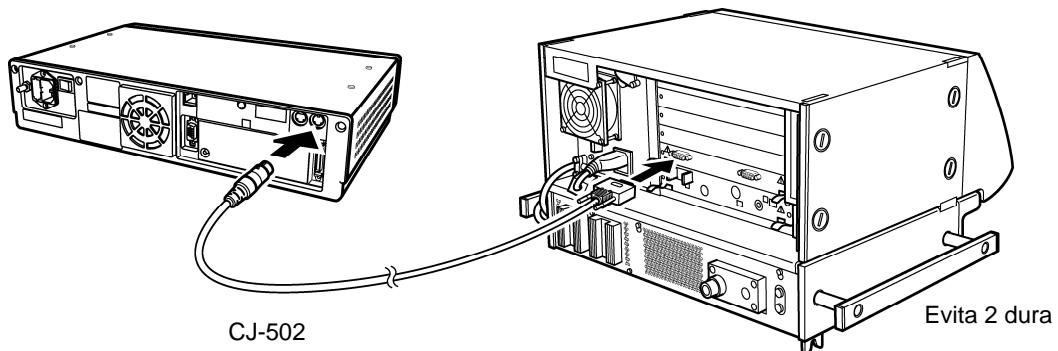
CAUTION

- When connecting the PURITAN-BENNETT ventilator, follow the precautions below.
 - The serial port (RS-232C) of the ventilator should be set as follows. Refer to the service representative of the ventilator manufacturer.
Baud Rate : 9600bit/s
Data Bit : 8bit
Parity Bit : none
(Stop Bit) : (1bit)
 - The DS-7300 system detects the “ventilator alarm” when the nurse call port on the ventilator outputs the alarm signal. For details of ventilator setup and alarm signal output condition from the nurse call port, refer to the service representative of the ventilator manufacturer.

[Connecting Evita 2 dura Ventilator via multiport relay cable]



[Connecting Evita 2 dura Ventilator via Super Module serial connector]

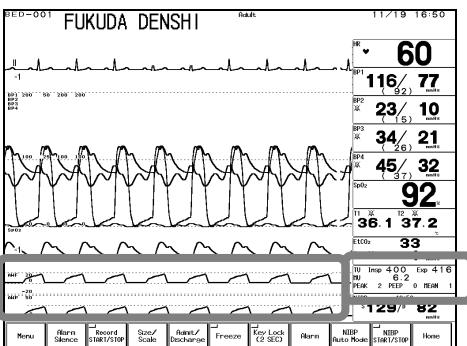


CAUTION

When connecting the Evita 4 / Evita XL / Evita 2 dura ventilator, the serial port (RS-232C) setup of the ventilator should be as follows. Refer to the service representative of the ventilator manufacturer.

Protocol : Medibus
Baud Rate : 19200bit/s
Data Bit : 8bit
Parity Bit : Even
Stop Bit : 1bit

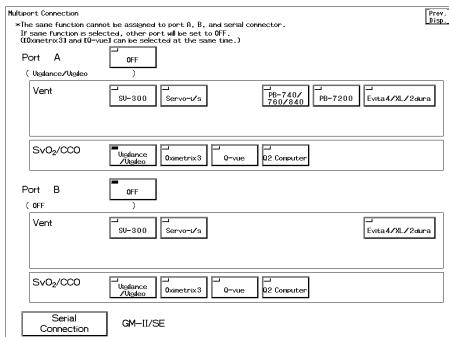
2 Verify that numeric data and waveform is displayed on the monitor.



Ventilator Selection

To input ventilator information, select the ventilator type on the multiport connection setup menu.

- 1 Press the **Menu** → **System Configuration** → **Pre-Set** → **Monitor Setup** → **Multiport Connection** keys on the DS-7300.



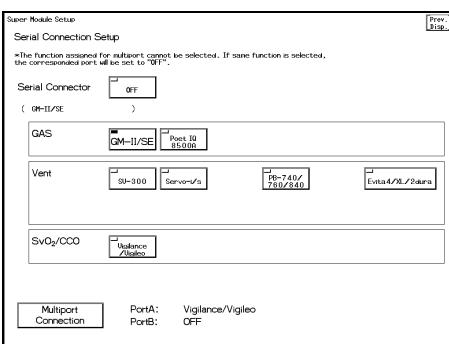
The multiport connection setup menu to select the ventilator will be displayed.

Select the ventilator from **SV-300**, **Servo- i/s**, **PB-740/760/840**, **PB-7200**, **Evita4/XL/2dura**.

NOTE

- The PURITAN-BENNETT ventilator can be connected to only port A of the multiport relay cable.
- If communication with ventilator is already established through the corresponding port, it is necessary to disconnect the communication in order to change the selection on this menu.

- 2 If connecting the ventilator to Super Module serial connector, press the **Serial Connection** key on the multiport connection setup menu.



The serial connection setup menu will be displayed.

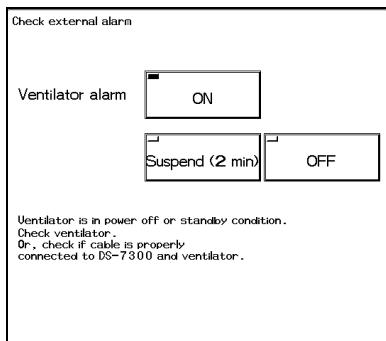
Select the connecting ventilator from **SV-300**, **Servo-i/s**, **PB-740/760/840**, **Evita4/XL/2dura**.

NOTE

- The PB-7200 cannot be connected to serial connector.
- If communication with ventilator is already established through the serial connector, it is necessary to disconnect the communication in order to change the selection on this menu.

Ventilator Alarm

A confirmation display will appear when ventilator cable is disconnected from the multiport relay cable or ventilator, or when power of the ventilator is turned OFF.



ON will continue communication with the ventilator during ventilator alarm condition. Check the ventilator power and cable connection.

Suspend (2 min) will suspend the ventilator alarm for 2 minutes. If ventilator alarm condition remains after 2 minutes, alarm will generate again.

OFF will cancel the ventilator alarm until ventilator connection condition returns to normal condition.

Oximeter Connection

By connecting the oximeter and CCO measurement device to the HS-700 series, oximeter data can be unified on the patient monitor.

The OXIMETRIX3 and Q-vue can be used in conjunction.

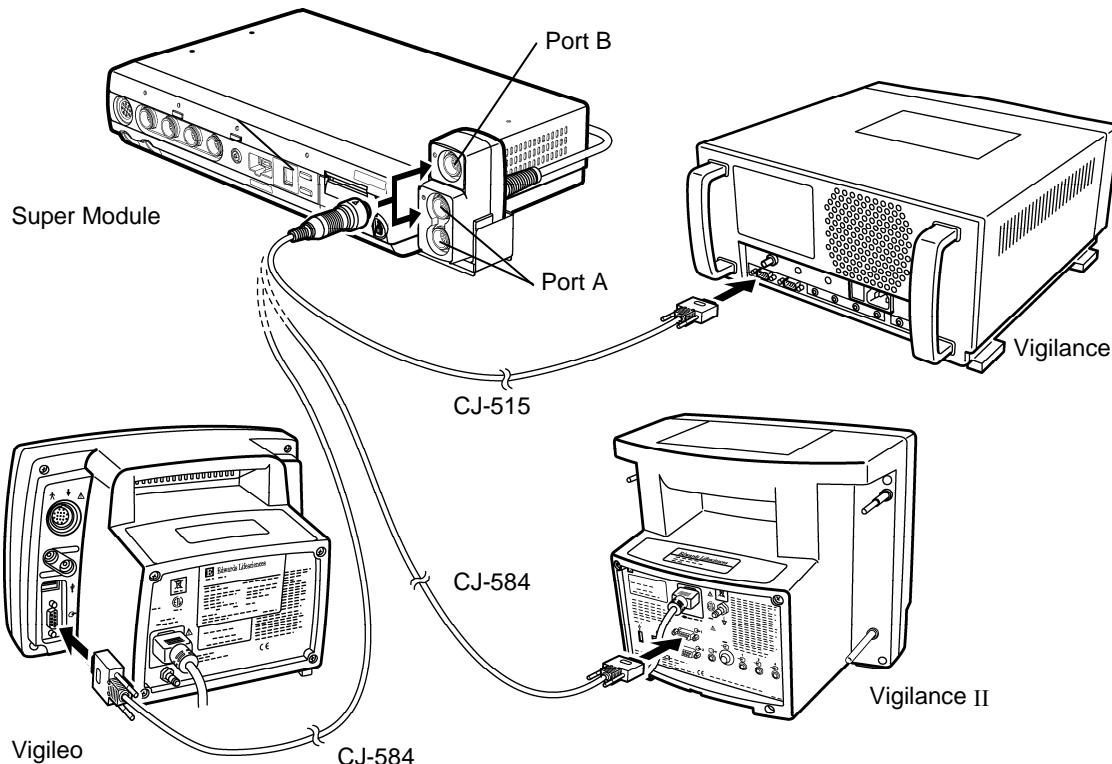
Oximeter Cable Connection

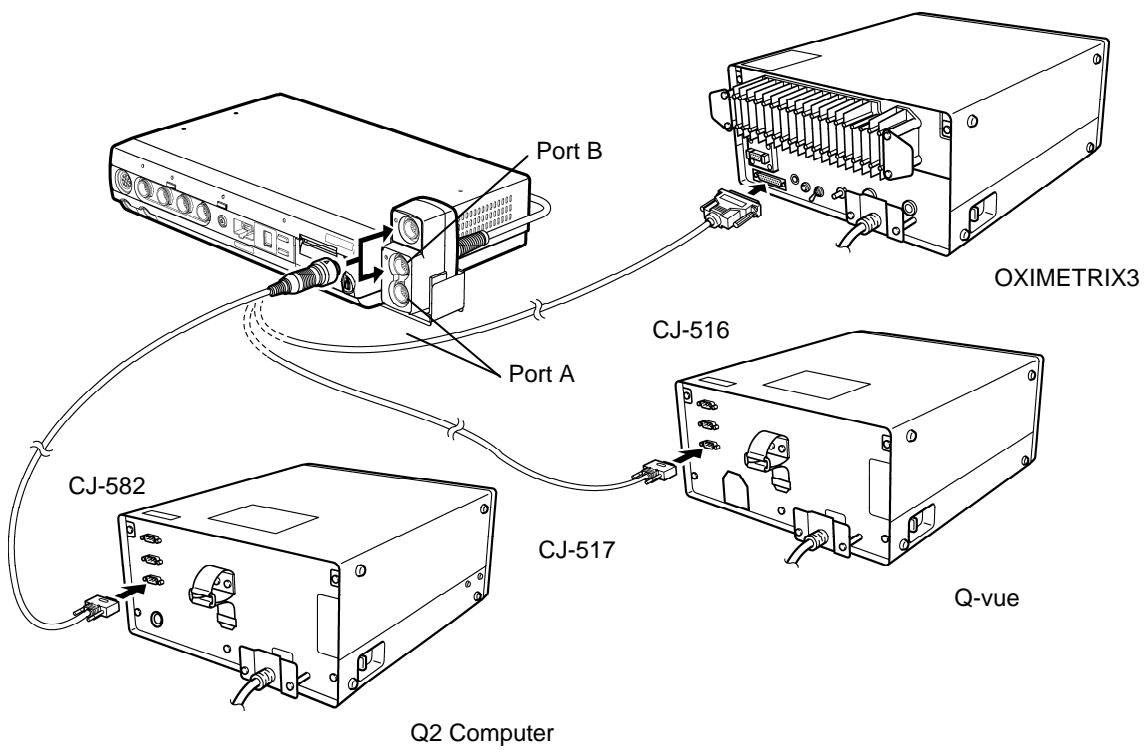
- 1 Connect the multiport relay box cable to the rear side of the HS-700. Connect the relay box and oximeter with optional ventilator cable.

Or, connect the Vigilance (or Vigilance CEDV, VigilanceII, Vigileo) to the serial connector on the HS-700 via oximeter cable.

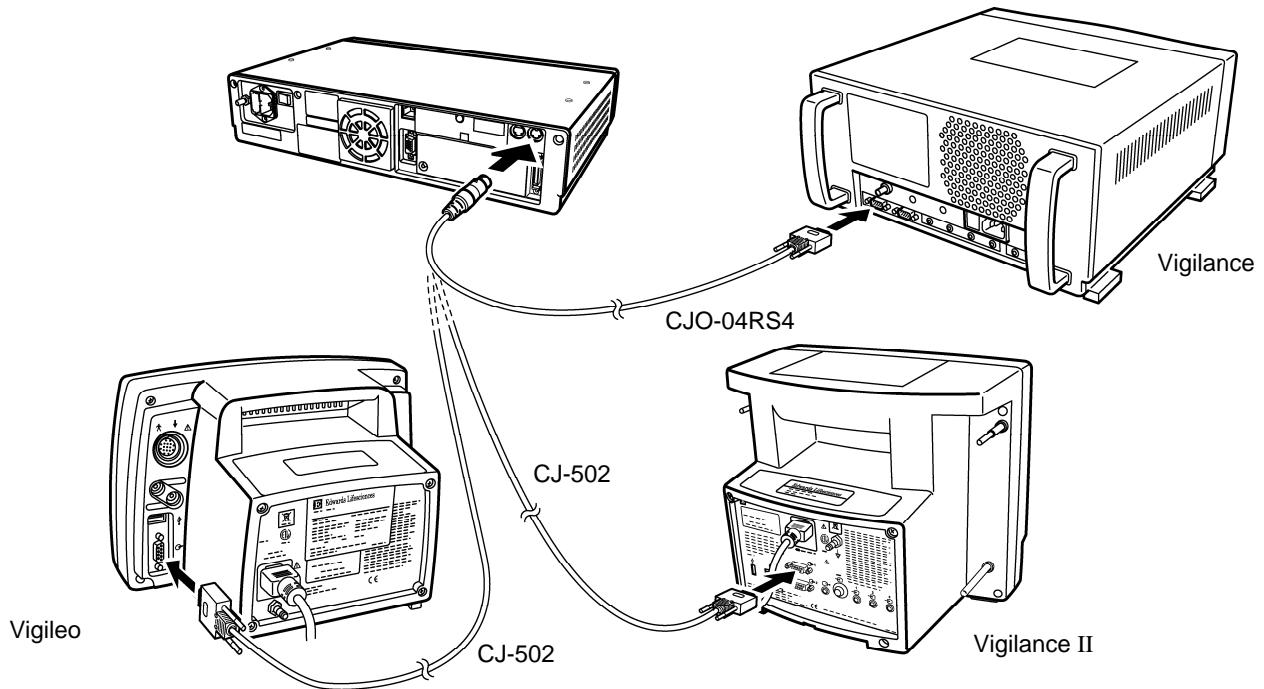
<i>Oximeter, CCO measurement Device</i>	<i>Oximeter Cable</i>	
	<i>via multiport relay cable</i>	<i>via Super Module serial connector</i>
Vigilance	CJ-515 (Q'ty: 1)	CJO-04RS4
Vigilance CEDV	CJ-515 (Q'ty: 1)	CJO-04RS4
VigilanceII	CJ-584 (Q'ty: 1)	CJ-502
Vigileo	CJ-584 (Q'ty: 1)	CJ-502
OXIMETRIX3	CJ-516 (Q'ty: 1)	(Connection not possible.)
Q-vue	CJ-517 (Q'ty: 1)	(Connection not possible.)
Q2 Computer	CJ-582 (Q'ty: 1)	(Connection not possible.)

【Connection of oximeter via multiport relay cable】





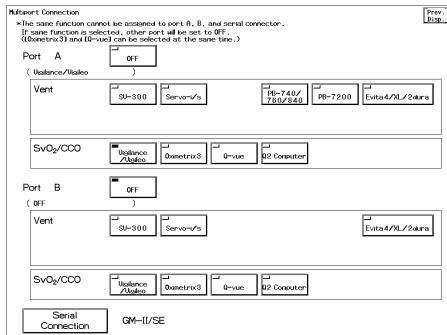
【Connection of Vigilance/Vigilance II/Vigileo via Serial Connector】



Oximeter Selection

To display the oximeter data, it is necessary to select the oximeter to be connected.

- Press the **Menu** → **System Configuration** → **Pre-Set** → **Monitor Setup** → **Multiport Connection** keys.

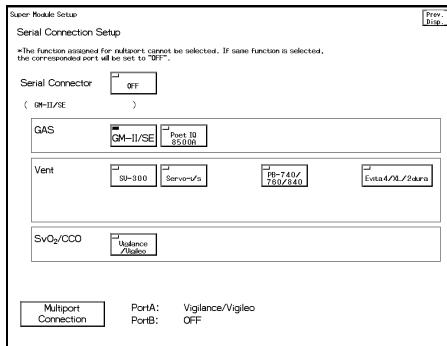


The multiport connection setup menu to select the oximeter will be displayed.

Select from **Vigilance/Vigileo**, **Oximetrix3**, **Q-vue**, **Q2 Computer**.

NOTE	<ul style="list-style-type: none"> The Oximetrix3 and Q-vue can be used in conjunction, but Vigilance (Vigilance CEDV, VigilanceII, Vigileo) and Q2 Computer cannot be used in conjunction with other oximeters. If communication with ventilator is already established through the corresponding port, it is necessary to disconnect the communication in order to change the selection on this menu.
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- If connecting the oximeter to the serial connector on the Super Module, press the **Serial Connection** key on the multiport connection setup menu.



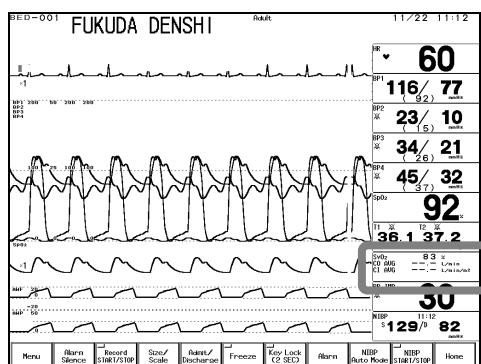
The serial connection setup menu will be displayed.
Only Vigilance (Vigilance CEDV, VigilanceII, Vigileo) can be connected to the serial connector.

Press the **Vigilance/Vigileo** key.

NOTE	<p>If communication with ventilator is already established through the serial connector, it is necessary to disconnect the communication in order to change the selection on this menu.</p>
-------------	---

- Verify that oximeter data is displayed on the monitor.

If not displayed, set "SvO₂+CO" on the display configuration setup. Or, check the oximeter network setup.



●Oximeter Network Setup

If the network setup on the Super Module and the oximeter is not corresponded, measured data will not be displayed on the patient monitor.

The network setup of Super Module is fixed to the default setting of each oximeter and cannot be changed. Make sure that the network setup of the connecting oximeter is in default setting.

- For Vigilance/Vigileo

The network setup for the Vigilance/Vigileo should be as follows.

- Device: IFM Out
- Baud Rate: 19200bps
- Parity Bit: None
- Stop Bit: 1
- Data Bit: 8
- Flow Control: 2 sec.

For procedure to check the Vigilance/Vigileo network setup, refer to the operation manual for the Vigilance/Vigileo.

- For Q2 Computer

The network setup for the Q2 Computer should be as follows.

- Baud Rate: 9600bps
- Parity Bit: ODD
- Stop Bit: 1
- Data Bit: 7

For procedure to check the Q2 Computer network setup, refer to the operation manual for the Q2 Computer.

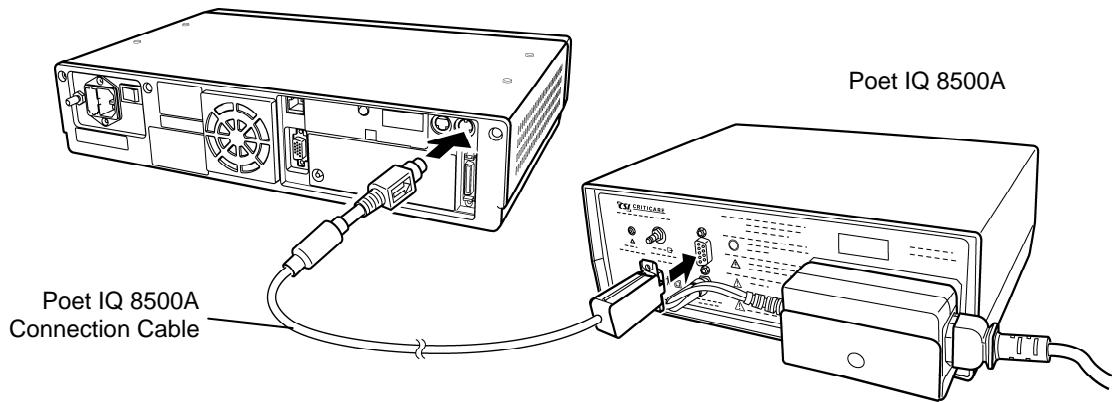
Poet IQ Connection

The gas module, Poet IQ 8500A (Criticare Systems Inc.) can be connected to the DS-7300 system via serial connector on the Super Module.

By connecting the Poet IQ 8500A, the measurement data of CO₂ concentration, anesthetic gas concentration, O₂ concentration, N₂O concentration can be monitored on the DS-7300.



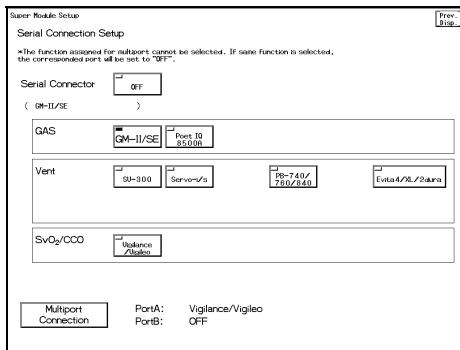
If the Super Module and the gas module are simultaneously used, the CO₂ measurement will be performed by the gas module.



Gas Module Selection

To monitor the Poet IQ data, select the gas module type on the serial connection setup menu.

- 1 Press the **Menu** → **System Configuration** → **Pre-Set** → **Monitor Setup** → **Super Module Setup** → **Serial Connection** keys.



The serial connection setup menu will be displayed.
Select **Poet IQ 8500A** for the gas module type.

NOTE

If communication with ventilator is already established through the serial connector, it is necessary to disconnect the communication in order to change the selection on this menu.

Analog Signal

This section explains the preparation procedure to output the analog signal.
ECG waveform and BP waveform can be output for this device.

 WARNING	<ul style="list-style-type: none">● Analog signal is a delay output. (about 35ms for ECG, BP) When connecting to a device using vital signs as trigger signals (ex. IABP), make sure the delay time fulfills the specifications of the connected device.● The delay time may differ depending on the waveform shape or artifact interference.
--	--

Cable Connection

- 1 Connect the analog output cable to the connector located at front side of the Super Module.

Output Waveform and Sensitivity

[Analog Output Connector 1]

Outputs the ECG waveform.

If lead I, II, or III is selected for ECG1, the selected lead will be output. If the lead other than lead I, II, or III is selected, lead II will be output.

Filter (frequency characteristic: 0.5–20Hz) and sensitivity (1V/mV) is fixed.

[Analog Output Connector 2]

Outputs the BP waveform. The following waveform will be output depending on the used Super Module.

- For HS-710, 710E, 720, 720E, 720C
The BP waveform input to BP-1 of CJ-7546 2ch BP conversion cable connected to multiparameter amplifier input connector 1 will be output.
- For HS-702C, 702E
The BP waveform input to the BP Input Connector 1 will be output.

Filter (frequency characteristic: DC–40Hz) and sensitivity (1V/100mmHg) is fixed.

[Sensitivity and Output Range of Analog Signal]

	Output Sensitivity	Output Range
ECG	1V/mV	−5 to +5mV
BP	1V/100mmHg	−50 to +300mmHg (0mmHg = 0V)

Chapter 4

Installation

Precautions for Installing the Equipment.....	4-2
Precautions about the Operating Environment	4-2
Fixing the HS-700.....	4-3
Fixing the DS-7300 to HS-700 (with OA-469 Mounting Bracket)	4-3
Fixing the OA-470 to HS-700	4-4

Precautions for Installing the Equipment

This section describes the environmental condition to use the HS-700.

Precautions about the Operating Environment

- The following environmental conditions should be observed when operating the HS-700.
 - Surrounding Temperature : 10–40°C
 - Relative Humidity : 30–85% (non-condensing)
 - Atmospheric Pressure : 700–1060hPa
- The HS-700 is intended for patient monitoring in ICU, CCU, surgery, and ward. Direct use in MRI environment or home-care should be avoided.
- The power source should fulfill the following condition.
 - Use a hospital grade 3-way outlet. If a hospital grade outlet is not available, make sure to connect the equipotential ground terminal with the accessory ground cable.
 - Verify power voltage and frequency before connecting to an AC power source.
 - Use the power source that can provide adequate power to the device.
- Pay attention when installing or storing the device. Do not install or store in the following locations.
 - where chemicals are stored or gas may generate
 - where the equipment will be subject to splashing water or humidity from a nebulizer or vaporizer
 - where the equipment will be subject to direct sunlight
 - Unstable place with inclination, vibration, or shock.
- Ensure proper ventilation to cool the device.
 - Do not cover the cooling fan.
A minimum of 5 cm is required between the vents on the back and side of the Super Module and the wall.



If the monitor is used in an environment not fulfilling the above conditions, not only the monitor will not deliver its maximum performance, but damage to the equipment may occur and safety can not be ensured.
If using in an environment other than specified above, contact our service representative.



Equipotential Grounding

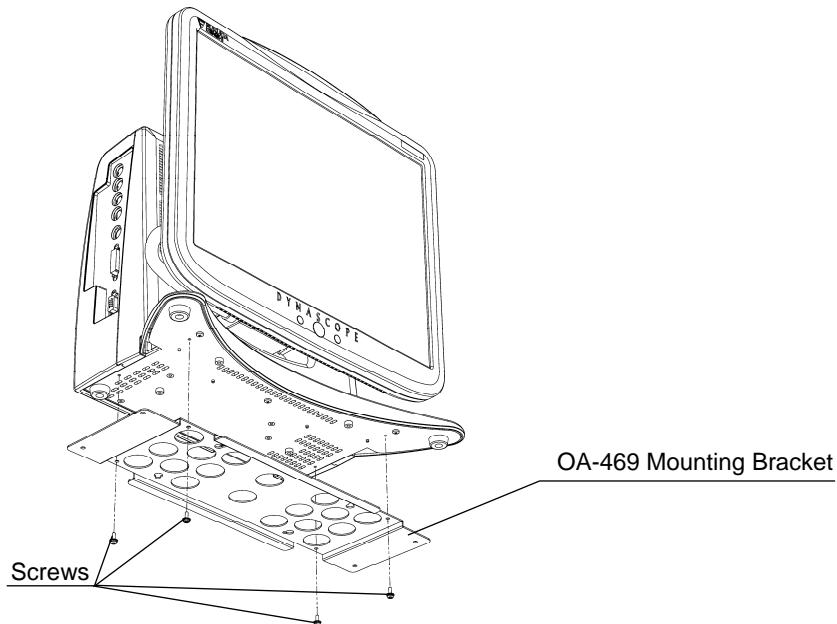
When connecting multiple devices, electrical potential difference may be generated between the devices. This may result in electric shock to the patient connected to these devices. Pay special attention for use in the operating room, ICU, CCU, Cardiac Catheter Laboratory, and Cardiovascular X-ray room. To avoid such electrical potential difference, use the accessory ground cable to connect each device's equipotential terminal to the same ground terminal. This is called equipotential grounding.

Fixing the HS-700

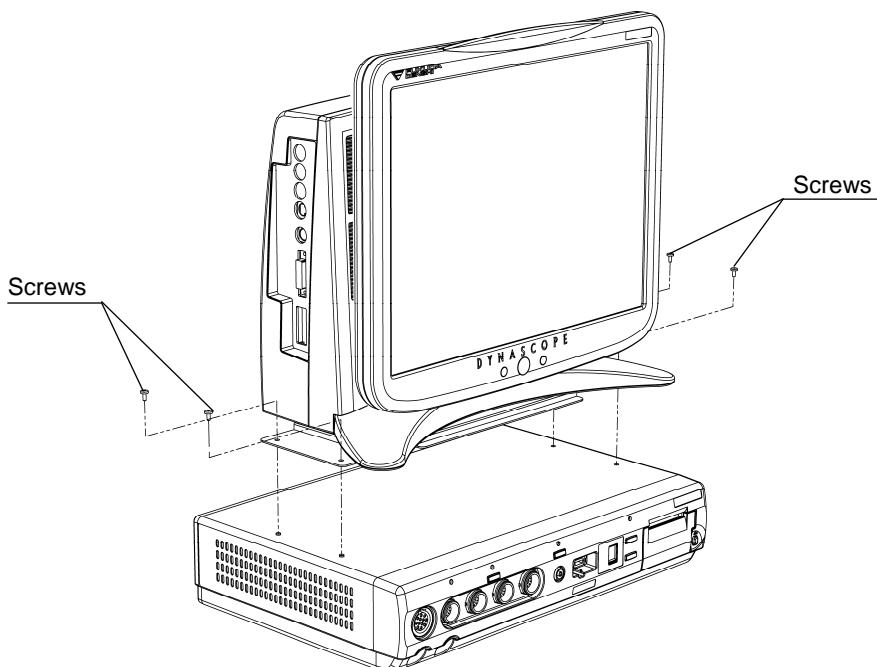
By using the OA-469 DS-7300 Mounting Bracket, the HS-700 can be fixed on to the DS-7300.
By using the OA-470 Relay Cable Mounting Bracket, a relay cable holder can be fixed on to the HS-700.

Fixing the DS-7300 to HS-700 (with OA-469 Mounting Bracket)

1. Attach the OA-469 Mounting Bracket to the bottom of the DS-7300 using 4 screws (small, M3×8, accessory of OA-469).



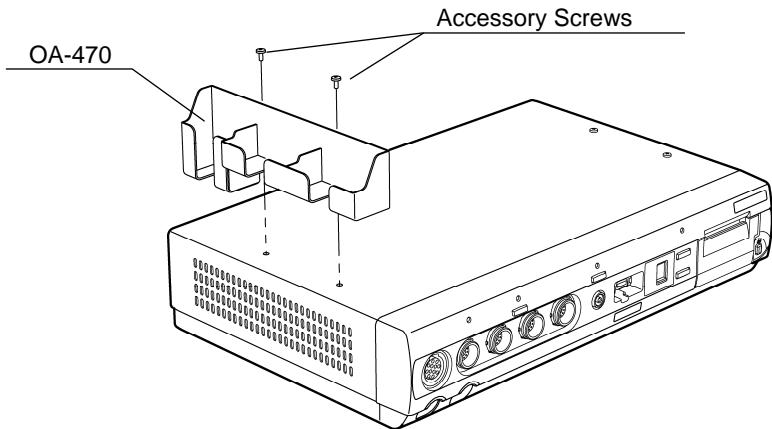
2. Disconnect the 4 screws attached to the panel of the HS-700. Place the OA-469 attached DS-7300 on the HS-700, and fix on with 4 screws (small, M3×8, accessory of OA-469).



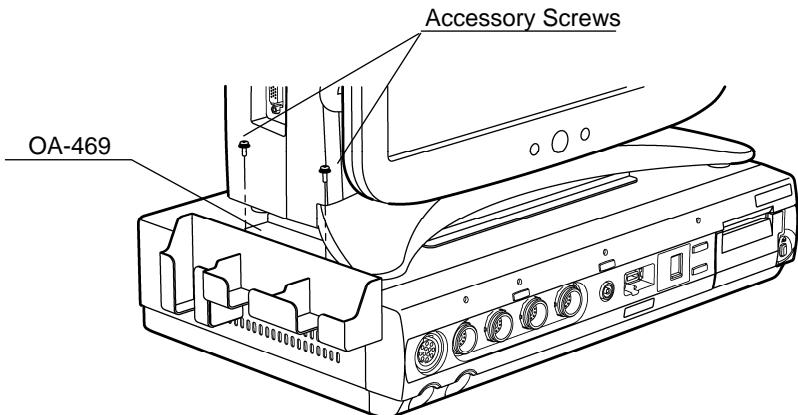
Fixing the OA-470 to HS-700

1. Disconnect the 2 screws attached to the panel of the HS-700.
Fix the OA-470 Relay Cable Mounting Bracket to the HS-700 using the screws (OA-470 accessory).

The OA-470 can be fixed on to the opposite side of the HS-700 using the same procedure.

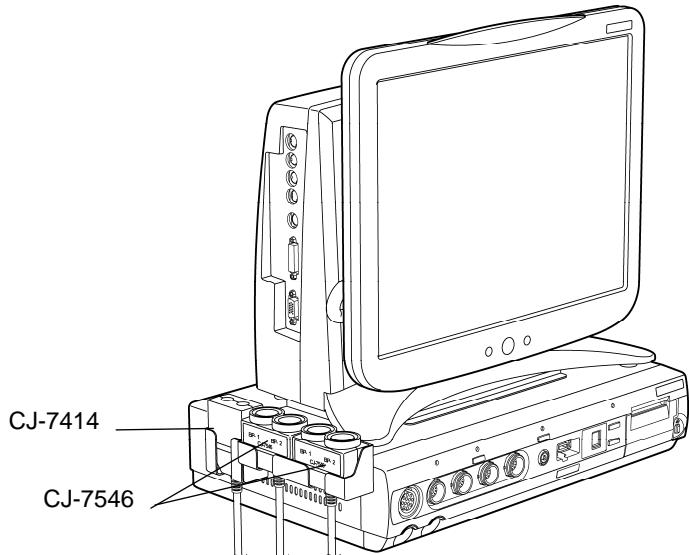


2. If using in conjunction with the OA-469, fix on with the same procedure as above using the screws (OA-470 accessory).



【Example of Usage】

The 2ch BP relay cable (CJ-7546) and 2ch temperature relay cable (CJ-7414) can be placed on the OA-470 as shown on the following illustration.



Chapter 5

Maintenance

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Handling

This section describes precautions for handling the equipment.



If you accidentally wet the device, dry it completely and verify it operates safely before usage.

Handling After Use

- Do not apply excessive force when disconnecting the cables. Always pull on the connector housing and not on the cable.
- Clean the unit, accessories, and cables, and keep them together in one place for next use.
- Always check for adequate supply of disposable accessories such as ECG electrodes. If any shortage, contact our service representative and supply as necessary.

This section describes about the storage of the device and recording paper.

Storing the Device

- Store in a place where the device will not be exposed to splashing water.
- Store in a place where the device will not be adversely affected by atmospheric pressure, temperature, humidity, ventilation, sunlight, dust or atmosphere containing salt or sulfur.
- Store in a level area where the device is not exposed to vibration and shock (including during transportation).
- The following environmental conditions should be observed when storing the device.

Storage Temperature : -10–60°C

Storage Humidity : 10–95% (at 60°C)

Storage Atmospheric Pressure : 700–1060hPa

Storing the Recording Paper

This device utilizes heat sensitive recording paper. If placed in a high temperature for long period of time, the print may become indistinct, and unable to read. When storing, follow the precautions below.

- Store in a place where light is shut off and avoid direct sunlight.
- Do not leave the paper in a high temperature (50°C or 122°F or above).
- Do not store the paper in polyvinyl chloride bag.
- Do not expose the paper to alcohol, hydrochloric acid, or ester ketone.
- Avoid using adhesive agents other than water based glue.

Cleaning

Housing and Cables

This chapter explains about the cleaning of the device and sensors.

Cleaning the Housing

Clean the housing using tightly squeezed gauze or an absorbent cotton cloth dampened with alcohol or a neutral cleanser.

⚠ CAUTION

- Clean the equipment frequently so stains can be removed easily.
- To prevent injury, it is recommended to wear gloves when cleaning the equipment.
- Do not allow liquids or cleaning solution to enter the monitor or connectors.
- Do not use organic solvents, thinner, toluene and benzene to avoid damaging the resin case.
- Do not polish the housing with abrasive or chemical cleaner.
- When sterilizing the entire room using a spray solution, pay close attention not to have liquids get into the monitor or connectors.
- Use only neutral detergent to clean the housing. Do not use chemical cloth, scrub brush, abrasive, polishing powder, hot water, volatile solvent and chemicals (cleanser, thinner, benzine, benzol, and synthetic detergent for house and furniture), or sharp-edged tools. The surface resin coating may be damaged, resulting in discoloration, scratches, and other problems.

Disinfecting the Blood Pressure Transducers

Disinfect the blood pressure transducers according to the manufacturer's guidelines.

Cleaning/Disinfecting the SpO₂ Sensor

【NELLCOR Sensor】

- Do not soak the sensor in water or antiseptic solution.
- Wipe the DS-100A with disinfectant such as 70% alcohol. Do not disinfect by applying radioactive rays, steam, or ethylene oxide.
- OXISENSOR is a disposable sensor. Do not reuse or attempt resterilization.

Cleaning/Disinfecting the Temperature Probe

Disinfect the temperature probe according to the manufacturer's guidelines.

When cleaning, follow the procedure below.

- (1) Wipe the probe using 70% isopropyl alcohol cotton.
- (2) Dry it completely with air before reusing.

Cleaning the Cardiac Output Relay Cable

Disinfect the cardiac output relay cable according to the manufacturer's guidelines.

When cleaning, follow the procedure below.

- (1) Wipe the cable using 70% isopropyl alcohol cotton.
- (2) Dry it completely with air before reusing.

Cleaning/Sterilizing the Airway Adapter for Capnostat 5

- Wash in lukewarm sudsy water. Then dip in antiseptic solution (ex. glutaraldehyde) for low-temperature sterilization. Desiccate after rinsing in aseptic water.
- Use EOG (Ethylene Oxide Gas) to sterilize. Proper ventilation must be performed.
- Before re-using an airway adapter, make sure the window is desiccated and no residue is left. Check if the adapter is not damaged by the operation or cleaning / sterilization.



- Do not sterilize the airway adapter using autoclave methods.
- Do not reuse / re-sterilize the disposable airway adapter.

Replacing the Air Filter

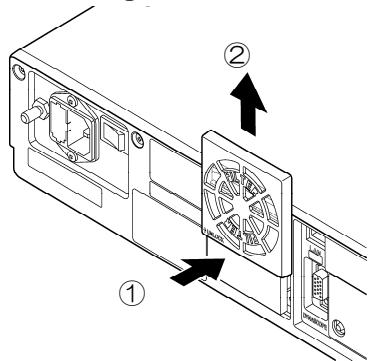
The cooling fan air filter on the Super Module is a consumable product. Continuous use of the Super Module will cause the air filter to inhale unclean air inside the equipment, reduce the cooling effect, and may damage the inner parts. Clean the air filter, or replace with a new air filter every 3 months.

WARNING

- When the air filter is washed with neutral detergent, dry it completely before reattaching. If the moisture is remained on the air filter, it may damage the equipment.
- The air filter must be attached after cleaning / replacing. If the equipment is used with the air filter detached, it may damage the equipment.

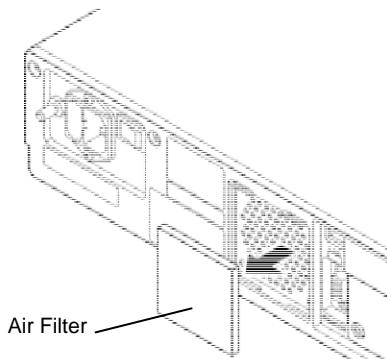
1. Remove the cooling fan cover located at the rear side of the Super Module.

- 1) Lightly press the lower part of the fan cover.
- 2) Slide the cover upward.



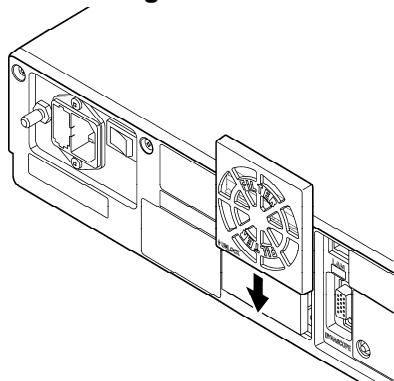
2. Remove the air filter.

To clean the air filter, beat the dust off, or wash off with neutral detergent.



3. Reattach the cooling fan cover.

Slide the fan cover downward and fix it on.



This section explains the daily check and periodic check items of the device.

About the Maintenance Check

Periodic inspection must be performed. When reusing the device which was left unused for a while, always check that the device operates properly and safely before use.

To ensure safety, reliability, and high performance, a "Daily Check" and "Periodic Inspection" must be performed. We are not liable for any accident arising from lack of maintenance.



- Do not open the housing of this device.
- Avoid alcohol or other liquids from getting into the equipment.

● Daily Check

Perform daily inspection using the "Daily Check List" on the next page.

● Periodic Check

The safety check conformed to IEC 60601 must be performed at least once a year.

Periodic inspection of medical electronic equipment is mandatory to prevent failures and accidents and to ensure safety and reliability.

Periodic maintenance may be performed by each medical institution or by a third party by concluding a "Maintenance Contract".

For more details, contact your nearest service representative.

Periodic Replacement Parts

To ensure reliability of safety, function, and performance of this device, the time-change components must be replaced periodically. When replacing, contact our service representative.

The periodic replacement period for each part is as follows.

EtCO₂ Unit 20,000 hours (EtCO₂ meas. accumulated time)

NIBP Unit 100,000 times of measurement

Recorder Unit 350 hours (Recording accumulated time)



The periodic replacement parts must be replaced at specified period.

Daily Check List

No. _____

Inspected Date _____ Inspected by _____ Location _____

Device _____ Serial No. _____ Date of Purchase _____

Item	Details	Criteria	Judgment
Appearance	Visually check the exterior for scratches, cracks, deformation, and rust.	No abnormality should be found.	<input type="checkbox"/> OK / <input type="checkbox"/> NG
Installation	Check whether the unit is installed on a level surface.	The installation area must be level and free from vibration and shock.	<input type="checkbox"/> OK / <input type="checkbox"/> NG
	Check whether the unit is installed in a place susceptible to adverse environment.	The environmental condition (ex. temperature, humidity) of the installed place should be as specified. The unit should not be subjected to splashing water.	<input type="checkbox"/> OK / <input type="checkbox"/> NG
Functions	Turn ON the monitor, and check whether it operates normally.	With the BP relay cable and transducer connected, pressing the BP zero balance switch should start the zero balance.	<input type="checkbox"/> OK / <input type="checkbox"/> NG
		Pressing the NIBP start/stop switch should inflate the NIBP cuff.	<input type="checkbox"/> OK / <input type="checkbox"/> NG
Cables	Visually check all cables for any damage.	No damage should be found.	<input type="checkbox"/> OK / <input type="checkbox"/> NG
Periodic Inspection	Check the date of previous periodic inspection.	Should be within 1 year.	<input type="checkbox"/> OK / <input type="checkbox"/> NG
Air Filter (Super Module)	Check the date, which the air filter was first used (cleaned, replaced). Used from: Day ____ Year ____ Month ____	Should be within 3 months.	<input type="checkbox"/> OK / <input type="checkbox"/> NG
CO₂ Calibration (HS-710E, 720E, 702E)	Check the date of previous calibration date. Previous Date Day ____ Year ____ Month ____	Should be within 6 months.	<input type="checkbox"/> OK / <input type="checkbox"/> NG

Comment

Troubleshooting

This section explains the troubleshooting for each case.

ECG

The “LEAD OFF” message is displayed on the monitor.

- Cause 1 : The electrode is detached, or is not making good electrical contact with the skin.
 Solution : • Check if the electrodes are properly attached.
 • Replace the electrode, or check the lead cable.
- Cause 2 : Even though the “3-lead Override” (ECG configuration) is set to ON, electrodes other than LA, RA, LL are connected.
 Solution : Set the “3-lead Override” to OFF. Or, detach the electrodes other than LA, RA, LL.

The “ECG failed” message is displayed on the monitor.

- Cause 1 : The ECG amplitude is 0.25mV or below for the waveform size of $\times 1$, $\times 1/2$, $\times 1/4$, and 0.150mV or below for the waveform size of $\times 2$, $\times 4$.
 Solution : Change the electrode attachment site, or select the lead with higher QRS amplitude.
 Note : Using 4-electrode or 5-electrode/10-electrode instead of 3-electrode allows more accurate QRS detection.
- Cause 2 : The electrode contact is poor.
 Electrical blanket or other noise source is near the patient.
 Solution : Electrical blanket or other noise source is near the patient.
 • Replace the lead cable if defective.
 • If any noise source is near the patient, locate it away from the patient as much as possible.
- Cause 3 : Even though the “3-lead Override” (ECG configuration) is set to ON, electrodes other than LA, RA, LL are connected.
 Solution : Set the “3-lead Override” to OFF. Or, detach the electrodes other than LA, RA, LL.

ECG waveform contains noise.

The “Artifact” message is displayed on the monitor.

- Cause 1 : The electrode contact is poor.
 Electrical blanket or other noise source is near the patient.
 Solution : Attach the electrodes firmly.
 • Replace the lead cable if defective.
 • If any noise source is near the patient, locate it away from the patient as much as possible.
- Cause 2 : EMG is interfering.
 Solution : • Change the electrode site to a location where EMG will less likely to interfere.
 • Select ESIS mode for the filter mode.
 Note : Selecting a ESIS mode for the filter mode will decrease the QRS amplitude and may result in not counting the heart rate.
- Cause 3 : Even though the “3-lead Override” (ECG configuration) is set to ON, electrodes other than LA, RA, LL are connected.
 Solution : Set the “3-lead Override” to OFF. Or, detach the electrodes other than LA, RA, LL.

The “Check electrode” message is displayed on the monitor.

- Cause 1 : The electrode contact with the skin is poor. There is substantial contact resistance between the electrodes.
 Solution : Replace all the electrodes.
 Use the electrodes of the same type.

- Cause 2 : Even though the "3-lead Override" (ECG configuration) is set to ON, electrodes other than LA, RA, LL are connected.
Solution : Set the "3-lead Override" to OFF. Or, detach the electrodes other than LA, RA, LL.

The "ECG unit error" message is displayed on the monitor.

- Cause : A communication error with the ECG measuring unit exists.
Solution : The breakage of wire or failure of the ECG unit can be considered.
Contact our service representative.

The measured data is displayed as "xxx" on the monitor.

- Cause : The heart rate is outside the measurement range.
Solution : • Check the electrode application.
• Replace the electrode, or check the lead cable.

Heart rate is not counted. Heart rate is low.

- Cause : The ECG waveform amplitude is below the QRS detection level (0.3mV).
Solution 1 : Change the electrode site, or select a lead with higher QRS amplitude.
Note : Using 4-electrode or 5-electrode/10-electrode instead of 3-electrode allows more accurate QRS detection.
Also, if large amount of noise is interfering, the noise may be erroneously detected as QRS. It is recommended to change the electrode site and increase the ECG amplitude.
- Solution 2 : Increase the waveform size. By increasing the waveform size, small QRS wave will become detectable. However, noise may be also detected.

Heart rate is not counted, and "LEAD OFF" message is displayed on the monitor.

- Cause 1 : The electrode of the displayed lead type is detached, or is not making good electrical contact with the skin.
Solution : • Check the electrode application.
• Replace the electrode, or check the lead cable.
- Cause 2 : Even though the "3-lead Override" (ECG configuration) is set to ON, electrodes other than LA, RA, LL are connected.
Solution : Set the "3-lead Override" to OFF. Or, detach the electrodes other than LA, RA, LL.

Artificial pacemaker is not displayed.

- Cause 1 : On the admit / discharge menu, **Not used** is selected for the pacemaker use.
Solution : Select **Used** for the pacemaker use.
- Cause 2 : In the ECG configuration menu, "Pacemaker Pulse" is set to **OFF**.
Solution : Select **ON** for "Pacemaker Pulse".

The "Pacemaker detection error" message is displayed on the monitor.

- Cause : The pacemaker pulse is detected 16 pulses or more per second.
Solution 1 : Attach the electrodes firmly.
• Replace the lead cable if defective.
• If any noise source is near the patient, locate it away from the patient as much as possible.
Solution 2 : If the patient is not wearing a pacemaker, set to **Not used** for the pacemaker use in the patient admit/discharge menu.

The "ECG not connected" message is displayed on the monitor.

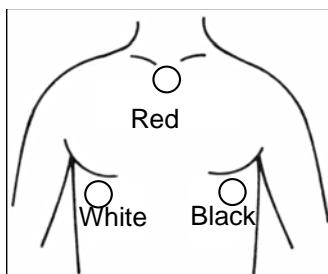
- Cause : When the ECG relay cable is disconnected during ECG monitoring, this message will be displayed.
Solution 1 : To cease monitoring, press the **Alarm Silence** key to clear the message and silence the alarm.
Solution 2 : To continue monitoring, plug in the ECG relay cable. This will clear the message and silence the alarm.

Respiration

The “CVA detected” message is displayed on the monitor.

Cause : Heartbeat is interfering and superimposed on the respiration waveform.

Solution : Place the electrode as shown below where the heartbeat will be less likely to interfere.



“0” is displayed for respiration rate, or apnea alarm is generated.

Cause : The respiration waveform amplitude is below the detection level (0.2Ω).

Solution 1 : Change the electrode site.

Solution 2 : Increase the waveform size.

The respiration waveform and respiration rate is not displayed.

Cause 1 : The ECG relay cable designed for electrosurgical knife is used.

Solution : The impedance respiration can not be measured if the cable designed for electrosurgical knife is used. Use the standard ECG relay cable if not using the electrosurgical knife.

Cause 2 : The impedance respiration measurement is ceased.

Solution : Turn ON the impedance respiration measurement on the admit / discharge menu or RESP configuration menu.

Note : If the pacemaker with the minute ventilation measuring function is used, turn OFF the impedance respiration measurement. Otherwise, both the pacemaker and the monitor will not be able to perform accurate measurement.

The measured data is displayed as “xxx”.

Cause : The respiration rate is outside the measurement range.

Solution : • Check the electrode application.
• Replace the electrode, or check the lead cable.

Non-Invasive Blood Pressure

The cuff is not inflated although the pump is operating.

Cause 1 : The air hose is not firmly connected, and the air is leaking.

Solution : Check if the air hose is properly connected.

Cause 2 : The cuff size is not corresponded to the selected patient type.

Solution : Check if the cuff size is corresponded to the selected patient type.

The monitor repeats the measurement, or “- - -” is displayed for the numeric data.

Cause 1 : The measurement accuracy is not reliable due to body motion artifact.

Solution : Have the patient stay still as much as possible during the measurement.

Cause 2 : The pulse is too small to acquire reliable measurement accuracy.

Solution : Check if the cuff application is proper, and if the cuff size is corresponded to the selected patient type.

The “Check NIBP hose” message is displayed.

- Cause : The applied pressure to the cuff has exceeded the maximum limit. The measurement time has exceeded the maximum limit.
- Solution : Check if the cuff application is proper, if the cuff size is corresponded to the selected patient type, or if the air hose is not bent. After checking the above, perform the measurement again.
If the same message is displayed again, a failure of the equipment can be considered. Cease the measurement, and contact our service representative.

The “NIBP unit error” message is displayed.

- Cause : The zero balancing before the measurement has failed, and measurement could not be started.
- Solution : The body movement or other artifact may cause zero balance failure. During the measurement, have the patient stay still as much as possible.
If the same message is displayed again, the failure of the equipment can be considered. Cease the measurement, and contact our service representative.

The “NIBP measurement failed.” message is displayed.

- Cause : The pressure applied to the cuff or the measurement time has exceeded the limit, and measurement could not be performed.
- Solution : Check if the cuff is properly attached to the patient, or cuff size is correct. Also check if the air hose is not bent, and perform the measurement again.
If the same message is displayed again, equipment failure can be considered. Contact our service representative.

The time of measurement disappears and the numeric data is displayed as “— — —”.

- Cause : The NIBP data will be erased when the preprogrammed NIBP erase time has elapsed.
- Solution : Select the appropriate time for NIBP data erase time from 10min, 30min, 60min, 24hrs which best fits the monitoring purpose.

SpO₂ (HS-710, 710E, 720, 720E, 720C, 702C, 702E)

The “Check SpO₂ sensor” message is displayed on the monitor.

- Cause : Sensor is detached from the patient.
- Solution 1 : Check if the sensor part is properly attached to the patient.
- Solution 2 : Check if the light emitting part and light receiving part of the sensor LED is aligned.

The “Pulse search” message is displayed on the monitor.

- Cause : The amplitude of the pulse waveform is low, or the sensor is not positioned correctly.
- Solution : Check if the light emitting part and light receiving part of the sensor LED is aligned.

The “No pulse detect” message is displayed on the monitor.

- Cause : The amplitude of the pulse waveform is low, or the sensor is not positioned correctly.
- Solution : Check if the light emitting part and light receiving part of the sensor LED is aligned.

The “Motion Artifact” message is displayed on the monitor.

- Cause : There is excessive body motion of the patient.
- Solution : Change the sensor position where the body motion will have less effect.

The pulse waveform is not displayed, or interrupted.

- Situation : “Check SpO₂ sensor” is displayed.
- Cause 1 : The amplitude of the pulse waveform is low, or the sensor is not positioned correctly.
- Solution : Check if the light emitting part and light receiving part of the sensor LED is aligned.
- Cause 2 : Sensor is defective.
- Solution : Replace the sensor.

Cause 3 : SpO₂ sensor is not firmly connected to the SpO₂ input connector.
 Solution : Make sure the SpO₂ sensor is securely connected.

Cause 4 : Sensor is exposed to light.
 Solution : Place a black or dark cloth over the sensor to avoid direct sunlight. Also when not used, avoid placing the sensor in light or unplug the sensor from the connector.

The SpO₂ measurement is unstable.

Cause : There is excessive body motion of the patient which disables correct measurement.
 Solution : 1. Have the patient lie still as much as possible.
 2. Relocate the sensor, or change the sensor to which the body motion will have less influence.

The “SpO₂ unit error” message is displayed on the monitor.

Cause 1 : Sensor is defective.
 Solution : Replace the sensor.

Cause 2 : There is a failure of communication with the SpO₂ measurement unit.
 Solution : Breaking of wire or SpO₂ unit failure can be considered.
 Contact our service representative.

The “SpO₂ sensor fault” message is displayed on the monitor

Cause 1 : Sensor is not securely connected.
 Solution : Securely connect the sensor.

Cause 2 : Sensor is defective.
 Solution : Replace the sensor.

Cause 3 : A wrong sensor is used.
 Solution : Replace the sensor. For details of usable sensors, refer to P7-4 “Optional Accessories SpO₂ Measurement (HS-710, 710E, 720, 720E, 720C, 702C, 702E)”.

The “SpO₂ not connected” message is displayed on the monitor.

Cause : When the SpO₂ relay cable is disconnected during SpO₂ monitoring, this message will be displayed.
 Solution 1 : To cease monitoring, press the **Alarm Silence** key to clear the message and silence the alarm.
 Solution 2 : To continue monitoring, plug in the SpO₂ relay cable. This will clear the message and silence the alarm.

Invasive Blood Pressure

The “BP* Transducer OFF” message is displayed on the monitor.

Cause : The BP transducer is not connected.
 Solution : Connect the transducer.

The “BP* not zero balanced” message is displayed on the monitor.

Cause : The BP zero balance has not been performed since the power is turned ON.
 Solution : Open the three-way valve of the transducer to air and perform zero balance.

The measured data is displayed as “- - -” on the monitor.

Cause : The BP zero balance has not been performed since the power is turned ON.
 Solution : Open the three-way valve of the transducer to air and perform zero balance.

BP value and waveform are not displayed properly.

Cause : Blood pressure line has not been zero balanced.
 Solution : Open the three-way valve of the transducer to air and perform zero balance.

The measured data is displayed as “×××” on the monitor.

Cause : The BP value is outside the measurement range.
Solution : Perform zero balance again.

The “BP not connected” message is displayed on the monitor.

Cause : When the BP interface cable or 2ch BP conversion cable is disconnected during BP monitoring, this message will be displayed.
Solution 1 : To cease monitoring, press the **Alarm Silence** key to clear the message and silence the alarm.
Solution 2 : To continue monitoring, plug in the BP interface cable or 2ch BP conversion cable. This will clear the message and silence the alarm.

Temperature

The “Wrong Temp Probe” message is displayed on the monitor.

Cause 1 : The YSI-700 is used.
Solution : Use the YSI-400 temperature probe for measurement.

Cause 2 : There is a contact failure of the temperature probe.
Solution : Check if the temperature probe is properly inserted.

The numeric data is displayed as “×××” on the monitor.

Cause : The temperature measurement is outside the measurement range.
Solution : Check if the temperature probe is properly inserted.

The “TEMP not connected” message is displayed on the monitor.

Cause : When the temperature sensor is disconnected during temperature monitoring, this message will be displayed.
Solution 1 : To cease monitoring, press the **Alarm Silence** key to clear the message and silence the alarm.
Solution 2 : To continue monitoring, plug in the temperature sensor. This will clear the message and silence the alarm.

The “TEMP auto check” message is displayed on the monitor. The numeric data is displayed as “- - -”.

Cause : The temperature is calibrated once every hour on this monitor. During calibration, the numeric data will be displayed as “- - -”.
Solution : The calibration will complete in 10 seconds. If the calibration does not complete within 10 seconds, cease the measurement and contact our service representative.

The “TEMP unit check” message is displayed on the monitor.

Cause : Error is detected during temperature calibration.
Solution : A unit failure can be considered. Cease the measurement and contact our service representative.

Cardiac Output

The CO value varies more than ±10% for consecutive measurements.

Cause 1 : The injection method is not appropriate.
Solution : Inject within 1 to 3 seconds.

Cause 2 : Injection temperature is not appropriate.
Solution : If iced injectate is used, pay attention not to warm the injector with hands.

Cause 3 : The thermistor location is not appropriate.
Solution : Reposition the thermistor.

Cause 4 : Arrhythmia event has occurred during the measurement.
 Solution : Wait until the patient has stable heart rhythm.

Cause 5 : There was patient body movement during measurement.
 Solution : Have the patient stay still during the measurement.

Cause 6 : The patient's hemodynamics has changed during measurement.
 Solution : Wait until the patient has stable hemodynamics.

Abnormal measurement value is displayed.

Cause : The catheter size, injectate volume, catheter constant (CC) is not correct.
 Solution : Set the proper condition, CC value for the used catheter.

The blood temperature (T_b), injectate temperature (T_i) is not displayed on the monitor.

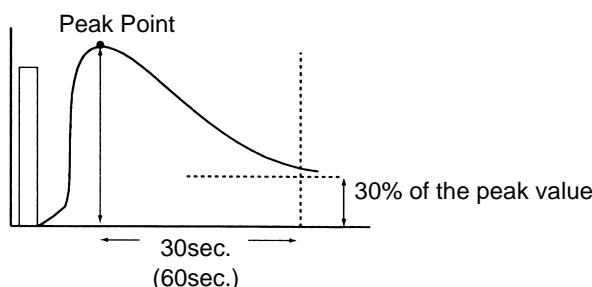
Cause : The catheter is not properly connected.
 Solution : Securely connect the catheter.

The thermodilution curve is deformed.

Cause : The injection is not smooth, steady motion.
 Solution : Injection should be performed within 1~3 seconds.

The baseline of the thermodilution curve is displaced to the minus side. The "LOWER FAULT" message is displayed on the monitor.

Cause : The blood temperature has not returned to stable condition after the measurement.

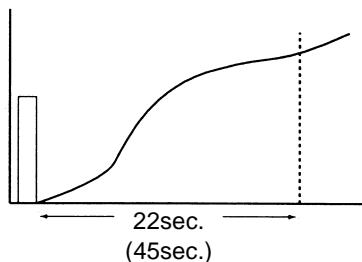


The thermodilution curve did not return to the cut off point soon enough. The temperature must return to a point that is 30% of the peak value within 30 seconds (or 60 seconds depending on the setup).

Solution : If performing continuous measurement, wait for 30~60 seconds and check the "Ready" display before performing the next measurement.

The thermodilution curve is low. The "PEAK FAULT" message is displayed on the monitor.

Cause : The peak of the thermodilution curve can not be detected.

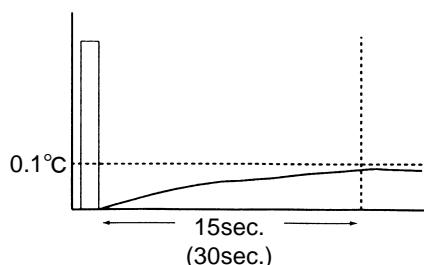


After injection, the peak of the thermodilution curve is not determined within 22 seconds (when the time scale is "30 sec") or 45 seconds (when the time scale is "60 sec").

Solution : The thermistor may be contacting the pulmonary artery wall. Reposition the thermistor and measure again.

The “UPPER FAULT” message is displayed on the monitor.

Cause : After the injection, the blood temperature is out of the measurement range.



After injection, the blood temperature is out of the measurement range. The thermodilution curve did not rise above 0.1°C within 15 seconds (when the time scale is "30 sec") or 30 seconds (when the time scale is "60 sec").

Solution : Use the iced injectate, and measure again.

The “OVER RANGE” message is displayed on the monitor.

Cause : The CO value is out of the calculation range.

Solution : The area of the thermodilution curve is too large to calculate. Perform the measurement again.

The measurement is interrupted, and the error message, “UPPER_FAULT”, “PEAK_FAULT”, “LOWER_FAULT”, “SENSOR_ERROR” is displayed on the monitor.

Cause 1 : The thermistor connector and relay cable is not securely connected.

Solution : Correct measurement cannot be performed unless the thermistor connector and relay cable is securely connected. Check the connection and perform the measurement again.

Cause 2 : The sensor or relay cable is defective.

Solution : If the sensor or cable is defective, measurement can not be performed. Replace the sensor or cable and perform the measurement again.

The “CO disconnect” message is displayed on the monitor.

Cause : This message will be displayed when the catheter relay cable is disconnected during monitoring the cardiac output.

Solution 1 : When ceasing the monitoring, press the **[Alarm Silence]** key to erase the message and silencing the alarm sound.

Solution 2 : To continue monitoring, plug in the catheter relay cable. The message display and alarm sound will be cancelled.

CO₂ Concentration (HS-710E, 720E, 702E)

The “Check filter line” message is displayed on the monitor.

Cause : The sampling tube is clogged.

Solution : Replace the sampling tube.

The “Self-diag CO₂” message does not disappear on the monitor.

Cause : An error has occurred to the self-check procedure at power ON.

Solution : The CO₂ unit failure can be considered.

The “Initializing CO₂” message does not disappear on the monitor.

Cause : An error has occurred during the initialization at power ON.

Solution : The CO₂ unit failure can be considered.

The “Check CO₂ unit” message is displayed on the monitor.

- Cause 1 : The exhaust connector is clogged.
 Solution : After checking the exhaust system and removing the clog, press the “Restart CO₂” key on the CO₂ configuration menu.
- Cause 2 : The sampling tube or nasal prong is clogged.
 Solution : After checking the inhalation system and removing the clog, press the “Restart CO₂” key on the CO₂ configuration menu.
- Cause 3 : The CO₂ unit needs to be replaced.
 Solution : Contact our service representative.

The “CO₂ unit error” message is displayed on the monitor.

- Cause : There is a communication error with the CO₂ unit.
 Solution : The wire break or CO₂ unit failure can be considered.
 Contact our service representative.

There is substantial measurement error.

- Cause 1 : 20 minutes have not yet elapsed since the power is turned ON.
 Solution : For 20 minutes from turning ON the power, there will be a substantial measurement error.
- Cause 2 : The calibration is not properly performed.
 Solution : Perform CO₂ calibration again.

The “CO₂ not connected” message is displayed on the monitor.

- Cause : When the filter line is disconnected during CO₂ monitoring, this message will be displayed.
- Solution 1 : To cease monitoring, press the **Alarm Silence** key to clear the message and silence the alarm.
- Solution 2 : To continue monitoring, plug in the filter line. This will clear the message and silence the alarm.

CO₂ Concentration (HS-720C, 702C: Capnostat 5)

The “CO₂ unit error” message is displayed.

- Cause : There is a failure in the CO₂ unit.
 Solution : Stop using the unit and contact our service representative.

The “CO₂ sensor failure” message is displayed.

- Cause 1 : The CO₂ sensor temperature is higher than 50°C.
 Solution : Remove any heat generating source around the sensor.
- Cause 2 : The CO₂ sensor is defective.
 Solution : Replace the CO₂ sensor.

Note : If error persists, the CO₂ unit may be damaged. Stop using the unit and contact our service representative.

The “CO₂ cal required” or “CO₂ adapter check” message is displayed.

- Cause : The CO₂ sensor is not zero balanced.
 Solution : Perform the airway adapter calibration.

The “CO₂ adapter check?” message is displayed.

- Cause 1 : The airway adapter is unclean.
 Solution : A clean airway adapter must be used. If reusing an airway adapter, clean and air-dry it. Then, wipe the window with swab, and sterilize (EOG, etc.) before use.

Cause 2 : The airway adapter is disconnected from the sensor.
Solution : Securely connect the airway adapter to the sensor.

Note : If the error persists, calibrate the airway adapter.
If the error still persists, perform the calibration again in the order of zero calibration, reference calibration, and airway adapter calibration.

The “Wrong CO₂ sensor” message is displayed.

Cause : The connected CO₂ sensor is not applicable.
Solution : Connect the applicable CO₂ sensor.

Although Capnostat 5 is connected, CO₂ data and waveform are not displayed.

Cause 1 : GAS CO₂ is selected for waveform and numeric data for the display configuration.
Solution : Select CO₂ instead of GAS CO₂ for the waveform and numeric data for display configuration.

Cause 3 : There is a communication failure with the Capnostat 5.
Solution : Contact our service representative.

Recorder (HS-720, 720E, 720C, 702C, 702E)

No recording is performed.

Situation : The “Paper Out” message is displayed on the monitor.
Cause : There is no recording paper.
Solution : Install a new pad of paper into the paper cassette.

Situation : The “Magazine Check” message is displayed on the monitor.
Cause 1 : The paper cassette is open.
Solution : Close the paper cassette firmly.

Situation : The “Paper jammed” message is displayed on the monitor.
Cause 2 : The paper is jammed.
Solution : Open the paper cassette, and install the paper properly.

Situation : No message is displayed, but recording can not be performed.
Cause : The recording paper is not correctly installed. The front and backside of the paper is set oppositely.
Solution : The “END” printed side of the paper should be facing down in the paper cassette.

The second waveform and third waveform are not recorded.

Situation : The second waveform and third waveform are not recorded for manual recording or alarm recording.
Cause : The second waveform and third waveform are not set on the recording setup menu.
Solution : Set the second waveform and the third waveform on each recording setup menu.

The “Recorder error” message is displayed on the monitor.

Cause 1 : The paper is jammed.
Solution : Open the paper cassette, and install the paper properly.

Cause : The thermal head temperature has increased.
Solution : A damage to the thermal head can be considered. Contact our service representative.

Analog Output

The signal is not output.

- Cause : The external output cable is not properly connected.
 Solution : Securely connect the external output cable.

General

The system does not start although the power switch is turned ON.

- Cause 1 : The power cable is not connected.
 Solution : Turn off the power and connect the power cable.

The “Check Super Module connection” message is displayed.

- Cause : The module connection cable is not properly connected.
 Solution : Securely connect the module connection cable.

The “SUB CPU error” message is displayed.

- Cause : The Super Module hardware failure has generated.
 Solution : Stop using the device immediately and turn OFF the power. Contact our service representative for service.

The “Analog board error” message is displayed.

- Cause : The analogue board failure can be considered.
 Solution : Immediately turn off the power and stop using the device. Contact our service representative for service.

The “Check HS-700 cooling fan” message is displayed.

- Cause : The cooling fan is unclean reducing the cooling effect.
 Solution : Clean or replace the air filter.

The “HS-700 hardware error” message is displayed.

- Cause : The Super Module hardware is malfunctioning.
 Solution : Immediately turn off the power and stop using the device. Contact our service representative for service.

“Check Super Module Rotary SW.” message is displayed.

- Cause : The rotary switch is not set to “0 (zero)”.
 Solution : If the rotary switch is not set to “0”, the equipment will not function properly. Immediately turn OFF the power and cease using the equipment. Contact our service representative.

Ventilator

The “VENT alarm” message is displayed.

- Cause : The following alarm has generated on the ventilator.
 • Parameter alarm such as AWP, MV, FiO₂
 • Technical alarm such as battery replacement
 Solution : Check the alarm cause of the ventilator, and take appropriate action.

The “Vent. Disable”, “Vent. Invalid” message is displayed. The ventilator screen is also displayed.

- Cause 1 : The cable is not properly connected.
 Solution : Securely connect the ventilator cable to appropriate connector.
- Cause 2 : The power of the ventilator is turned OFF.
 Solution : Turn ON the power of the ventilator.

- Cause 3 : The ventilator is in standby mode.
 Solution : Start the ventilation on the ventilator.
- Cause 4 : The communication setup of the DS-7300 system and ventilator is not corresponded.
 Solution : The communication setup of the DS-7300 system and ventilator is fixed as follows.
 Check the communication setup of the ventilator.
 For procedures, refer to the operation manual of the ventilator.

<u>PB-7200 / 740 / 760 / 840</u>	<u>Evita 2dura / 4 / XL</u>
Baud Rate : 9600bps	Baud Rate : 19200bps
Parity Bit : None	Parity Bit : EVEN
Data Bit : 8 bit	Data Bit : 8 bit
Stop Bit : 1 bit	Stop Bit : 1 bit
	Communication : MEDIBUS

Gas Module (Poet IQ 8500A)

The “WRONG AGENT” message is displayed.

- Cause : The primary agent selected by the user does not match the highest concentration agent detected by the gas module.
 Solution : Check the primary agent setting and the agent delivery system immediately. This alarm does not function if the automatic detection of primary agent is selected.

The “MIXED AGENT” message is displayed.

- Cause : More than one halogenated agent is present.
 Solution 1 : Check if only one anesthetic agent is used. Check if the anesthetic gas carburetor setting is correct.
 Solution 2 : If the trouble persists, contact our service representative.

The “AGT: OCCLUSION” message is displayed.

- Cause : The sampling line or water trap to the gas module is completely blocked. The gas module is attempting to clear the blockage by drawing the occlusion to the water trap.
 Solution : Replace the sampling line as necessary.

The “AGT: INSERT TRAP” message is displayed.

- Cause : The water trap of the gas module is not inserted. The water trap is partly blocked.
 The water trap type is wrong or defective.
 Solution : Replace the trap.

The “AGT: NO EXHAUST” message is displayed.

- Cause : The scavenging line of the gas module is blocked, or the scavenging system is defective.
 Solution : Remove the blockage, or correct the gas scavenging system.

The “AGT: BENCH FAIL” message is displayed.

- Cause : The gas module detected a hardware failure.
 Solution : Contact our service representative.

The “AGT: IR FAIL” message is displayed.

- Cause : The gas module detected a hardware failure.
 Solution : Contact our service representative.

The “AGT: PNEUMATICS” message is displayed.

- Cause : The gas module detected a hardware failure.
 Solution : Contact our service representative.

The “AGT: BADCAL” message is displayed.

- Cause : The gas module failed to calibrate the anesthetic agent detector.
 Solution : Contact our service representative.

The “AGT: WARM UP” message is displayed.

- Cause : The gas module has not reached the full accuracy for anesthetic agent concentration.
 Solution : Wait until the warm up completes.
 If the warm up does not complete within 30 minutes, check all the connected cables, sampling tubes, nasal cannula, and turn OFF and ON the power again.
 If the trouble persists, contact our service representative.

The “O2: SENSOR” message is displayed.

- Cause : The O₂ cell of the gas module has been consumed and needs replacement.
 Solution : Contact our service representative.

Oximeter

The measurement data is not displayed.

- Cause 1 : The cable is not properly connected.
 Solution : Securely connect the following cable to multiport relay cable and each corresponded device.

Device	Oximeter Cable	
	Multiport Relay Cable	Super Module Serial Connector
Vigilance	CJ-515 (Q'ty. 1)	CJO-04RS4
Vigilance CEDV	CJ-515 (Q'ty. 1)	CJO-04RS4
VigilanceII	CJ-515 (Q'ty. 1)	CJ-502
Vigileo	CJ-515 (Q'ty. 1)	CJ-502
OXIMETRIX3	CJ-516 (Q'ty. 1)	(Connection not possible.)
Q-vue	CJ-517 (Q'ty. 1)	(Connection not possible.)
Q2 Computer	CJ-582 (Q'ty. 1)	(Connection not possible.)

- Cause 2 : The multiport connection is not properly set.
 Solution : Select Vigilance/Vigileo, Oximetrix3, Q-vue or Q2Computer on the multiport connection setup menu.
- Cause 3 : The measurement data is not displayed on the oximeter display.
 Solution : The measurement data of SvO₂, CO, etc. will not be displayed on the monitor unless the data is displayed on the oximeter display. Check if the data is displayed on the oximeter display.
- Cause 4 : The CCO is not measured.
 Solution : The monitor will display CCO/CCI data only during the process of CCO measurement on the oximeter. When CCO is in wait or failure condition and CO AVG data is stored in Q-vue or OXIMETRIX3, CO AVG data will be displayed.
- Cause 5 : The BSA is not input.
 Solution : To display the CCI data on the monitor, it is necessary to input the BSA to the Q-vue/Q2 Computer. To display the CI AVG data, it is necessary to input the CO AVG and BSA to the Q-vue/Q2 Computer. For procedures, refer to the operation manual of the Q-vue/Q2 Computer. For OXIMETRIX3, CI AVG, BSA cannot be displayed on the monitor as BSA cannot be received from the OXIMETRIX3.
- Cause 6 : The network setup of Super Module and the oximeter is not corresponded.
 Solution : The network setup of Super Module is fixed to the default setting of each oximeter and cannot be changed. Check if the network setup of connecting oximeter is in default setting.
 In case of Q2 Computer, check if the network is set as follows.
 • Baud Rate: 9600bps • Stop Bit: 1
 • Parity Bit: ODD • Data Bit: 7
 For procedure to check the Q2 Computer network setup, refer to the operation manual for the Q2 Computer.

- Cause 7 : The software version of Vigilance is not corresponded.
Solution : If the Vigilance without the STAT function is connected, the STAT data will not be displayed. Check the software version of the Vigilance.

An error is caused between the data of Q2 Computer and bedside monitor.

- Cause : Due to difference such as number of significant digit, an error may be caused between the displayed data and transmitted data of the Q2 Computer. Also, updating of monitor data may be delayed due to transmission delay which causes the difference of value between the Q2 Computer.

The CO average value is displayed although not measured.

- Cause : The past CO data is stored in OXIMETRIX3, Q-vue, Q2 Computer.
Solution : Clear the stored CO data in the OXIMETRIX3, Q-vue, Q2 Computer before connecting to multiport relay cable.

Chapter 6

Technical Information

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Specification / Performance

This section states the specification and performance of this equipment.

Specification

Size

382 (W) ± 10mm × 255 (D) ± 10mm × 87 (H) ± 5mm (not including the protrusion)

Weight

6 ± 1kg (not including the accessory)

Environmental Condition

Operating Temperature	: 10 to 40°C
Operating Humidity	: 30 to 85% (without condensation)
Operating Atmospheric Pressure	: 700 to 1060hPa
Transport / Storage Temperature	: -10 to 60°C
Transport / Storage Humidity	: 10 to 95% (at 60°C)
Transport / Storage Atmospheric Pressure	: 700 to 1060hPa

Safety

General Standard : EN60601-1:1990

(Medical electrical equipment – Part 1: General requirements for safety)

Amendment A1 to EN 60601-1:1993

Amendment A2 to EN 60601-1:1995

Classification

The class of protection

against electric shock : Class I

The type of protection

against electric shock : ECG Input Connector	: Type CF
Multiparameter Amplifier Input Connector	: Type CF
NIBP Cuff Connector	: Type CF
SpO ₂ Input Connector	: Type CF
CO ₂ Measurement Connector	: Type CF
Serial Communication Connector (RGM)	: Type CF

Waterproof Level : IPX0 (no protection)

Disinfection Method : Cleaning only

Usage in Presence of

Flammable Gas : Equipment inappropriate to use in presence of air/flammable anesthetics, or oxygen or nitrous oxide/flammable anesthetics.

Operation Mode : Continuous Operating Equipment

Power Requirements

Voltage : AC 100–240V

Frequency : 50Hz or 60Hz

Power Consumption : 100VA

Usable Life

6 years : According to self-certification
Refer to "5. Maintenance Periodic Replacement Parts" for components requiring periodic replacement.

Performance

ECG

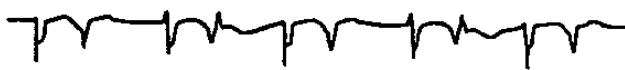
Lead Type	: Wired 3-electrode, 4-electrode, 5-electrode, 10-electrode
Frequency Characteristic	: 100Hz / 40Hz / 15Hz (High-cut filter can be changed.)
Input Impedance	: 5MΩ or above
Max. Input Voltage	: ±10mV
Polarization Voltage	: ±825mV or above
Common Mode Rejection Ratio	: 80 dB or above
Lead-off Sensing	
DC Current	: Less than 0.1μA
HR Meas. Range	: Adult 0, 12–300bpm Neonate 0, 30–300bpm
HR Meas. Accuracy	: ±3bpm
HR Display Response Time	: Average HR Adult/Child: average of 6 sec., Neonate: average of 3 sec. Instant HR Latest RR interval is used to calculate HR of every second
Waveform Size Selection	: ×1/4 (2.5mm/mV) ×1/2 (5mm/mV) × 1 (10mm/mV) × 2 (20mm/mV) × 4 (40mm/mV)
Waveform Display Accuracy	: Less than ±10%
Defibrillation Proof	: Provided
Transient Characteristic	: 3.2 sec, 0.3 sec, 0.1 sec (time constant can be changed)
Tall T-wave Rejection Capability	: 1.2mV T-wave can be removed.
Heart rate meter accuracy and response to irregular rhythm	
	80bpm Ventricular Bigeminy : 80bpm



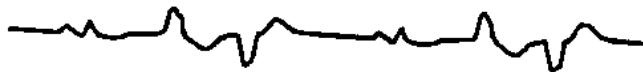
60bpm Slow Alternating Ventricular Bigeminy : 60bpm



120bpm Rapid Alternating Ventricular Bigeminy : 120bpm



90bpm Bidirectional Systoles : 90bpm



Response time of heart rate meter to change in heart rate

HR change from 80bpm to 120bpm : Range 4.8–6.1 sec.
HR change from 80bpm to 40bpm : Range 5.1–5.7 sec.

Average 5.4 sec.
Average 5.4 sec.

Time to ALARM for tachycardia		
Ventricular Tachycardia 1mVpp, 206bpm	: Range 7.8–8.5 sec.	Average 8.1 sec.
		
Ventricular Tachycardia 2mVpp, 206bpm	: Range 8–8.8 sec.	Average 8.5 sec.
Ventricular Tachycardia 0.5mVpp, 206bpm	: Range 10.1–10.4 sec.	Average 10.4 sec.
Ventricular Tachycardia 2mVpp, 195bpm	: Range 6.7–7.3 sec.	Average 7.0 sec.
		
Ventricular Tachycardia 4mVpp, 195bpm	: Range 6.8–7.4 sec.	Average 7.0 sec.
Ventricular Tachycardia 1mVpp, 195bpm	: Range 8.6–9.5 sec.	Average 8.9 sec.
Pacemaker Pulse Display Capability		
3-electrodes	: Detects with the selected lead.	
4, 5, 10-electrodes	: If lead I, II, III is selected for ECG1, pulse is detected with the selected lead. If a lead other than lead I, II, III is selected, pulse is detected with lead II.	
	Capable to detect pulses of pulse width 0.5 to 2msec, amplitude ± 2 to ± 700 mV	

Rejection of Pacemaker Pulse

a) Pacemaker Pulse without Over/Uncorrected:

Capable to reject pulses of pulse width 0.1 to 2msec, amplitude ± 2 to ± 700 mV

b) Pacemaker Pulse with Over/Uncorrected:

Rejection is not possible.

Respiration

Method	: Impedance Method
Frequency Characteristic	: 1.5Hz (adult, child) / 2.5Hz (neonate)
Transient Characteristic	: Time Constant 1.5 sec.
Current	: 100 μ A or lower, 66.7kHz $\pm 5\%$
Measurement Range	: 0, 4–150Bpm
Accuracy	: ± 3 Bpm
Base Impedance	: 500 Ω –2k Ω
Max. Input Delta Impedance	: Base Impedance $\pm 5\Omega$
Waveform Size Selection/	
Detectable Delta Impedance	: $\times 1/4$ (2.5mm/ Ω) / 1.6–10 Ω $\times 1/2$ (5mm/ Ω) / 0.8–10 Ω $\times 1$ (10mm/ Ω) / 0.4–10 Ω $\times 2$ (20mm/ Ω) / 0.2–10 Ω $\times 4$ (40mm/ Ω) / 0.1–10 Ω
Waveform Display Accuracy	: Less than $\pm 20\%$

Temperature

Method	: Thermistor Method
Probe	: only YSI-400 series
Measurement Range	: 0–50°C
Accuracy	: ± 0.2 °C
No. of Channels	: Max. 8 channels
Measurement	
Response Time	: Less than 150 sec.

SpO₂ (Arterial Oxygen Saturation)**Nellcor (HS-710, HS-710E, HS-720, HS-720E, HS-720C, HS-702C, HS-702E)**

Method	: 2 Wavelength Pulse Wave Method		
Measurement Range	: 1–100%		
Resolution	: 1%		
Accuracy	Adult	70 to 100%	±2%
	Neonate	70 to 100%	±2%
	The accuracy depends on the used sensor. Refer to the operation manual of the used sensor for details.		
PR Measurement Range	: 20–300bpm		
PR Accuracy	: ±3bpm for 20–250bpm		

Blood Pressure

Transducer Sensitivity	: 5 μV/V/mmHg		
Measurement Range	: -50–300 mmHg		
Frequency Characteristic	: DC–6Hz/8Hz/12Hz/40Hz		
Accuracy	: ±2% of full scale or within ±1mmHg		
Zero Balance Range	: Less than ±150mmHg		
Measurement Range	Adult	20–300bpm	
	Neonate	30–300bpm	
Accuracy	: The larger of ±3% or 1bpm		
No. of Channels	: Max. 8 channels		

NIBP (Non-Invasive Blood Pressure)

Method	: Oscillometric Method		
Measurement Range	: Adult Systolic BP: 30–280mmHg Mean BP: 15–260mmHg Diastolic BP: 10–240mmHg		
Child	Systolic BP:	30–180mmHg	
	Mean BP:	15–160mmHg	
	Diastolic BP:	10–150mmHg	
Neonate	Systolic BP:	30–120mmHg	
	Mean BP:	15–110mmHg	
	Diastolic BP:	10–100mmHg	
Resolution	: 1mmHg		
Static Pressure Accuracy	: ±4 mmHg		
PR Measurement Range	: 40–240bpm		
PR Measurement			
Accuracy	: Less than ±5%		
Inflation Target Value (Default)	Adult	180mmHg	
	Child	140mmHg	
	Neonate	110mmHg	
Inflation Target Value (After normal completion)	: Previous systolic value + 40mmHg		
Deflation Speed	: 5±1mmHg/sec.		
Safety Mechanism	Adult	310mmHg and below	
	Child	210mmHg and below	
	Neonate	160mmHg and below	
Measurement Duration	Adult	less than 120 sec. (15mmHg and above)	
	Child	less than 90 sec. (15mmHg and above)	
	Neonate	less than 60 sec. (10mmHg and above)	
Accuracy	: When compared with auscultation of representative patient population, standard deviation and mean error is less than 8mmHg and ±5mmHg respectively.		

CO₂ Concentration

Oridion® Unit (HS-710E, HS-710EM, HS-720E, HS-702E)

The performance is according to the Oridion Medical 1987 Ltd. MiniMediCO₂ Microstream® CO₂ Module specification.

Method	: Infra-Red Solid-State, Microstream
CO ₂ Measurement Range	: 0 to 99mmHg (at sea level)
CO ₂ Resolution	: 1mmHg
CO ₂ Accuracy	: 0 to 38mmHg: ± 2mmHg 39 to 99mmHg: ± (5% of reading + 0.08% for every 1 mmHg above 38 mmHg)
Flow Rate	: 50ml/min (+15ml/min, -7.5ml/min) flow measured by volume
Initialization Time	: Typically 30 seconds (maximum 180 seconds). At full accuracy when value appears.
RR Measurement Range	: 0 to 150bpm
RR Measurement Accuracy	: 0 to 70Bpm:±1Bpm 71 to 120Bpm:±2Bpm 121 to 150Bpm: ±3Bpm
Response Time	: 2.9 seconds (Typical)
Calibration Interval	: Initial calibration after 1,200 operating hours, then once a year or after 4,000 operating hours, whichever comes first.

RESPIRONICS® Capnostat 5 (1015928) (HS-720C, HS-702C)

Method	: Infra-Red Solid-State Method, Mainstream Method
Measurement Range	: 0–150mmHg
Warm-up Time	: Less than 15 sec. until measurement can be performed. 2 min. until maximum accuracy is achieved.
Accuracy (After warm-up time when maximum accuracy is achieved) :	0–40mmHg: ±2mmHg 41–70mmHg: ±5% 71–100mmHg: ±8% 101–150mmHg: ±10%
Initialization Time	: Full specifications within 60 seconds, waveform data in less than 15 seconds at an ambient temperature of 25°C
Response Time	: Adult Airway Adapter: Less than 60ms. Infant Airway Adapter: Less than 50ms
RR Measurement Range	: 0–150Bpm
RR Measurement Accuracy	: ±1Bpm

Cardiac Output

Measurement Method : Thermodilution Method

Measurement Range : 0.1–20L/min

Measurement Accuracy: 0.1–10L/min: less than ±10%
10–20L/min: less than ±15%

Measurement Temperature Range and Accuracy

Blood Temperature : 17–45°C±0.3°C

Injectate Temperature: –1–35°C±0.5°C

Recording

(HS-720, HS-720E, HS-720C, HS-702C, HS-702E)

Recording Speed: 50mm/s, 25mm/s (Error: less than ±5%)

Resolution

Head Direction : 8 dots/mm

Feed Direction : 40 lines/mm (at recording speed of 25mm/s)

Rec. Waveform : 3 waveforms

Rec. Type : Waveform Recording, List Recording, Graphic Recording

Detection : Paper out, page mark, paper cassette error, printhead temperature

Protective Circuit : Printhead overcurrent, printhead overheating, motor overcurrent, surge current

The Printed Device ID

The 19-digit value printed at the bottom of the recording paper indicates the device setup in codes, which can be described as follows.

0 0 3 1 0 4 0 0 0 0 0 0 0 2 1 1 3 2 0
 (1) (2) (3) (4) (5) (6) (7)

	Digits	Description				
(1)	1 to 4	Indicates the equipment's 4-digit serial number.				
(2)	5 to 6	Indicates the ECG lead type. '00' : not connected '01' : 3-electrode '02' : 4-electrode '03' : 5-electrode '04' : 10-electrode '81' : 3-electrode (electrosurgery-proof) '82' : 4-electrode (electrosurgery-proof) '83' : 5-electrode (electrosurgery-proof)				
(3)	7 to 9	Indicates ECG lead condition (lead-off) in hexadecimal form. 0: Normal 1: Lead-Off				
		Bit	3-electrode	4-electrode	5-electrode	10-electrode
		D0	LL	LL	LL	LL
		D1	RA	RA	RA	RA
		D2	LA	LA	LA	LA
		D3	—	—	V	V1
		D4	—	—	—	V2
		D5	—	—	—	V3
		D6	—	—	—	V4
		D7	—	—	—	V5
		D8	—	—	—	V6
		D9	—	RL	RL	RL
(4)	10 to 12	Indicates ECG lead condition (attachment) in hexadecimal form. The bit definition is the same as ECG lead-off condition.				
(5)	13 to 14	Indicates ECG setup in hexadecimal form. D1 : AC filter ON/OFF D3 : ECG drift filter ON/OFF D0, D2, D4–D15: OFF				
(6)	15 to 18	Indicates probe type connected to multiparameter amplifier input connector (4ch) in codes. '0' : Not connected '1' : IBP Probe '2' : TEMP Probe '3' : CO Catheter Relay Cable '4' : CO In-line Sensor Relay Cable '5' : CO Flow-Through Sensor Relay Cable '6' : CO Injectate Probe Relay Cable				
(7)	19	Indicates arrhythmia analysis filter setup in codes. '0' : Disp. Waveform '1' : Fixed				

External Connection

Pin Assignments

This section explains the connector pin assignments.

RS-232C Connector Output Signal (Serial Connector)

No.	Signal Type	Description	Signal Level
1	RESET	Port Reset	TTL Hi Level Reset TTL
2	EXT_IN+(Logic)	External Input+	Isolation Logic Input (5mA)
3	TxD	Serial Transmit Data Output	RS232C
4	SG	Signal GND	
5	RxD	Serial Receive Data Input	RS232C
6	+5V	+5V	+5V power supply (150mA)
7	EXT_IN- (Return)	External Input Return	Isolation GND
8	NC	No Connection	—

Status I/O Signal (Status II Connector)

No.	Signal Type	Description	Signal Level
1	QRS SYNC	QRS SYNC Output (Alarm Output 1)	Logic TTL
2	STS_OUT2+	Status Output 2+ (Isolation)	Photo MOS Relay Contact
3	TxD	Serial Transmit Data Output	RS232C
4	RxD/STATUS 1IN	Serial Receive Data Output / Status Input 1 under 25V (against GND)	RS232C / Logic
5	STATUS 2IN+(Logic)	Status Input 2 (Isolation)	Logic Input (5mA)
6	STATUS 2IN-(Return)	Status Input 2 Return (Isolation)	Isolation
7	+5V	+5V	+5V power supply (150mA)
8	STS_OUT2-	Status Output 2— (Isolation)	Photo MOS Relay Contact
9	GND	Power Supply Digital GND	—

* As the same isolation power source is used for RS-232C connector and status connector, the total power source capacity for +5V is max. 200mA.

* If isolation is necessary for RS-232C and status connector, use alarm input 2 and output 2.



- QRS synchronizing signal is a delay output.
(30–75msec for 100msec width)
Do not use the QRS synchronizing signal for the defibrillator.
- Make sure the delay time of QRS synchronizing signal fulfills the specifications of the connected device.

Analog Output Connector 1

ECG Waveform Output :

If lead I, II, or III is selected for ECG1, the selected lead will be output. If the lead other than lead I, II, or III is selected, lead II will be output.

Filter (frequency characteristic: 0.5–20Hz) and sensitivity (1V/mV) is fixed.

Accuracy of ECG Output Sensitivity :

within 1V/mV \pm 10%

Output Impedance : 100Ω ± 5%

Load Impedance : 1kΩ to ∞

Pacemaker Pulse : No pacemaker pulse

Analog Output Connector 2

BP Waveform Output :

The following waveform will be output depending on the used Super Module.

For HS-710, 710E, 720, 720E, 720C

The BP waveform input to BP-1 of CJ-7546 2ch BP conversion cable connected to multiparameter amplifier input connector 1 will be output.

For HS-702C, 702E

The BP waveform input to the BP Input Connector 1 will be output.

The BP waveform will not be output if cable other than BP is connected to the multiparameter amplifier input connector.

Filter (frequency characteristic: DC–40Hz) and sensitivity (1V/100mmHg) is fixed.

Accuracy of BP Output Sensitivity :

within 1V/100mmHg \pm 10%

Output Impedance : 100Ω ± 5%

Load Impedance : 1kΩ to ∞



- Analog signal is a delay output. (about 35ms for ECG, BP)
When connecting to a device using vital signs as trigger signals (ex. IABP), make sure the delay time fulfills the specifications of the connected device.
- The delay time may differ depending on the waveform shape or artifact interference.

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Chapter 7

Accessories

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Accessories

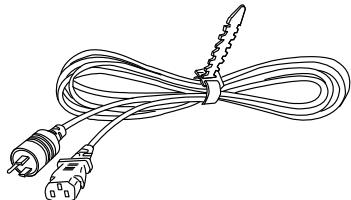
This section lists the accessories for the HS-700 series.

⚠ CAUTION

- Use only the accessories specified for this device. Otherwise, proper function cannot be executed.
- For quality improvement, specifications are subject to change without prior notice.

Accessories

Power Cable: CS-24 (3m)



⚠ CAUTION

When the product is used in regions whose voltage is other than 110-120V, a cable appropriate to the regulations and voltage of the country in which the product is being used shall be used.

This Operation Manual

Optional Accessories

The following products are available as optional accessories for the HS-700 series. Purchase them as required.

⚠ CAUTION

- Use only the accessories specified for this device. Otherwise, proper function cannot be executed.
- For quality improvement, specifications are subject to change without prior notice.

ECG, Impedance Respiration Measurement

Item	Model Type	Q'ty	Description
ECG Lead Cable	3380.0648.13	1	3-electrode AAMI
ECG Lead Cable	500308800	1	4-electrode
ECG Lead Cable	3380.0661.13	1	10-electrode (limb) / 5-electrode AAMI
ECG Lead Cable	3380.0661.15	1	10-electrode (limb) / 5-electrode AAMI
ECG Lead Cable	500403200	1	5-electrode (chest) AAMI
ECG Relay Cable	CI-700D-3 (FA)	1	3-electrode (defibrillation-proof)
ECG Relay Cable	CI-700E-3 (FA)	1	3-electrode (electrosurgery-proof) *
ECG Relay Cable	CI-700D-4 (FA)	1	4-electrode (defibrillation-proof)
ECG Relay Cable	CI-700E-4 (FA)	1	4-electrode (electrosurgery-proof) *
ECG Relay Cable	CI-700D-5 (FA)	1	5-electrode (defibrillation-proof)
ECG Relay Cable	CI-700E-5 (FA)	1	5-electrode (electrosurgery-proof) *
ECG Relay Cable	500403000	1	10-electrode AAMI

⚠ CAUTION

* When using the electrosurgery-proof type ECG relay cable, respiration measurement can not be performed.

Non-Invasive Blood Pressure Measurement

Item	Model Type	Description
Adult Cuff (Large)	CUF-7101	
Adult Cuff (Medium)	CUF-7102A	
Adult Cuff (Small)	CUF-7103	
Pediatric Cuff	CUF-7104	
Pediatric Cuff	CUF-7105	
NIBP Air Hose (1.5m)	OA-7109A	
NIBP Air Hose (3.5m)	OA-7109B	
NIBP Extension Hose (1.5m)	OA-7110A	
NIBP Extension Hose (3.5m)	OA-7110B	
BP Conversion Socket	CUFJ-MO1	for connection to neonate cuff

SpO₂ Measurement (HS-710, 710E, 720, 720E, 720C, 702C, 702E)

Item	Model Type	Description
SpO ₂ DURASENSOR®	DS-100A	
SpO ₂ OXISENSOR® III	D-25	24 per box
SpO ₂ OXISENSOR® III	D-20	24 per box
SpO ₂ OXISENSOR® III	I-20	24 per box
SpO ₂ OXISENSOR® III	N-25	24 per box
SpO ₂ OXISENSOR® III	R-15	24 per box
MAX-PACi	MAX-PACi	D-25×2, N-25×2
MAX-FAST	MAX-FAST	24 per box
SpO ₂ Relay Cable	DOC-10	

Temperature Measurement

Item	Model Type	Description
Rectal Temperature Probe (for adult)	401J	
Rectal Temperature Probe (for pediatric)	402J	
Body Surface Temperature Probe	409J	
2ch Temperature Relay Cable	CJ-7414	
Probe Cover	70 14 616	10/1 bag

Invasive Blood Pressure Measurement

Item	Model Type	Description
Interface Cable (for Gambro)	CJ-369	
Interface Cable (for Becton Dickinson)	CJ-410	
Interface Cable (for Baxter)	CJ-428	
BP Transducer	P-23XL	
BP Transducer	P-10EZ	
2ch BP Conversion Cable	CJ-7546	

CO Measurement

Item	Model Type	Description
Catheter Relay Cable	CJ-7382	
Flow-through Sensor Relay Cable	CJ-7413	
In-line Sensor Relay Cable	CJ-7412	
Injectate Probe Relay Cable	CJ-7411	

CO₂ Concentration Measurement (HS-710E, 720E, 702E)

Item	Oridion P.N.	Note
Intubated EtCO₂		
Filterline® H Set (Adult/Pediatric)	XS04624	with Nafion, adapter
Filterline® H Set (Infant/Neonate)	006324	with Nafion, adapter
Filterline® H Set (Adult/Pediatric)	XS04620	with adapter
Non-Intubated O₂ and EtCO₂		
Smart CapnoLine® O ₂ (Adult/Intermediate)	009822	for oral/nasal, with oxygen delivery
Smart CapnoLine® (Pediatric)	007269	for oral/nasal, with oxygen delivery
CapnoLine H O ₂ (Adult)	008180	for nasal, with Nafion, oxygen delivery
CapnoLine H O ₂ (Pediatric)	008181	for nasal, with Nafion, oxygen delivery
Non-Intubated EtCO₂		
Smart CapnoLine (Adult/Intermediate)	009818	for oral/nasal
Smart CapnoLine (Pediatric)	007266	for oral/nasal
CapnoLine H (Adult)	008177	for nasal, with Nafion
CapnoLine H (Pediatric)	008178	for nasal, with Nafion
CapnoLine H (Infant/Neonate)	008179	for nasal, with Nafion
NIV Line (Adult)	008174	for nasal
NIV Line (Pediatric)	008175	for nasal
Calibration Gas Kit (5% CO ₂)	GR08081	

CO₂ Concentration Measurement (HS-720C, 702C: RESPIRONICS® Sensor)

Item	Model Type	Description
Capnostat 5 CO ₂ Sensor	1015928	
Airway Adapter (Adult)	7007	
Airway Adapter (Neonate)	7053	
Airway Adapter (Disposable, Adult)	6063	10 per box
Airway Adapter (Disposable, Neonate)	6312	10 per box

Others

Item	Model Type	Description
Recording Paper	OP-124TE	
Multiport Relay Cable	CJM-01SR0.6	
DS-7300 Mounting Bracket	OA-469	
Relay Cable Mounting Bracket	OA-470	For HS-700
GCX Plate Adapter	OA-473	For HS-700
Air Filter	OA-485	For HS/IB cooling fan. (10 in each pack)

【External Equipment Connection Cable】

External Equipment	Model Type	Description
For multiport relay cable connection		
SV-300	CJ-514	
Servo-i / Servo-s, VigilanceII, Vigileo	CJ-584	
PB-7200ae / 7200e	CJ-518, CJ-525A	
PB-740 / 760 / 840	CJO-02RR4, CJ-527	
Evita 4 / XL / 2 dura	CJ-583	
Vigilance, Vigilance CEDV	CJ-515	
OXIMETRIX3	CJ-516	
Q-vue	CJ-517	
Q2 Computer	CJ-582	
For Super Module serial connector connection		
SV-300	CJ-501	
PB-740 / 760 / 840	CJ-504	
Servo-i / Servo-s, Evita 4 / XL / 2 dura	CJ-502	
Vigilance, Vigilance CEDV	CJO-04RS4	



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